The London School of Economics and Political Science

Three Frameworks for Commodity-Producer Decision-Making Under Uncertainty

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Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I warrant that this authorization does not, to the best of my belief, infringe the rights of any third party.

I declare that my thesis, inclusive of its various sections, consists of *61,953* words.

Statement of Conjoint Work

Portions of fieldwork and surveys occurred in collaboration with my friend and colleague Jennifer F. Helgeson of the Grantham Institute of the London School of Economics and Political Science. While we designed different questions due to our substantially different academic interests, these questions were administered as part of the same survey sequence chiefly to save time and cost. We then performed entirely separate analyses of the resulting data. To avoid any conflict or potential conflict, I have not, as of the submission of this thesis, read or discussed her approach or her findings or her thesis. Jennifer F. Helgeson and I each contributed 50% of the work in the survey's design, though 100% of the analysis of the data gathered by the survey appearing here is my own work. To be clear, there is no overlap in our analysis and the surveys were only administered together for efficiency and financial reasons.

The plan drawings herein were created by Tiziano Mion, an excellent draftsman, based upon my drawings, observations, and research. I contributed all of the information needed to create them, including rough drafts and reference photography, but lacked the architectural drafting skills needed to create the final product. These drawings are the only example of something created in collaboration with another person that appears in the thesis; note these drawings appear for their descriptive, not analytical, value. I would attribute 100% of the content of the drawings to myself, but 100% of their aesthetic value to Mr. Mion.

Statement of Use of Third Party for Editorial Help (if applicable)

Small sections of the text were copy edited for conventions of language, spelling, and grammar by my mother, Rita D. Tan. Some of the foreign-language phrases used in the text were confirmed for spelling or grammar with local native speakers or with Dr. Holly E. Porter or both.

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locate materials that were helpful in positioning this research within the broader literature. Thanks also to research librarians at the Joseph Regenstein Library and at the British Library who helped me navigate several difficult research problems.

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Leaving the best for last, thanks to Hannah Meyer, who never leaves my thoughts. She guides and inspires me every day – when we are apart, from the front row of my imagination. This work is dedicated to her.

Contractually Required Disclosure

"Data gathered on behalf of Grameen Foundation"

Under the terms of my work for Grameen Foundation in Africa, which appear as an Appendix to this thesis, I am required to include the phrase "data gathered on behalf of Grameen Foundation" in any publications that utilise or analyse this dataset. Though it is not contractually required, I include the relevant parts of Sections 5.1 and 6.2 of the applicable contract here, and append the entire Agreement, executed 4 January 2011 as Appendix B.

5.1, in relevant part:

Volunteer shall not publish any data gathered while rendering the Services without the notation, "Data gathered on behalf of Grameen Foundation" or a similar notation. Volunteer shall send two (2) bound proof copies of the Ph.D. thesis to Camilla Nestor or Grameen Foundation for review and comment at least forty-five (45) days prior to the viva (defence).

6.2, in relevant part:

Without the express written consent of GFUSA, Volunteer shall not incorporate into any Work Product any third party material or third party intellectual property. Notwithstanding the foregoing, GFUSA grants Volunteer a limited license to use the Work Product for any academic, non-commercial purpose, including dissertations and other academic work.

I hereby certify that I have met my contractual obligations to Grameen Foundation as to use of this dataset for my Ph.D. research and that two bound proof copies were provided to Grameen Foundation for comment forty-five days or more in advance of the viva.

I was present in Uganda on a visa sponsored by Grameen.

Abstract [*168* words].

This monograph examines the – at times, seemingly irrational – decision-making behaviour of entrepreneurs in the East African agricultural market. It seeks to reconcile empirical observations made between 2011 and 2014 in the towns of Oyam and Kapchorwa, two communities with centuries of entirely separate agricultural history, with a larger decision-making framework.

Drawing on decision sciences, development economics, and other literatures, various theoretical frameworks are explored to explain the domain-specific decision-making observed in Uganda. First, two largely rational, cost-focused decision-making scenarios are described, with the context and domain-specific boundaries of each described. Next, a third, economically sub-optimal decision-making scenario is described, with the factors distinguishing it from the first two explained. In other words, the agricultural entrepreneurs behave as econs[1] (exhibiting the anticipated behaviour) in the first two instances, but exhibit System 1 thinking[2] (demonstrating unexpected behaviour) in the final instance.

A comprehensive discussion reconciles the seemingly-conflicting empirical observations by segregating them by context and arguing the two decision-making systems employed, while contradictory, can and do co-exist as domain-specific approaches.

[1] "Econs" is an abbreviation for the concept of absolutely economically rational actors, the liberal ideal of an economy's individual constituent, similar to the "homo economicus" theoretical person often invoked.

[2] A terminology popularised by American polymath Daniel Kahneman; in this bifurcation of cognitive process, System 1 thinking is fast and instinctive while System 2 thinking is effortful and deliberative.

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Introduction

Interest in the management, risk-taking, and asset allocation questions facing the managers of small firms predates the seventeenth century, when Dutch and Saxon insurers began allowing small merchants access to various types of insurance. Academic interest in small businesses, however, did not blossom until the 1970's and 1980's, with a recognition that small enterprises were worthy of study (at the time, they represented an increasing percentage of American economic activity, both as a percentage of GDP and under discrete sector analysis), but sometimes required different approaches. This led to now-well-known articles such as *A Small Business is not a Little Big Business*[3] by John A. Welsh and Jerry F. White and Neil C. Churchill and Virginia L. Lewis's *Five Stages of Business Growth*.[4] In 2009, Daryl Collins[5] et al. published Portfolios of the Poor… (Princeton University Press), illustrating how the daily financial lives of the poor are not so radically different from – and not so inexplicable with the analytical tools developed for – the financial lives of wealthier individuals.

The instant research occurs through a lens that can be thought of as a blend of Welsh and White's recognition that businesses are not uniform in their amenabilities to analysis and Collins et al.'s proposition that existing frameworks or concepts for business or investment analysis can be adapted when studying businesses that are smaller in size or narrower in scope. The business decisions of entrepreneurs are then classified in the

[3] Harvard Business Review, pp. 18-27 (Harvard Business School, July 1981), accessible via hbr.org.
[4] Harvard Business Review, pp. 21-22 (Harvard Business School, May 1983), accessible via hbr.org. At the time of this article, Professor Churchill was the director of the Caruth Institute of Owner-Managed Business, and in following years owner-managed small businesses would become a focus of business school scholarship.
[5] B.Sc. Economics (1991), The London School of Economics; M.Sc. Economics (1992), The London School of Economics; Ph.D. Public Policy (2010), New York University.

broader taxonomy of behavioural models, for instance Kahneman's concept of System 1 thinking[6] and Thaler and Sunstein's work on systems of choice architecture.[7]

First, two situations are examined wherein entrepreneurs behave in expected ways predicted by traditional liberal models of behaviour. Next, a situation shows entrepreneurs who fail to optimise in ways expected under traditional, and even quasi-traditional (first evolution) models of decision-making common in the late Twentieth Century literature. The differences between these expected and unexpected behaviours is acknowledged, explained, and a hypothesis as to the differences' presence and resiliency is offered.

[6] D. Kahneman, Thinking, Fast and Slow (Farrar, Straus & Giroux 2011).
[7] R. Thaler, et al., Choice Architecture (April 2, 2010). Available at SSRN: http://ssrn.com/abstract=1583509 or http://dx.doi.org/10.2139/ssrn.1583509

Sample and Scenario: Who and Where

The sample chosen for this research included over 3,000 entrepreneurs cultivating a wide variety of crops. All entrepreneurs chosen for participation appeared in databases maintained by the Bill & Melinda Gates Foundation,[8] Grameen Bank, Grameen Foundation, and/or the World Food Programme Local Office System. The sample was uniform in that no participant was a member of a household that, during calendar 2010, earned more than five USD per day. Further, no entrepreneur in the study controlled (through fee simple absolute, government privilege, term of years, or simple lease) an arable area of more than two hectares and no participant in the study had other sources of income (outside his or her agricultural activities) that would violate the five dollars per day rule for inclusion, *supra*. Entrepreneurs studied ranged in age from 17 to 55 and were included regardless of gender, religion, or tribal affiliation. Most of the entrepreneurs in the study were within the formal borders of Kapchorwa (in the east) or Oyam (in the west), though some maintained farms on the periphery of these formally-designated areas (particularly coffee farmers in Kapchorwa, who were often up on the slopes of Mt. Elgon's junior siblings, hence in areas with no formal designation). The amount of formal schooling participants had received ranged from 3 to 13 years (the latter number including the first two years of university study toward a four-year degree) and basic literacy and numeracy were tested at the beginning of the study (requiring that a short passage be read in English and that basic addition and subtraction skills be demonstrated) to ensure a degree of uniformity (or, if not uniformity, accuracy) in how communications, instructions, or questions would be interpreted.

[8] The Community Knowledge Worker database is maintained by the Bill & Melinda Gates Foundation.

Figure I.

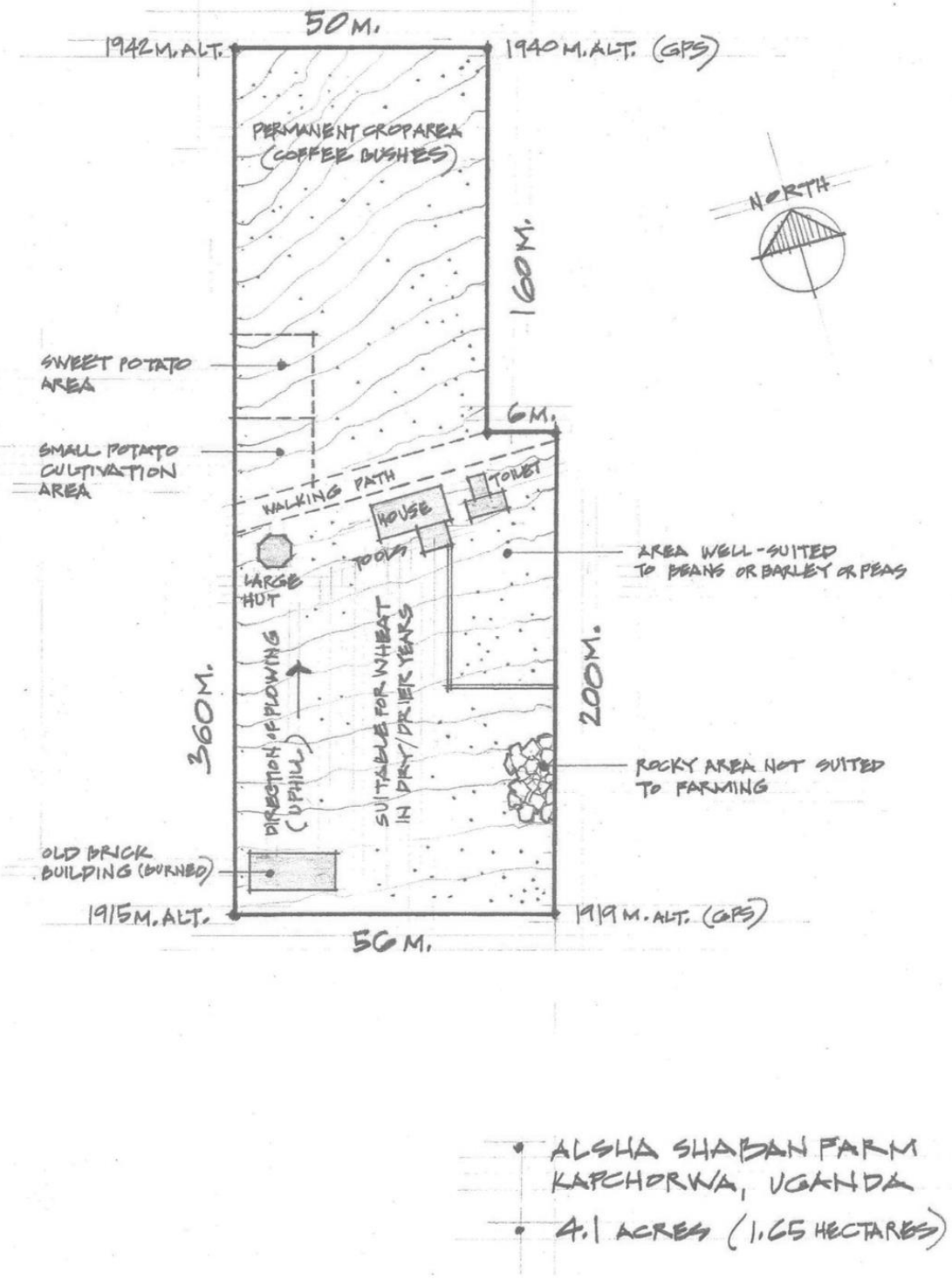
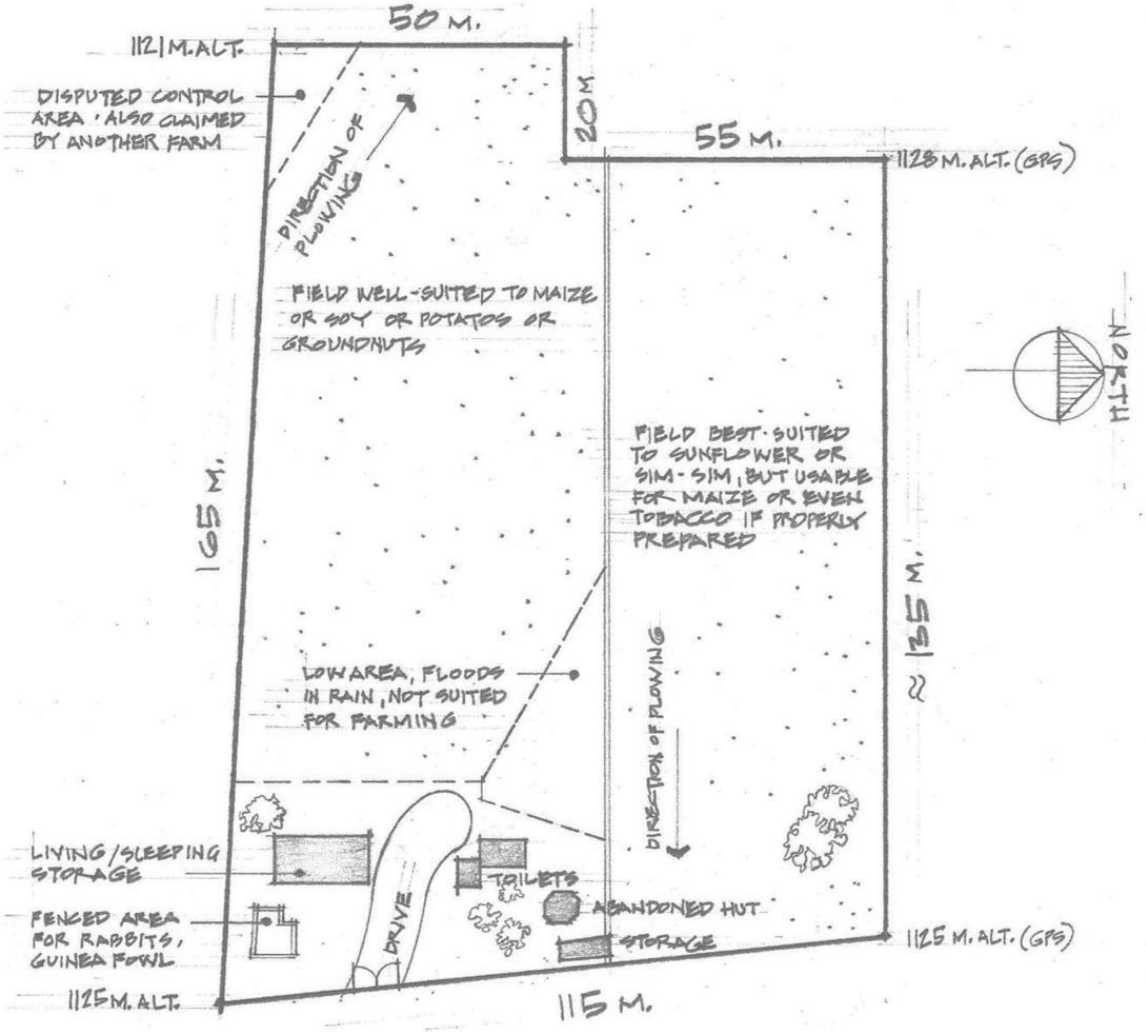

50 M.
1942 M. ALT.
1940 M. ALT. (GPS)
PERMANENT CROP AREA (COFFEE BUSHES)
NORTH
160 M.
SWEET POTATO AREA
SMALL POTATO CULTIVATION AREA
6 M.
WALKING PATH
TOILET
HOUSE
TOOLS
LARGE HUT
AREA WELL-SUITED TO BEANS OR BARLEY OR PEAS
360 M.
DIRECTION OF PLOWING (UPHILL)
SUITABLE FOR WHEAT IN DRY/DRIER YEARS
200 M.
ROCKY AREA NOT SUITED TO FARMING
OLD BRICK BUILDING (BURNED)
1915 M. ALT.
1919 M. ALT. (GPS)
50 M.
ALSHA SHABAN FARM
KAPCHORWA, UGANDA
4.1 ACRES (1.65 HECTARES)

Figure II.



- WILLY OKELLO FARM
  OYAM, UGANDA
- 4 ACRES (1.6 HECTARES)

Obviously, farms are not perfectly uniform, but these farms illustrated in detail, *supra*, are representative of typical entrepreneurial agricultural operations in the north of the country. Note the slope of these plots of land, particularly in Kapchorwa and the surrounding area (the Elgon foothills), is often substantial, meaning that good practices around drainage, irrigation, and soil preservation (or, more technically, "erosion abatement") are highly relevant and important in the rainy season. I accompanied workers from Gates, Grameen, and the World Food Programme on both village visits (to town centres) and site visits (to individual farms) and found the level of knowledge on agricultural issues to be very high and surprisingly technical, extending not only to the cultivation of food or irrigation, but also the business environment. For instance, one entrepreneur was able to explain Monsanto's strategy around selling 7080 and 6080 maize[9] together more completely and plausibly than any of the European "experts" with whom I spoke.

In all, I personally visited over 1,100 farms, contacted (via text message, email, Skype, or telephone call) over 3,000 farms, and made periodic site visits (once or twice per season) to 85 farms, 45 of which were in the Oyam region and 40 of which were in or near Kapchorwa. Only two farmers refused to take part in the study and about 280 of the farms in the study were removed ex post because incomes on the farm either dropped to negligible/subsistence levels or rose to commercial levels. Specifically, any farm generating less income per adult than the world poverty line (calculated in equivalent

[9] Monsanto's 7080 and 6080 products are aggressively drought-resistant genetically-modified maize varieties. The 6080 variety contains a measure of starfish DNA and has spiny, hard calcified stalks that are alien in appearance and stout in construction (so stout that fields must be cleared by fire, as the stalks will slash through tractor tires). The 7080 variety is substantially more tame and terrestrial in appearance, but also offers substantial windfalls in years where mild drought, or intermittent drought, is the prevailing condition. In Kenya, Monsanto only markets 7080 maize, but – as a Lango farmer correctly observed during a site visit in Oyam – Monsanto markets both in Uganda because "no one can afford tractors, so there is no danger to the tires." The 7080 designation means with 70% of ideal rainfall, it still produces 80% of peak yield. Meanwhile, the exotic 6080 variety promises 80% of peak yield even when rainfall is 40% below ideal levels.

2010 dollars) was considered to be a subsistence-level farm and hence not a "small business" for the purpose of this study; any farm generating more than 5 times the world poverty line in income per adult (again in equivalent 2010 dollars using 1USD:2500UGX as an estimated rate of exchange) was classified as operating at a commercial level (and hence no longer a "small business" for the purpose of this study, with recognition these boundaries are both necessary and arbitrary.[10] These farms were located through the Gates Foundation's Community Knowledge Worker database, which is co-maintained by, and funded by, Grameen Foundation.

The research project was supported by, but its bounds and design were not dictated by, Grameen Foundation. Grameen required me to write periodic reports on the local appetite for agricultural insurance, estimates of household income, reports on fluctuations in local crop prices around harvest time, and similar topics. Occasionally, Grameen would ask specific questions that I would attempt to weave into my encounters and interviews with farmers, particularly on the desirability of (and price sensitivity surrounding) agricultural insurance; I would include answers (including direct quotes) in my reports to Grameen. These reports were used by Grameen's product team to understand how to create and market products to Ugandan agricultural entrepreneurs. As I was present as a volunteer in Grameen's Bankers Without Borders programme, I was not paid for my time or for the reports I created, though I did enjoy access to Grameen vehicles for transport and Grameen lists of Community Knowledge Workers, which helped me locate areas, villages, and households to include in my research. I also made use of a cubicle in Grameen's office space when in Kampala, where I visited roughly every six weeks.

[10] The 5x poverty line standard may seem high at first glance, but the additional capital requirements of super-subsistence farming (hiring workers at weeding and harvest periods, investing in capital goods, etc.) are substantially different from subsistence farming and require substantially higher current-period cash flow.

During this research, I maintained a small residence (a roofed, simple, cinderblock structure with running water and a sanitary vault but no air conditioning or piped gas or reliable electricity supply) rented from a local man, Ojara,[11] and interacted daily with my neighbours in the village, an area of Ariaga northwest of Gulu Town in the northern area of Uganda and seven hours' drive from Entebbe, the nearest Ugandan airport offering direct commercial service to Europe. This allowed me to be immersed in a community of Acholi and Lango speakers where I was seen as a local resident and someone elementarily conversant in the local language. I was also able to maintain my own small vegetable garden of herbs, tomatoes, groundnut, lettuces, and chilies, and experience the seasons along with the people I was studying. My own experience living in Uganda, particularly during the harsh conditions and scarcity of the dry season, informed my questions to ask (and sensitivity when asking) local people about their lives.

These questions posed to local people – sometimes in person, sometimes facilitated by technology – were the source of data vital to this research. Data was gathered during site visits to individual farms, through conversations with local people, and through a smartphone application I designed that allowed questions to be sent to hundreds or thousands of farmers at once (or individual farmers as needed). The approach employed was to study the agricultural entrepreneurs' decisions (which were empirically verified and quantitatively measured) and then to explore the nature of those decisions more qualitatively, through semi-structured interviews and through examination of each decision in the context of both liberal and heterodox explanatory frameworks. Because most farmers did not have smartphones or access to a smartphone, a smartphone was provided as a conduit for research (though farmers were permitted and encouraged to

[11] Many Acholi children are named for their physical characteristics, the circumstances of their births, or things noticed about their bodies in the first days of life outside the womb. Ojara means a person who was born with extra (more than five per hand) digits.

use the phone for other purposes, such as surfing the Internet or texting friends or talking to relatives). The reasons for choosing this mode of investigation, along with biases and limitations of the chosen methods, are discussed in detail in the methodology section, *infra*.

My residence in a small agricultural village near a larger town (much like the scenario of nearly all of the 3,000 farms studied) aided my research efforts in that I began to understand the economic and social dynamics driving local businesspeople in their decision-making and to appreciate the normative rules by which decisions were expected to conform (or, at least, not deviate wildly). This residential, participant-observer position in the local economy was key to my understanding of the choice of approaches employed by local businesspeople in various decisions and how those approaches differed, both from a decision sciences or analysis-of-decision-making perspective and in the bounds of the local cultural context. My interest in exploring decisions made by Ugandan agricultural entrepreneurs, some of which seemed to be easily-explained in the traditional liberal frameworks, others of which seemed uniformly and conspicuously sub-optimal in the liberal sense, lay at the intersection between decision sciences studies and development studies. Further exploration of my observations and conversations, along with the relevant literatures, I hoped would inform my understanding and reconciliation of this seemingly-inconsistent pattern of decisions.

Two Intersecting Literatures: Development and Decision-making

Since the dawn of European colonialism, there has been writing on the topic of how people in less-technologically-developed civilisations reason and make decisions. This tradition perhaps begins with accounts written on the periphery of the Roman Empire

(particularly Roman Britain)[12] where armies of barbarians and invaders were seen as fundamentally irrational and hence immune to negotiation. Similar commentaries during China's Han Dynasty survive,[13] with similar commentaries on the decision-making capacities (or, more dispassionately, methods) of less-developed rival armies, cultures, and groups. Intrinsic in the early writings about those in the developing world, often – though not always – certain assumptions were made: that material scarcity or technological disadvantage was the result of lower intellectual capacity or incompetence or sloth; that European or Occidental methods (whether of farming, justice, or worship) would improve or "civilise" the less-developed civilisation; that European conquest was, in itself, evidence of superiority that was general, irrefutable, and irreversible.

In the Twentieth Century, the rise of liberal economics led to the concept that all market participants were rational actors, reacting to rationally-bounded forecasts[14] of the (expected value, all knowable probabilities included) implications of their choices,[15] though they might possess differing computational abilities (or limits on those abilities or "blind spots")[16] or might apply differing utility curves, even those running counter to prevailing normative rules concerning legality, morality, or other governing concepts.[17]

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[12] *See generally*, *e.g.*, descriptions by Lucius Cassius Dio, *Historia Romana* at §§ 49, 53 (completion year disputed).

[13] *See in particular* 王充 (Anglicised: "wang chong") *and* 揚雄 (Anglicised: "yang ziong")'s writings on whether there is a prevailing notion of oughtness or right judgement in decisions. Particularly the latter's focus on a universal decision-making framework for morality touches on the concept that people may, regardless of education or ethnicity, make the same conclusions as to what is desirable applying logical as well as normative (cultural, moral) frameworks.

[14] John F. Muth. (1960). "Optimal Properties of Exponentially Weighted Forecasts," JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION 55, pp. 299-306.

[15] John F. Muth. (1961). "Rational Expectations and the Theory of Price Movements", *Econometrica* 29, pp. 315-335.

[16] Herbert A. Simon. (1972). "Theories of Bounded Rationality," Ch. 8 in C. B. McGuire and R. Radner, eds., Decision and Organization. Amsterdam: North-Holland Publishing Company.

[17] Becker, G. and K. Murphy (1988) "A theory of rational addiction." JOURNAL OF POLITICAL ECONOMY, 96, pp. 675-700. *But see* Elster, J. Ed. (1986). Rational Choice. Oxford: Basil Blackwell; *see also* Elster, J. (1989). The Cement of Society. Cambridge: Cambridge University Press. (arguing mechanisms like shame and pity are differentiated from strictly pecuniary conceptualisations of reward and loss).

This led to prescriptive postures that certain legal systems, systems of trade, and so on were more logically desirable – even if one is impartial to other factors – due to their fundamental efficiency characteristics.[18] These principles of efficiency, freshwater thinking, and liberal analysis were applied in the development context by many scholars, perhaps most notably Samuel L. Popkin in his landmark text,[19] now a classic in the Anglophone liberal peasant studies literature.[20]

However, many of these liberal scholars struggled to explain the behaviours of people in developing countries with these models, as the normative rules of fairness often cannot be explained with profit-maximizing efficient exchange imposed as the prevailing framework.[21] For instance, levels of agricultural and industrial production were rarely optimised,[22] even when the person involved (the decision-maker) enjoyed relatively fine control over the production level and sufficient information to gauge the level of likely production at the start of a process. Errors in judgement or blunders in basic arithmetic would need to be too severe and too prevalent to fully explain the observed behaviours. This led to two primary, well-pedigreed lineages of literature, one more liberal and one heterodox. Like the broader debates in economics, each has seen swells and troughs in popularity.

Taxonomy of Relevant Literatures

The core question to be explored is why, in the context of Northern Uganda's agricultural small businesses, observed decisions about the production of crops and the

[18] Richard A. Posner. (1973). Economic Analysis of the Law. Harvard University Press.
[19] *But see*, *contra*, James C. Scott. (1977). The Moral Economy of the Peasant. Yale University Press.
[20] Samuel L. Popkin. (1979). The Rational Peasant. The University of California Press.
[21] Noted as early as Durkheim, E. 1893. The Division of Labour in Society. London: Macmillan, 1984 (reprint).
[22] Accord. Scott. (1977). S*upra* (profit maximization disregarded in favour of tempering yield volatility).

procurement of capital goods are predictable in the liberal sense, but production of other farm resources (labour) does not conform to predicted values. This question contains concepts that involve the literatures of industrial organisation, agricultural economics, development studies, prospect theory, and decision sciences, but the core research question rests firmly in the decision sciences area: how are these entrepreneurs making decisions and why are their decisions in one area seemingly being made with a different mechanism from that in other areas?

The question of whether farmers in the developing world behave, at least in the majority of measurable aspects, like businesspeople in the developed world is not at issue; recent empirical work confirms that this is true and true even among the poorest people cultivating a living in the so-called informal economy.[23] However, the question of how farmers in Northern Uganda operating supersubsistence agricultural enterprises make decisions surrounding product mix, capital, and labour (arguably the three most important choices made by any business) remains unanswered. I hope to contribute to this literature and expand our collective understanding of these mechanisms.

To explore this work's location in the broader literature, however, requires venturing back a century in the work on decision-making (and rational choice).

Prior to the convergence of philosophical (and anthropological) theories on decision-making with mathematics and microeconomics, the explanation of decision-making in business contexts was dominated by rational explanation (the "best" or "most advantageous" choice for the individual) combined with explanations of exceptions based upon other values (such as emotion and tradition).[24] These theories were

[23] *See*, *e.g.*, *generally* the work of Daryl Collins, B.Sc. (econ) '91, LSE, M.Sc. (econ) '92, LSE. *See in particular* D. Collins et al. 2010. Portfolios of the Poor. Princeton University Press.
[24] *See*, *e.g.*, Weber, M. 1920. *Conceptual Exposition*. In Economy and Society. Eds. G. Roth and C. Wittich (1968); *see also* Parsons, T. 1937. The Structure of Social Action. New York: McGraw-Hill.

generally based upon qualitative observations of social exchange, abstract (non-ledger) concepts of indebtedness, and estimations of actors' accumulation (or spending) of social capital.[25] Though focused on individual decision-making, this epoch of literature also occasionally ventured into the management of the enterprise, with exchange theory recognised to have both personal and mercantile (as well as broader societal) implications.[26]

In the mid-Twentieth Century, in part due to the law-and-economics movement,[27] the framing of decision sciences in the context of purchases and allocations – particularly at the firm level[28] – but also in the context of risk,[29] shifted from being chiefly psychological to being primarily mathematical or quantitative.[30] This shift is relevant to this research in that it largely disregarded, or at least substantially discounted, the concept that preferences between choices may shift not only with the probability of outcomes but also with the underlying mechanism by which the choice is being made, differences in outcomes largely being explained through the miscalculation or mis-estimation by the actor or the poor information available to the actor.[31]

Around this same time, business schools' interest in examining corporate finance, decision-making, and corporate strategy together was evolving quickly, with this

[25] *See cf*. Malinowski, B. 1922. Argonauts of the Western Pacific. London: Routledge and Kegan Paul. *Accord*. Mauss, M. 1925. The Gift. London: Routledge and Kegan Paul, 1966.
[26] *See*, *e.g*., Homans, G. 1961. Social Behaviour: Its Elementary Forms. London: Routledge and Kegan Paul.
[27] *See* R. Coase. "The Problem of Social Cost." *Journal of Law and Economics* 3 (1): 1–44. 1960. doi:10.1086/466560.
[28] *See* R. Coase. "The Nature of the Firm." *Economica* 4 (16): 386–405. 1937. doi:10.1111/j.1468-0335.1937.tb00002.x
[29] *See*, *e.g*., K. J. Arrow. (1970). Essays in the Theory of Risk-Bearing. Amsterdam: North-Holland Pub. Co. ISBN 9780720430479.
[30] *See* R. M. Hogarth & M. W. Reder, Rational Choice: The Contrast Between Economics and Psychology. The University of Chicago Press, pp. 201–216, ISBN 9780226348575.
[31] *See* Arrow, Kenneth J.; Hurwicz, Leonid (1972), "Decision[-]Making Under Ignorance." in Carter, C. F., Ford, J. L., Uncertainty and Expectations in Economics. Oxford / New York: Basil Blackwell / Augustus M. Kelley, ISBN 9780631141709.

intersection becoming a being a fertile area for study in the 1950's.[32] Similarly, in the post-war climate the concepts of finance and strategy were increasingly present in agricultural studies, as farms in the developed world began to grow to industrial sizes and to substantially diversify production profiles.[33][34]

Review of Particularly Applicable Lineages of Scholarship

Most immediately applicable to the questions contemplated here is the extent to which the economic and decision-making literatures are embraced by development studies scholars, recognising the environment – and population – in which business decisions are made, though not itself dispositive, greatly influences the decisions eventually selected. While this doctoral research is the first empirical examination of how Ugandan agricultural entrepreneurs exhibit a persistent paradoxical pattern of both profit-maximizing (in the cases of logistics and crop choice, as well as in the acquisition of capital equipment) and non-optimal (in the case of human resources or human capital management) decisions.[35]

In the development studies literature,[36] the famous – and applicable – rivalry in this regard is between James C. Scott's work on agricultural insurance markets in

[32] This relationship continues to evolve, with Schrager's 2013 paper arguably being the newest substantial contribution (examining the potential for applying Simon's research to the practice of strategic decisions). Schrager & Madansky. "Behavioural Strategy: A Foundational View." *Journal of Strategy and Management* 6(1), pp.81-95. 2013.

[33] The number of family farms in the United States today is estimated to be less than 5% of the number in 1950.

[34] *See* N. Walford. "A Past and a Future for Diversification on Farms?" *Geografiska Annaler* 85 (1): 51–62. 2003. doi:10.1111/1468-0467.00130.

[35] This work both directly and conceptually draws upon the rich literature in decision-making of executives and firm-level decision-making. The question of whether business decision-makers are rational (econs) or more human in their approaches is a persistent one, arguably beginning (as to the contemporary lineage) with H. A. Simon. *Rational Decision Making in Business Organizations*. American Economic Review. 1979.

[36] It is important to note the anthropological lineage of literature that informed, and made possible, Scott's and Popkin's work. *See*, *e.g.*, E. E. Evans-Pritchard, The Nuer. Oxford: Clarendon. 1940; Elizabeth Colson, The Plateau Tonga of Northern Rhodesia. Manchester: Manchester University Press. 1962.

preindustrial agricultural societies (societies exhibiting farm sizes and levels of cultivation inefficiency similar to those I observed in Uganda) and Samuel L. Popkin's[37] work[38] on similar topics (including empirical observations of opportunistic and profit-maximizing behaviours exhibited by peasants tending areas similar to those in Scott's study). Subsequent work by economists[39] and interdisciplinary scholars has focused on self-interest versus altruism, fair versus more-than-fair deal structures,[40] and other similar aspects of erection (or destruction) of social safety nets as the centre of the "rational actor versus clearly sub-optimal" conversation.[41] Quantitative literatures have focused on the use of economic modelling and financial modelling to better-understand (or, more accurately, classify) the choices made on farms as compatible with strict rationality (in other words, compatible with a plausible utility function) or not.[42] Others have focused on incentives – which Scott himself recognised as fertile ground for further exploration – and the need for alternative explanations given the visible incentives.[43] This work pursues this exploration of incentives and optimal ("rational") choices given

[37] Both Scott and Popkin were political scientists.
[38] *See* James C. Scott, *The Moral Economy of the Peasant: Rebellion and Subsistence in South-East Asia*. Yale University Press. 1976; Samuel L. Popkin, *The Rational Peasant: The Political Economy of Rural Society in Vietnam*. University of California Press. 1979, *respectively*.
[39] L. Ellsworth. *Mutual Insurance and Non-Market Transactions among Farmers in Burkina Faso*. Ph.D. diss., University of Wisconsin – Madison. 1989. Available from the University of Wisconsin Library Archives. Housed at Somers Social Science Reference Library, 1180 Observatory Dr, Madison, WI 53706.
[40] Perhaps the University of Chicago's most prolific interdisciplinary living scholar, the Hon. Richard A. Posner wrote on this topic explicitly in 1980 (and contributed substantively to adjacent areas of scholarship in subsequent years). *See* R. A. Posner, *A Theory of Primitive Society, with Special Reference to Law*. Journal of Law and Economics 23: 1-53. 1980. University of Chicago Press. Available from University of Chicago Journal of Law and Economics (Archival).
[41] For comprehensive discussion of theory in this context, *see* Jean-Philippe Platteau, *Traditional Systems of Social Security and Hunger Insurance: Past Achievements and Modern Challenges*, in Social Security in Developing Countries. Eds. E. Ahmad, J. Dreze, J. Hills, and A. Sen. Oxford: Clarendon. 1991.
[42] *See*, *e.g.*, Christopher Udry. *Rural Credit in Northern Nigeria: Testing the Role of Credit as Insurance*. Yale
University. Department of Economics. 1989. Mimeograph.
[43] As used here, rational behaviour would be pure "opportunism" as expressed by Gluckman, Williamson, and others. *See cf*. Oliver E. Williamson. The Economic Institutions of Capitalism. New York: Free Press. 1985. *See*, *in particular*, pp.47-49.

the provided incentives, rather than the branch of literature fixated on increasing the precision of (and thereby the distance of) financial or economic models for rural farmers that are then compared to those farmers' actual behaviours.[44]

The central dichotomy examined here – the split between rationally-explainable behaviours in some instances and more-difficult-to-explain (apparently suboptimal) choices in the other instance, in the sub-Saharan African context – has been of interest to scholars since at least the 1980's. In the study of suboptimal African financial arrangements in agriculture, access to land[45] and capital[46] seemingly without any expectation of return or reciprocity has been classified as an extreme case of suboptimal behaviour inexplicable through classical liberal theory. Interest-free lending has also been examined, as some African cultures feature classes of loans that are made at zero interest while other loans bear substantial interest (or "fees" that are a proxy for interest rates).[47] This discussion further includes within its ambit literature within the substantivist school in anthropology, which often attributes "non-rational" or "non-

[44] Early financial calculation and estimation models from developed countries at earlier stages of agricultural industrialisation are not particularly applicable to developing countries, despite the apparent similarity between the two contexts. For instance, Nadler's Modern Agricultural Mathematics, a mainstay text in the American context, translates poorly to how Ugandan farmers operate their businesses (for instance, the assumption in the layout of corn farms and their density and harvest estimates is that corn rows are tilled 40 inches apart and planted 44 inches apart – this does not hold in the non-American context). Hence, auditing actual performance against these calculated expectations yields little in terms of useful information. M. Nadler. Modern Agricultural Mathematics. Orange Judd. 1949 (first edition copyright 1910).

[45] *See*, *e.g*., the rich literature on rent-free use of arable land. *See* R. Norhona. A Review of the Literature on
Land Tenure Systems in Sub-Saharan Africa. World Bank Report ARU. 1985; *see also* P. Matlon, *Patterns of Land Use, Indigenous Land Tenure Systems, and Investments in Soil Fertility: Results from Three Agroclimatic Zones in Burkina Faso*. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). 1988. Mimeograph. Available at and stored in ICRISAT research archives.

[46] The zero or near-zero rental (leasing) price of animals and other livestock is an interesting case explored in some depth. Though mentioned as early as Evans-Pritchard, *supra*, *see in particular* C. Odegi-Awuondo. Life in the Balance: Ecological Sociology of Turkana Nomads at ch. 6. ACTS Press, Nairobi. 1990.

[47] *See* R. A. Posner, *supra*; *see also* J. Platteau & A. Abraham. *An Inquiry into Quasi-Credit Contracts: The Role of Reciprocal Credit and Interlinked Deals in Small-Scale Fishing Communities*. Journal of Development Studies vol. 23, no. 4. 1987.

econ" behaviour to rituals or unobservable cultural artefacts.[48] For reasons resembling the earlier criticisms of Popkin and Posner, I reject this substantivist argument, which requires one to believe each culture's notion of value and exchange is *sui generis* or, at a minimum somehow economically alien to the basic accounting of the Occidental world. The Ugandan entrepreneurs with whom I interacted were acutely aware of concepts of value and were able to locate (or, often, recite) in their personal histories deals they felt were unfair or where they had been out-bargained or inadequately compensated.[49] Contrary to the observations of some earlier scholars doing fieldwork in societies with a less entrepreneurial outlook,[50] the Ugandan farmers I interviewed and observed did not oppose the accumulation and management of private wealth, but did oppose what they saw as unfairnesses: e.g., agreements reached by coercion and contracts of adhesion.

Most of the literature – particularly literature descended from or contemporary with Feeny's now well-known article on the topic in the Asian context[51] – seeks to choose between, rather than reconcile the coincidence of, both "moral" and "rational" behaviours occurring in the same populations. Instead, I seek to acknowledge that the same population – and often the same samples or individuals within that population – exhibit both modes of decision-making and that this is not inexplicable. In so doing, I seek to dispel the concept that functional or rational decision-making and decision-making on bases other than calculable and predictable economic utilitarianism are fundamentally mutually-exclusive for Ugandan agricultural entrepreneurs; rather, such

[48] *See* S. Popkin, *supra*, for an excellent criticism of this wholesale classification of non-econ behaviour.
[49] *See cf.*, *contra*, the description of solidarity and fondness trumping a need for per-instance fairness in K. Polanyi. The Great Transformation. Holt, Rinehart, & Winston, New York. 1944.
[50] *See*, *contra*, K. Poewe. Religion, Kinship, and Economy in Luapula, Zambia. Edwin Mellen, New York. 1989.
[51] D. Feeny, *The Moral or the Rational Peasant? Competing Hypotheses…* . Journal of Asian Studies 42, vol. 4.
1983.

entrepreneurs make decisions in at least two constructs, discussed here. They are, as Posner,[52] Thaler,[53] and Kahneman[54] might say, "part time econs."[55] Exploring why and how these entrepreneurs are intermittently (Popkin might argue "inconsistently") adherent to Popkin's strict "econ" optimisations[56] in their choices comes down to examining the context in which these choices are selected – something not yet explored in this geographic or industrial context (i.e., production choice, capital equipment decisions, and human resource decisions).

Inapplicability of Select Lineages of Financial Modelling Literature

Just as Nadler's classic text[57] contributes little to one's understanding of agricultural business in the Ugandan context, transposition of the work of Keyes and others to the African context[58] proves similarly unhelpful. In the world of financial modelling, the analogy of work contributed to ownership in an enterprise limited by shares does not hold in this instance, as the contributions to Ugandan farms is essentially limited to the bounds of the household or extended family, except in rare moments of surging human capital requirements, discussed *infra*. Hence, studies that examine "econ versus non-econ" behaviour in the context of shared resources for shared labour, attempting to

[52] For an example of a "Posnerian" interpretation of how bargains are struck in such an environment by econs or near-pure econs, *see* M. Eswaran and A. Kotwal. *A Theory of Contractual Structure in Agriculture*. American Economic Review 75, vol. 3. 1985.
[53] *See generally* R. Thaler & C. R. Sunstein. Nudge. Penguin Books. 2009. *See also* R. Thaler, et al. *Choice Architecture*. 2010. Available at SSRN: http://ssrn.com/abstract=1583509.
[54] *See* D. Kahneman. Nobel Laureate Lecture. Transcript. Reference 081202. 2002.
[55] C. Camerer. *Bounded Rationality in Individual Decision*[-]*Making*. Experimental Economics. 1998. For a basic set of observations on the humans versus econs dichotomy, *see* M. Rabin. *Psychology and Economics*. Journal of Economic Literature, vol. 36, pp. 11-46. 1998. "Because psychology systematically explores human judgment, behaviour, and well-being, it can teach us important facts about how humans differ from the way they are traditionally described by economists."
[56] *See generally* H.A. Simon. *Theories of Decision-Making in Economics and Behavioural Science*. American Economic Review. 1959.
[57] M. Nadler. Modern Agricultural Mathematics. *Supra*.
[58] *See* Charles F. Keyes. *Peasant Strategies in Asian Societies: Moral and Rational Economic Approaches*. Journal of Asian Studies, vol. 42, no. 4. 1983.

model the financial equivalents of these exchanges, are not applicable.[59] Similarly, the rich literature modelling the financial or economic implications of the gender dynamics surrounding the cultivation of resources in Africa is not applicable to the instant work;[60] though some gender dynamics do drive decision-making in Ugandan agriculture (rice is seen as a feminine crop to cultivate, for instance), this is not the focus of my research inquiry and not central to any of my findings.

Some financial modelling (including economic and financial modelling, and game theory work as to finance) has focused on the concept of "non-econ" behaviour as an iterative game or as an extension of classical game models.[61] While the decision to produce children (discussed *infra*) is a repeated per-instance decision, it is not an iterative game in the sense this literature implies. Hence, this literature – despite its strong mathematical provenance[62] – is not applicable here. Nor is the finance literature attempting to build overarching game theory frameworks for how theories of exchange in primitive societies function, as this literature is focused on the uniform conceptualisation of exchange rather than the differences between "econ" and "non-econ" decision-making behaviour.[63] The decisions examined here are different in type, scope, and framework for decision-making. Thus financial modelling or economic

[59] *See* various studies of the harvest of fish from the sea, *e.g.*, J. Platteau & J. Baland. *Income-sharing through*
Work-spreading Arrangements: An Economic Analysis with Special Reference to Small-Scale Fishing. Cahiers de la Facultk des Sciences Economiques et Sociales de Namur. Facultes Universitaires Notre-Dame de la Paix. 1989.
[60] *See*, *e.g.*, F. Sow. *L'economie du poisson sur la petite cote*. Etudes Scientifiques. University of Dakar. 1986. Available online (Université de Dakar).
[61] See, e.g., A. Rubinstein. *Equilibrium in Supergames with the Overtaking Criterion*. Journal of Economic Theory 21. 1979. *See also* R. J. Aumann. *Repeated Games*. Chapter in Issues in Contemporary Microeconomics and Welfare. Ed. George Fiewel. New York: Macmillan. 1985. *See cf.* D Fudenberg and E. Maskin. *The Folk Theorem in Repeated Games with Discounting or with Incomplete Information*. Econometrica 54. 1986.
[62] *See* M. S. Kimball. *Farmers' Cooperatives as Behavior toward Risk*. American Economic Review 78. 1988.
[63] For an example of an early game theory application to African societies' exchange frameworks, *see* R. H. Bates. Essays on the Political Economy of Rural Africa. University of California Press. 1983.

modelling (or game theory modelling) literature that hinges upon, or presumes, a uniform system across all decisions is not directly applicable to this work (though I've included for comparison literature presuming one or the other for comparative analysis). I do not argue there is a single framework that is uniquely explanatory as to how all observed decisions in this study were made; in fact, it is the heterogeneity among these decision-making mechanisms that piqued, and holds, my interest.

Finally, the financial modelling literatures focused on developing-world systems of agriculture that have distinguishing features not present in Uganda are not applicable. For instance, there exists a rich and persistent literature on the financial implications of, financial modelling of, and econometric analysis of systems of sharecropping. Since all the agricultural entrepreneurs I studied enjoy exclusive ownership and control over their land and do not employ sharecroppers (sharecropping does not exist in Uganda, commercially or conceptually), the financial literature as to the economic and financial dynamics of sharecropping does not inform this work.[64] Similarly, the work done on modelling the financial dynamics of general partnerships in agribusiness, profit-sharing agreements, and option contracts on harvest benchmarks does not apply, as these mechanisms do not currently exist or apply in the Ugandan context.

Rather than attempting to build financial models that reflect the decisions made by Ugandan entrepreneurs, I follow the more holistic decision analysis framework and method described in Cyert et al.'s "Observation of a Business Decision," still one of the best papers on how business decision-making can be witnessed, recorded, and analysed with a combination of anthropological and business-oriented observations.[65]

[64] *See* S.N.S. Cheung. The Theory of Share Tenancy. The University of Chicago Press. 1969.
[65] R.M. Cyert et al. *Observation of a Business Decision*. The Journal of Business, vol. 29, pp. 237-48. 1956. "While the framework employed here[ ]is far from a complete or finished theory, it appears to provide a useful technique of analysis for researchers interested in the theory of

Methodology

The method employed is that of an ethnographic study of the businesspeople making the decisions at issue, accompanied by – and with reference to – quantifiable measurements of those decisions and their implications. My fieldwork, which lasted nearly two years, focused on understanding the context of decision-making, including study of the conditions[66] in which the entrepreneurs live, collaborate, do business, and make decisions. To ensure the group I studied was uniform in its financial position, I chose to only study small-holder farmers who were operating businesses.[67] To ensure the findings in Oyam (the initial and more frequent observation area) were not unique or unable to be used across the Northern Ugandan region, I also studied agricultural entrepreneurs similarly situated[68] in Kapchorwa, an agricultural community substantially to the east of Oyam with a different mix of crops, a different cultural history, and a different tribal and linguistic affiliation. This section discusses, within its subsections, the methodological approach as well as the scenarios under which research was designed, conducted, and terminated.

Methods Employed

My work in Uganda began as a researcher for Grameen, a Bangladeshi financial institution with a deep interest in building and selling financial products in East Africa, including in Uganda. As I was originally contracted to work with Grameen and the Gates

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decision as well as for busi[]ness executives who may wish to review the decision-making procedures of their own companies." *Id*. at 248.

[66] "Conditions" here is used broadly to describe economic, living, market, and social conditions.

[67] As discussed, *supra*, I excluded farmers who were merely engaged in subsistence farming or household production and also excluded farms that were of such a large size (in hectares or revenue) to be full-scale commercial operations. While the cut-off for the latter was arbitrary (a multiple of the world poverty line income metric), the cut-off for the former was relatively easy to observe and enforce. Grameen Foundation and the Bill and Melinda Gates Foundation offered substantial assistance in locating the individuals who were eventually included in the sample.

[68] "Situated" here is meant to describe the businessperson's socioeconomic situation, amount of land controlled, and ability to extract revenue from his or her business activities.

Foundation in assessing the appetite for, and market for, insurance products among Ugandan farmers, the design of my research methods was initially strictly quantitative: My goal was to design a series of experiments to assess farmers' willingness to pay for insurance, understanding of risk, and financial literacy. During my initial visits to Uganda, I introduced myself as an economist working for Grameen and several people, including my driver, Miles, continued to call me "the economist" for the duration of my time in the country. Nearly all people in this study, however, met me after my work with Grameen had either concluded or largely concluded and those people saw me in the context of being a student and researcher living in the village of Ariaga.

The shift in my methods came, in large part, from my recognition that the decisions most interesting to study were not the decisions to buy insurance (which are, unsurprisingly, relatively uniform across populations and vary primarily with the numeracy and literacy of the people involved) but decisions made in the running of the business enterprise that insurance is designed and intended to protect. I was struck, in my first several visits, by the degree of uniformity my fellow researchers at Grameen expected (assumed) they would find in decision-making among agricultural businesspeople in Uganda. These assumptions were in line with the behaviours of the "econ": farmers would only pay roughly actuarially-fair insurance premiums, they would lease rather than buy capital equipment where it was more efficient financially,[69] they would staff their farms with the ideal number of workers and set labour-and-capital trade-offs to reasonably efficient ratios, and so on. Over time, I realised the decisions made by businesspeople running agricultural operations conformed, in many cases, to these expectations but, in important and intermittent moments of decision-making, did

[69] This disregards the difficulty of leasing equipment in Uganda's undersupplied and inefficient market for ox ploughs and other items, discussed *infra*.

not. I focused my work in late 2010 on designing a mixed methods approach that would record the experiences of businesspeople making decisions while also recording the economic outcomes of those decisions. Reaching beyond a simple ledger system[70] of audit accounting, I attempted to record market environmental factors, including crop prices, inflation relative to the GBP and the USD, and the local price of labour.[71] In essence, I engaged in a qualitative, ethnographic investigation of how people do business in Northern Uganda but, where appropriate and possible, confirmed my observations with measurable metrics on the financial performance of the firms being observed, incorporating factors like prices, inventory, sales, and performance against earlier periods.[72]

In my qualitative investigation of entrepreneurial life in Uganda and business decision-making, I met frequently with farmers from Oyam, often several times per week. I combined site visits (for those less able to travel) with gatherings at a popular local pub in Gulu Town called Lacan Pe Nino where I would often buy the first round of beverages. When we did not meet at Lacan Pe Nino, we met at an abandoned colonial cricket pitch near Senior Quarters, an area inhabited by senior British officers more than fifty years earlier; its once-manicured gardens and large houses have been repurposed into vegetable gardens and utilitarian housing – I thought this transformation was a suitable backdrop for a conversation about agriculture that often culminated in conversations about Ugandan-led (rather than foreign-led or NGO-led) development. I established that I was the convener of these gatherings, but not its administrator or master of ceremonies; I often simply listened to businesspeople discussing the issues of the day,

[70] *See cf.* Collins et al., *supra*.
[71] Labour prices were wildly variable and difficult to observe, though I did manage to make a record of rough ranges of cost of hiring extra boys and men during each of the major periods of the season.
[72] This is similar to, for instance, the quantifiable audit of school involvement in student career outcomes by Willis. *See* P. Willis. Learning To Labor. Columbia. 1977. *See in particular* p. 90.

from pests to prices to weeding to selection of seeds for the coming planting period. I was careful not to intervene, even when what I considered disastrous business decisions were being contemplated, recognising that my judgement on these matters was less experienced and less expert and that, even if that were not true, I was present as an observer and not as a business consultant. Often, I scribbled notes on a single conversation among one small group of the businesspeople gathered; other times, I attempted to circulate and take less in-depth notes on a variety of conversations. Though I encouraged female entrepreneurs to attend, this was rarely met with success.[73]

I met less frequently (twice per month) with entrepreneurs in Kapchorwa, to the east of where I lived. The conditions in Kapchorwa were characterised by its difficult topography,[74] the Karamajong culture,[75] its harsh rainy season,[76] and its lack of a central market equivalent to Oyam's Macho Dwogo.[77] In Kapchorwa, and the surrounding area, I made an effort to accommodate the difficult transport conditions (particularly during the rainy season) by meeting entrepreneurs at locations they would need to visit whether or not they were meeting me. The most common gathering place was the office of Samuel and Innocent, two local young men who operated as a team from an "office" roughly the size of two portable toilets one might find at a local concert in England. While coffee is not a common crop in Oyam (there, the key cash crop is tobacco), coffee is the economic lifeblood of Kapchorwa. Samuel and Innocent provide, on the small

[73] Toward the end of my time in Uganda, female attendance at these gatherings increased, though only marginally (from zero to one or two out of a dozen in attendance).
[74] This area is among the most mountainous in interior Africa.
[75] The Karamajong culture stretches from the Upper Nile zone in Sudan all the way south to the southernmost slopes of Mount Elgon. It includes six languages, five population centres, three official governments, and a dozen armed conflicts in the past generation.
[76] Literally the season of mud or "flowing earth" in the local languages, an indication of the degree to which erosion is a concern and, perhaps, an inevitability.
[77] This made it substantially more difficult to track and understand complex transactions.

chalkboard outside their "office," the price Starbucks and other international buyers are offering for coffee on that day. While most businesspeople, due to their scarce bargaining power and limited market data, are mere price-takers,[78] at times those entangled in the supply contracts of Starbucks and others come up short; it is at these moments that Samuel and Innocent make their money, negotiating with much larger players and often getting good prices for those they represent (and taking 50% of the amount they secure in excess of the prevailing price).[79] The decisions discussed at Samuel and Innocent's office were not limited to coffee brokerage, however, and often involved a dozen people standing outside, enjoying the shade of banana trees, and arranging everything from harvest-season logistics to village-level childcare. These decisions and discussions were more diverse than I initially expected, often intertwining business dealings with personal relationships and community issues in a way portrayed by some of the early anthropological literature.[80]

One flaw in much of the early literature[81] – including literature I cite here – is a colonial or immediately post-colonial perspective (lens) for examining decisions made by African (and Asian) farmers. This often includes a range of detrimental assumptions about the farmer in the developing world, including 1) that nearly all farms in the developing world are run at a subsistence level, 2) that farmers in the developing world do not aspire to operate at scale, 3) that farmers with low numeracy or literacy are less intelligent or less able to reason, 4) that diversification[82] into other lines of business (retail sales,

[78] "Price-taker: A company that must accept the prevailing prices in the market of its products, its own transactions being unable to affect the market price." Oxford Dictionary of Economics. Oxford University Press.
[79] Though it was obvious Samuel and Innocent manipulated prices on their chalkboards downward and made their "negotiation gains" larger as a result, no one seemed to mind.
[80] *See*, *in particular*, Scott, *supra*.
[81] I generally class the "early literature" as being that literature produced during the period when "peasant studies" was the dominant Anglophonic taxonomy for any anthropological, economic, ethnographic, geographic, or other study of societies that were not in the process of rapid industrialisation.
[82] Business diversification is discussed, *infra*, and is common.

equipment leasing, etc.) is not interesting to developing-world farmers, and so on. I sought to include in my interpretation of – and embrace of – cultural relativism a sort of "business relativism," recognizing that the Ugandan business environment – and those who inhabit it – is unique and not susceptible to post-colonial or ethnocentric analyses. Aside from the application of the most basic Occidental financial calculations to audit claims made by those with whom I conversed, I did not view my role as being to audit, critique, or improve Ugandan business practices; I took Ugandan business decision-making to be what it is, and my goal was to better-understand – and not modify – it.

I felt strongly that I, to the extent possible, become a member of the community near Oyam that would be my primary observation sample. This also meant being part of the community of people cultivating crops. Rather than being a wholly divorced observer (as many earlier scholars have been, particularly in malaria-endemic landlocked areas of Africa, including Uganda), I elected to live in conditions as close as possible to the people I was observing. I lived in a cinderblock building on a plot of only one half hectare in size. Inside, I kept 12-volt automotive batteries to run lighting at night; water came from a small water tower (capture tower) next to my home and small propane (actually a mixture of propane and natural gas) tanks were bought from the local French-owned petrol station. I kept my own small garden, cultivating six rows of crops including lettuces, peppers (kalara munu), herbs, and other ingredients. I also tended to an avocado tree and a lemon tree that predated my occupancy of the area. My purpose in tending to these plants was both to provide part of my sustenance but also to synchronise my thinking with those of the people I was studying; I found I had more interesting conversations about planting or weeding or pests if I shared the schedule, experiences, and concerns of subjects. Throughout my time in Uganda, I asked businesspeople for recommendations and frank feedback as to my integration with the community, often receiving (and taking to heart) critique of my questions, language

skills, manners, and so on (at one point, a subject of the study nearly killed a chicken – a valuable asset – to have meat to host me for dinner because sunset was near).

While I recognise any qualitative methodology that immerses the researcher in a foreign culture for years at a time will inevitably introduce the subjective impressions and, yes, judgements of the researcher, I attempted to mitigate this risk (albeit only partially) by making recordings of some interactions, by taking exhaustive notes during interviews (in Lango, where possible, for later translation rather than introducing the risk of contemporary mistranslation), by taking other researchers with me (including Tom Kirk and Jenn Helgeson, both of the LSE) on select visits and interviews and reviewing their impressions afterward, and by creating quantitative reference points for purchases, sales, prices, amounts, and other events that were quantifiable, even if only with a dated notebook annotation that "X sold Y quantity of Z crop at A market for B price to C." Though my translation of conversations and negotiations observed may have been imperfect, I did attempt to check important translation questions with both native speakers and formally trained linguists – Holly Porter of the LSE was invaluable in helping me examine not only translations, but also contextual meaning and comments at the edge that separates the literal from the metaphoric; an early example of this in my research notes is the comment "anyim col" literally meaning "the future is dark" which Dr. Porter corrected in one of our sessions to mean "what lies ahead from here is un-seeable or impossible to predict." Realising that reducing oral interactions to text is, itself, a simplification that forfeits the physical gestures and emotional inflections so important to meaning,[83] I experimented with using a small FlipCam digital camera to record video of interviews during November and December of 2012, but found it too difficult to keep camera batteries charged in the challenging, electricity-scarce

[83] *See*, *e.g.*, H.L. Gates. The Signifying Monkey. Oxford University Press. 1988.

conditions of the field; though I was frustrated by the battery issues, this experimentation ended prematurely with the theft of my FlipCam, which I elected not to replace. Though over 3,000 farming businesses are represented in the study – meaning they answered at least one survey via smartphone (the minimal level of interaction) – the interactions, individuals, and conversations highlighted are only those where my interaction was sufficiently frequent that I felt I understood the fundamentals of the person's business and the operations of the same; where conversations are excerpted, this is done sparingly and with the most literal translation possible unless, as in the case of "anyim col" above, the literal translation would be substantively misleading. Measurements made in local units have been carefully translated into metric or Imperial units as appropriate for a British audience, with petrol being measured in litres (rather than NATO 19.6L jerrycans) and land measured in hectares and acres (rather than local units).

In some cases, I would record conversations, negotiations, and arguments only to later figure out (with the benefit of hindsight, the advantage of better linguistic and translation skills, and the asset of deeper cultural understanding) these situations had largely occurred for my benefit. Consider, for example, a tape-recorded argumentative negotiation I witnessed at a market near Oyam in 2012 (relatively early in my fieldwork):[84]

Seller: a tye ki sim-sim miya acel kay	Literally: I have 100 kilos of [ready-to-press] sesame seeds [for oil].
Buyer: amito weng, ka weng kono?	Literally: I want all of it, how much for all of it?

[84] I translated the conversation later that evening, by candlelight, in *Gulu Town*, but later revised those translations with a stronger understanding of the linguistics and style of conversation. This translation reflects my later (2014) translation and includes the dichotomy between literal and contextual translation of the same source material.

Seller: pe wilo weng	Literally: You cannot buy the total.
Buyer: a tye ki ciling million ayet!	Literally: I have millions of shillings! Translated: I have plenty of money (this was not a real offer of millions of shillings, but a common phrase)!
Seller: pe tero	Literally: You cannot take [it]. Translated: I still don't want to sell the whole amount to you.
Buyer: (begins to walk away)	
Seller: ka emito adaa…	Literally: Well, if you really want it…
Buyer: watuki, atwero wele neé	Literally: Let's play, I can afford your price. Translated: Then let's negotiate, I have plenty of money (bragging, but also indicating the speaker's financial savvy and that he will not overpay).
Seller: konya ket ciling; wel weng rom	Literally: Help me of money, all prices are equal. Translated: Make a fair offer. I am not impressed by your bragging, I know there is a market price for things.
Buyer: dowk wele piny!	Literally: Slam the price on the floor! Translated: Give me your best price!
Seller: ku (unintelligible mumbling) opoto	Literally: No… falling… Translated: I am willing to compromise.

Buyer: kwany wiye manok	Literally: Cut from the top. Translated: If you deduct a bit from your top price, we can make a deal.
Seller: ka ngwec ki aguragura	Literally: Run with a camel. Translated: You negotiate like an Arab, you must run with camels (an insult that buyer is being difficult / absurd).
Buyer: (unintelligible) ya-twon	Literally: Big and masculine. Translated: I'm just being tough, it's the way I am.
Seller: a luwoko cinga	Literally: I wash my hands. Translated: I'm done with this, I am done with this conversation/negotiation.
Buyer: ibedo calo bim! (walks away)	Literally: You have a monkey's existence. Translated: You are too primitive in your thinking to reason with me, I will not negotiate with a monkey.
Seller: (laughing) wenen diki	Literally: See you tomorrow. Translated: You're merely posturing, you'll be back.

In retrospect, this conversation was almost certainly held at least in part as theatre for my benefit (and the benefit of other bystanders). While it is not uncommon for men to posture and have long preliminary negotiation-like discussions like these before actually discussing price, the context of some comments is particularly theatrical here and the insult involving a monkey was likely chosen thinking I had a limited (correct at the time)

vocabularial inventory of animals and the buyer (Oloya, with whom I would later become friends and who I would later assert had exaggerated the interaction) wanted to make sure I had recorded an insult, like an amateur boxer looking to the table after a blow to ensure a point was marked. Over time, I was able to disentangle theatre from substance, but never fully discounted the value of the theatre – there was a structure and ritual and currency to these interactions, even when they were tailored for my consumption (sometimes by the addition or subtraction of profanity, sometimes by the slightly slower pacing of speech, sometimes by amplified gesturing). While I don't claim to have performed perfect translations of all interactions I observed, I do believe I've been able to locate the meaning in conversations and negotiations I observed to a degree a non-resident, more removed researcher might have found impossible.

Most challenging, however – and far more challenging than translating language, or units of measure – has been the effort to keep the framing of this research on the entrepreneur.[85] This word, important to setting both the purpose and bounds of my conversations with my subjects, illustrates that these are fundamentally businesspeople trying to run successful agricultural enterprises. They are not peasants,[86] or victims of poverty, or martyrs suffering in their communities (from disease, poverty, or other ills),[87] or accidental residents of the lands they cultivate. However, they are also not merely "econs" or robots; they have a cultural history, an ethnopolitical location within the broader context of Africa, and a set of practices and views that dramatically predate my arrival in Uganda. Balancing respect for this rich history while accurately portraying the contemporary reality of these entrepreneurial men and women as savvy and striving

[85] *See* P. Keller et al. *Affect, Framing, and Persuasion*. Journal of Marketing Research. 2003.
[86] The word peasant, even in the broader context of "peasant studies" characterises and classifies the individual in a way that is unhelpful, and possibly counterproductive, here. *See*, *contra*, Scott, *supra*.
[87] A. Kleinman et al. *Social Suffering*. University of California Press. 1997.

businesspeople has been the central challenge to writing, and re-writing, this text. Examining the industrial operation of a farm in the abstract while not artificially stripping it of its history or cultural locus is central to the success, and future usefulness, of this research.[88]

Considerations in Sample / Geography Selection

Two of the considerations in sample selection were the inventory of potential participants and the linguistic ability of the researcher.

As to the first, while working as an economist for Grameen in East Africa, I became familiar with the database co-curated by Grameen and the Gates Foundation called CKW-M9. This database would become the basis for my sample. CKW-M9 (hereafter referred to as the "CKW" database) contained a list of Community Knowledge Workers who had either agreed to work with Grameen or had agreed to act as a resource for local farmers through the Gates Foundation's Community Knowledge Worker initiative. I became familiar with the CKW dataset at a Grameen meeting in Nairobi in 2010 when I was asked to approach certain people in Northern Uganda to discuss, and market, an agricultural insurance product. I was told these people would be flagged in the CKW database. I later negotiated a contract with Grameen that would allow me to approach entrepreneurs listed in the CKW dataset who had not been approached with any insurance product – I made clear my interest was in understanding these entrepreneurs as businesspeople and not as customers for agricultural insurance policies. After months of negotiation, Grameen agreed to grant me access to the CKW dataset for this purpose. Importantly, none of the people selected for this study is a person I approached as an "insurance salesperson" on behalf of Grameen – in other words, my research was, to the

[88] On these issues in particular, *see* critique in E. R. Wolf. Europe and the People without History. University of California Press (Berkeley). 1982

extent possible, partitioned and isolated from my work on Grameen's insurance products. Though there were people in the CKW dataset whom I did approach to discuss the purchase of insurance policies (including agricultural insurance), I was careful to not approach any of those individuals for this study, and the vast majority were not eligible as their farms were of commercial size.[89] This assured that the initial impression, and hopefully ongoing impression, of my subjects would be divorced from the work I was doing for Grameen (though this isolation of one from the other was admittedly incomplete; some farmers had heard of me prior to my site visits or did mention neighbours had spoken to me about insurance).

The second issue was my ability to communicate with farmers. While I purposely chose farmers who were flagged in the CKW database as having above-average English skills, the average against this was measured was of dubious consistency (and questionable value). It quickly became clear, in initial exploratory time in the field in 2010 and early 2011, that local language ability at a conversational, if not fluent, level would be important. I had already begun studying Nilotic (particularly Luo) language and had developed a basic conversational level of ability in Acholi and Lango by the end of 2010. I continued to study these languages rigorously – often with four or five days of study per week – through 2011 and 2012. Conversations with farmers here are generally transcribed in translated form; however, in cases where I feel the original wording or phrasing is particularly important, I have included transcription in the original, either from my notebooks or, in some cases, from audio recordings. In cases where the language is shown in the original, the format of tables illustrated below is used, with notation of any metaphorical or non-obvious meaning.

[89] The primary insurance customer for the types of insurance Grameen was designing and offering was a farming operation substantially more profitable and sophisticated than the businesses studied here.

ki munu a tye ka yenyo leb	Literally: I am looking for tongue. Figuratively: I'm not sure of the right word in English.
a bedo ka cam ki wele tek	Literally: I was eating and your pricing is very strong. Figuratively: The price you demand is so high it is insulting or a waste of my time.

The primary intersection of my linguistic ability and the CKW database led me to Oyam, a bustling market town in Northern Uganda where the CKW data suggested thousands of farms operated at the scale I was most interested in. This meant Oyam would become (and did become) my primary locus for this research.

To test the transferability of my findings and observations across Ugandan geographies, however (or at least to illustrate my findings are not peculiar to Oyam itself), I wanted to look at a similar community that was not intertwined with the Oyam community in terms of language, patterns of trade, or mercantile agreements. The best choice, it seemed, was Kapchorwa. I visited Kapchorwa in early 2011, along with various other communities, and found it to be roughly as different as any community one day's drive from Oyam could be; relative to Oyam, it grew different crops, presented different topography,[90] experienced a different climate, was linguistically alien, and had a very different recent history. I spent only a few days per month in Kapchorwa, focusing my research on Oyam and bringing hypotheses, theories, and observations from Oyam to Kapchorwa to test their universality, reception, and peculiarity. It quickly became clear

[90] The Sebei people of Kapchorwa live on the slopes (and in the foothills) of Mount Elgon, a radically different environment from the flatlands of Oyam, the once-undersea remnants of a Jurassic floodplain.

that I had substantially more difficulty learning the language in Kapchorwa (despite Sebei's also being a Nilotic language) – both due to lack of experience with structure/vocabulary and lack of exposure to local accents – and would need a translator. I chose a translator fluent in both English and Acholi, which I believe allowed for some conceptual or metaphorical comments to be transliterated more accurately than would have been possible with immediate Anglicisation. I speak of Sebei as a language throughout this text which is consistent with much of the literature produced by the School of Oriental and African Studies (SOAS), University of London in London and other contemporary literature; Sebei is a category, when used in this sense, and embraces at least four different Kalenjin dialects spoken by Sabiny people, two of which are often grouped and distinguished as Kupsabiny. As the focus of this piece is the commercial, rather than linguistic, orientation of the subjects studied, I have simplified what are almost unimaginably nuanced differences between dialects and subdialects; I do this also in Oyam, not distinguishing between two different orientations of Lango language and often using mixtures of Lango and Acholi notation, as is customary locally.

Where comments in Sebei are used, they are shown as having been translated:

(narration in Sebei)	Translated: It is not a lack of birth control drugs. I choose to have children in part because it is expected of me.

To the extent possible (and where it is relevant), the exact geographical and ethnolinguistic context of conversations is noted, and where Lango and Sebei individuals' opinions or statements are compared, I have attempted to ask comparable questions in a comparable setting, to the extent field conditions allowed. The involvement of Sebei people in Kapchorwa is not meant as a "control" or an

experimental rival group, but rather as a venue for examining observations about Ugandan farmers made in Oyam within a materially different Ugandan context.

Assessments of Reliability / Validity

The primary assessment of reliability and validity in this study is consistency of behaviour and responses across the large sample size, that sample being spread across two ethnically, culturally, linguistically, and geographically divergent groups with minimal shared history, minimal trade, and minimal social interaction. Aside from being located in Uganda at roughly similar latitude, Oyam and Kapchorwa have little in common.

Using the “more like econs” versus “more like humans” framework of Thaler and others is helpful in that it is, in some senses, a binary scale – either the expected behaviours of econs are detected or something else occurs that is clearly suboptimal and not the behaviours of an econ. My initial hypothesis, the classical or liberal hypothesis, was that all Ugandan behaviour observed would be consistent (across actors and between domains), predictable, repeatable, and econ-like.

The operative criterion across all three domains is the same: Is the subject (at the individual level and, in the analysis, collectively) behaving more like an econ or more like a human? While one might (correctly) suppose the spectrum between the two is arbitrary and infinitely divisible, the precise orientation of any subject on the spectrum is not being tested, but rather his or her affinity for one of the two types of decision-making; I appreciate – and believe – the two are not mutually-exclusive or wholesale-adopted by many of my subjects (in fact, my research suggests that a given subject may prefer one in one domain context and another in a separate domain context). In essence, this is a test of discriminant validity, in that I have chosen scenarios where I

know, empirically, how an econ should behave in a given scenario and business operationalisations that are contrary to this behaviour are classified as human.

Researcher Habitation / Colocation and Countertranference / Neutrality

The decision to physically locate my home for two years very near the marketplace in Oyam was rooted in my greater cultural and linguistic familiarity with Lango subregion, where Oyam is located. However, this also poses a challenge, as I began to affiliate as a resident of Oyam (and not of London, where I had relinquished my flat, nor of Kapchorwa, where I visited monthly for several nights at a time but did not reside). Though I made efforts to check my degree of neutrality both in my actions (not extending loans to farmers even when it would be mutually-beneficial, for instance) and in my conversations (not revealing to farmers the farming practices of more successful neighbours, even if there was minimal risk these improved methods would be detected), I do believe my colocation with Oyam's farmers made me, on the margin, more sympathetic to the situation of those in Oyam. Though I was dismissive of (often vocally) sweeping generalisations often made by Lango people in Oyam about the Sebei people in Kapchorwa as being primitive, Ludditeish, or overly violent, even my adoption of one language over another sent a message of affiliation or even loyalty.

To give a sense of the sentiments often expressed by Lango entrepreneurs about their Sebei neighbours to the east, I've included an excerpt from my seventh interview with Ojok, a 32-year-old Lango farmer born in Acholi subregion who dislikes the Sebei.

Ojok: They are violent over that way. They are killers.

Karl: What leads you to believe the Sebei are so violent?

Ojok: They are ethnically like Dinka.[91] They are warriors.

Karl: Warriors?

Ojok: Exactly.

Karl: And are they the dominant group in this area?

Ojok: Loya a bye bye.

loya a bye bye	Literally: Winners on an anthill. Translated: They are at the top (the anthill is a common analogy for how Ugandans live in a constant struggle for power in a loose hierarchy).

Karl: Do they win because they are smart or strong?

Ojok: (laughing) A wea? Eteryi.

a wea? eteryi.	Literally: The head? The last in a series. Figuratively: When it comes to smarts, they're the stupidest ones around (eteryi, which has no Occidental equivalent, specifically refers to the single item at the bottom of a stack or the final item in a descending list).

[91] The Dinka are a tribe known as warriors in east Africa and are the dominant tribe in the rural areas of South Sudan, to the north of Kapchorwa. Depending upon which history one believes, the Dinka are either indistinguishable from the Sebei or closely ethnolinguistically related.

I was cautious not to adopt these biased inter-tribal stereotypes and views, but did occasionally reference them in my attempts to better-understand the gulf separating Oyam and Kapchorwa, which I learned was measured in divergence of cultural history as often as it was measured in comparative prosperity or perceived business acumen.

However, in my interactions in both Oyam and Kapchorwa, I found myself often having to suppress my business consultant instincts. Having started a company that went on to win a Google Grant[92] and as someone who consults at a high level to companies on issues of finance and strategy, it was tempting to frame these Ugandan entrepreneurs as bumbling or uninformed businesspeople simply needing the right advice. There were times when I struggled to muster the patience to sit silently watching the entrepreneurs struggle to complete basic arithmetic tasks or, after much calculation and recalculation, fill out ledgers incorrectly. As someone accustomed to helping students with these very issues, it took enormous restraint for me to (nearly always) resist giving input as to how my research subjects were managing their business affairs. Constantly reminding myself that the entrepreneurs in Uganda were neither my fellow startup entrepreneurs nor my business students at Northwestern University required more work, and discipline, than I ever would have anticipated *ex ante*. This effort influenced my perceptions, my neutrality, and my interactions – particularly where I had to remind myself to judge the finance savvy and business management of these entrepreneurs in the context of their (limited) formal education, (substantial) experience on others' farms, and (generally good) instincts being trusted more than arithmetic or accounting in many cases.

I was also aware of the effect my home and living arrangements – which would inevitably be observed and appraised by local people – would have on perceptions of my life, lifestyle, social status, degree of integration, and neutrality. I purposely chose a

[92] Google Grants (2003).

structure that was similar to those inhabited by my subjects – water from a simple catch water tower, no on-site electric generator (NGO and government compounds have generators, as do some “ex-pat” homes, but I decided against this), and cooking gas supplied from canisters purchased at the local petrol station (this is the normal supply of cooking gas; plumbed gas is rare). The structure itself is a cinderblock, rectangular structure covered in an iron-rich stucco-like mud that is commonly used in the region. This would have to be refreshed, and then painted over again, several times during my stay to prevent “cway” (leaking or flowing of water in one’s home) and “ton” (dripping or slight intrusions into the home by water during the rainy season). Yellow or white paint is generally used, both for its ability to repel the heat of the dry season sun, and to make detecting flaws easier, as the bright red stucco will begin to reveal itself through the lighter paint when a new coat is required. I purposely chose a home with a tin-and-tile roof rather than the more robust roofs of many “ex-pat” homes, as roofing material is an important status symbol in Northern Uganda (the hierarchy generally being thatch, corrugated tin, tile, sheet membrane roofs, rubber membrane roofs, and modern roofs).

Above: My vehicle in front of my residence.

Another concern was attempts by curious neighbours to attempt to ascertain the value of my vehicle, the amount I was paying to my landlord, and other aspects of my financial life. I felt strongly, in part due to experiences I had in Chicago and in London, that local discussion of my financial position might distract from, or prevent, interactions I would otherwise have with local people. With this in mind, I imported a five-year-old Toyota truck in mechanically-reliable but aesthetically-imperfect condition, the kind of vehicle with which local people would be familiar. I purposely chose a silver vehicle, as white vehicles are associated with the government and with NGO commercial fleets. As I owned (and had practiced maintaining) the truck in the United States before shipping it to Uganda, there was no local transaction local people could examine or inquire about to attempt to estimate the value of the vehicle.

The housing situation, however, posed a more difficult problem. I often heard, in early visits to the region, local people (most of whom assumed I could not understand Acholi

or Lango) bragging about the amounts they'd extracted from foreigners living in villages. Implicit in these comments was a low appraisal of the bargaining ability (or intelligence, or both) of the foreigner involved. In some cases, the mixture of stupidity and extravagance attributed to the foreign aid worker, executive, or researcher had been so toxic as to permanently poison the person's local credibility. I decided I would rent from an absentee landlord who hardly ever visited my village and who was ethnically Dinka and hence distrusted by the people to whom I would be a neighbour. Most foreigners would drive every two weeks (or, in some cases, every month) to a local bank branch where they would meet their landlord, exchange dollars or sterling for local currency at the teller window, then hand the local currency to the landlord. This not only produced an uncomfortably large (to me) number of people who knew exactly how much and how often rent was being paid, but created a spectacle out of the transaction. I decided I would pay the entire sum, eighteen months' rent, up front and tell my landlord that if he wanted to have subsequent meetings, they would happen out of town. I would take on responsibility for all maintenance of the home, repairs, and so forth in an effort to appear as independent as possible. As promised, my landlord only visited my home on rare occasions, and usually in the quiet early hours of weekend evenings, only to check on me and make sure I was still occupying the residence.

Above: Paying eighteen months' rent to my Dinka landlord, Ojara, on 4 May, 2011.

I also did not make use of the "delivery services" in town, which posed a bit of a moral dilemma. On the one hand, I approved of – and even rooted for – the young men with motorbikes who made a fraction of their livings delivering bottles of Coca-Cola and other Western staples to the compounds of *munus*.[93] On the other hand, these men were seen as earning "easy money" (*ciling kany*, *see* translation *infra*) from gullible and lazy foreigners who wanted everything delivered – I chose, on this basis, to not participate in the delivery services and to instead acquire things myself in town, often walking forty to fifty minutes on foot to the market, as my neighbours did.

ciling kany	Literally: Money here.

[93] Throughout this document, "*munu*" and "*munus*" (pl.) is used to describe outsiders. While this derives from the Kiswahili term "*mizungu*" (particularly used when speaking of white colonists), the term *munu* in northern Uganda applies to a wider set of individuals, including outsiders of any pigmentation or cultural orientation.

	Translated: Money acquired too easily; money without effort. Often used when discussing money earned from wealthy *munus* or companies. Contrast with "ciling kwica" or "ciling wii cere" meaning "money far away" or "money on top of a hill" respectively, each conveying the sense that one must travel far or work hard to get money. In both Acholi and Lango, distance travelled is often used as a metaphor for amount of work done.

Though my decision to not avail myself of the delivery services – or other local "luxuries" – did not make me financially equal to those who did not partake of these services due to scarcity or poverty, it did make my day more similar to the days lived by those I was studying and this was noticed on more than one occasion. One unanticipated advantage of not using the delivery services was that I often would have occasion to walk and talk between home and the market (either to, or from, or both), which gave a valuable opportunity to hear farmers' thoughts in a less formal interview setting.

Causal Assessments / Reflexivity Concerns

While absolute autonomy is not an achievable or realistic goal, I worked with several other researchers to attempt to "audit" each other's' levels of social reflexivity. For instance, my friendship with Jenn F. Helgeson,[94] performing very different research from my own but in a similar environment (her primary Ugandan place of residence being

[94] Researcher for the Grantham Institute For Climate Change.

only a few hours from mine by car), offered an opportunity to explore questions of autonomy, reflexivity, subject influence, observer effect, and other factors. By comparing each other's' experiences, and by inviting other long-time researchers in the region (particularly Dr. Holly Porter, who lives in a thatched hut and has lived in the same Acholi village nearby for nearly a decade) to join in these conversations, a clearer picture emerged of what was typical in terms of our experiences in interviews and interactions with our subjects and other local people.

Two of my primary concerns had to do with the interaction between prior researchers' interactions with my sample group and my own interactions. It was possible that a prior group – for instance, a group trying to sell insurance to the farmer – would have encouraged econ-like (rather than human-like) replies that would then cause a skew in responses I received. It was further possible that my own reactions to farmers during interviews would portray a preference for econ-like or human-like replies and that this would recall, or reinvigorate, cues given by earlier researchers.

The second concern was that questions asked by my colleague Jenn Helgeson, though wholly separate from my own queries would lead entrepreneurs in a certain direction. We attempted to minimise this effect by asking questions in person whenever possible, ensuring that our questions were clearly addressing different issues (business practices versus climate change), and confirming answers by posing the same substantive query with different examples or hypotheticals or, in some cases, asking the same question via smartphones and in person to the same (and similar) entrepreneurs.

At the same time, my own causal assessments and reflexivity concerns focused on the interpretation of these qualitative interview encounters. For instance, even if I did not cue or socially reward certain responses (through my reactions, follow-up questions, or even facial expressions), was my interpretation of these responses skewed by my own

interpretation of the subject's willingness to engage on these topics, or to discuss certain issues? As I learned several months into my research, the reluctance to discuss certain farming practices (that I had initially attributed to interpersonal animosity aimed toward me generally as an outsider or specifically as a researcher) stemmed mostly from concern about trade secrets or the anticipation of my comparing one entrepreneur's farming methods to those of others and thus inadvertently divulging the valuable methods the first entrepreneur might have spent generations[95] developing. During my time in Uganda, I encountered dozens of these situations where only with a more nuanced, contextual understanding of my physical, social, and mercantile position could I begin to appreciate the causes for the behaviours I observed.

Technological Survey Method

Questions were delivered to farmers every morning or every other morning (in some cases) and never on Sunday (out of respect for the most observant). The questions arrived via a box that would appear on the farmer's mobile phone, which I provided (these phones were provided to me as part of a grant from Google). Upon receiving a phone, the farmer would log in with his or her Farmer ID number (a unique number I'd assigned for the purpose of this research). All further interaction was automated and through the phone's survey app (software I had designed while in London).

[95] It is not uncommon in Lango and Sebei culture to speak in terms of generations in the context of learnings, or invention, or other processes of innovation. For instance, for a person to say "it has taken four generations [to complete a task or to learn about a process]" is not uncommon; the continuity of learning between generations in these statements is so complete that each participant is not an individual within the statement, the focus of the sentence is instead on the process itself and its intergenerational continuity.

My first meeting to distribute phones in the first week of March in 2011.

The woman to my left, *supra*, is a Community Knowledge Worker and wears an “ask me about farming” t-shirt from the Gates Foundation. The t-shirt indicates she has basic knowledge of how to raise crops and livestock and can answer questions for local agricultural entrepreneurs. The two men who can be seen in the background are farmers from Oyam. The meeting was held beneath citrus trees for good luck.

kacoke me la pwur	Literally: Meeting for farming. Translated: There is a long history of Northern Ugandan farmers meeting about farming, to discuss practices, or to brag to each other about harvests. These meetings (“kacoke”) are generally held in

	the open and money is never discussed. Compare to *rwate*, *infra*.
rwate me la pwur	Literally: Meeting (of two) for farming. Translated: "Rwate," whose closest (but imperfect) translation in English would be colloquy, specifically means a meeting of two people. It has the implicit implication of collecting a debt or threatening a person and is considered rude to propose in public. For instance, a predatory lender or unscrupulous seed dealer might call a "rwate me la pwur" with a farmer who owed him money. Hence, I was careful, even if it was a one-on-one meeting, to call it a "kacoke me la pwur" (a "coke" can describe a meeting of any number of people greater than one, including two) and never a "rwate."

Google provided 3,190 mobile handsets to be distributed to farmers as part of the study. These handsets were ordinary smartphones in every way, except they came pre-installed with a survey tool I had designed during the first year of my doctoral studies and allowed third parties (specifically me, Google, the Gates Foundation, and Grameen Bank) to observe their locations via software installed on the handset.

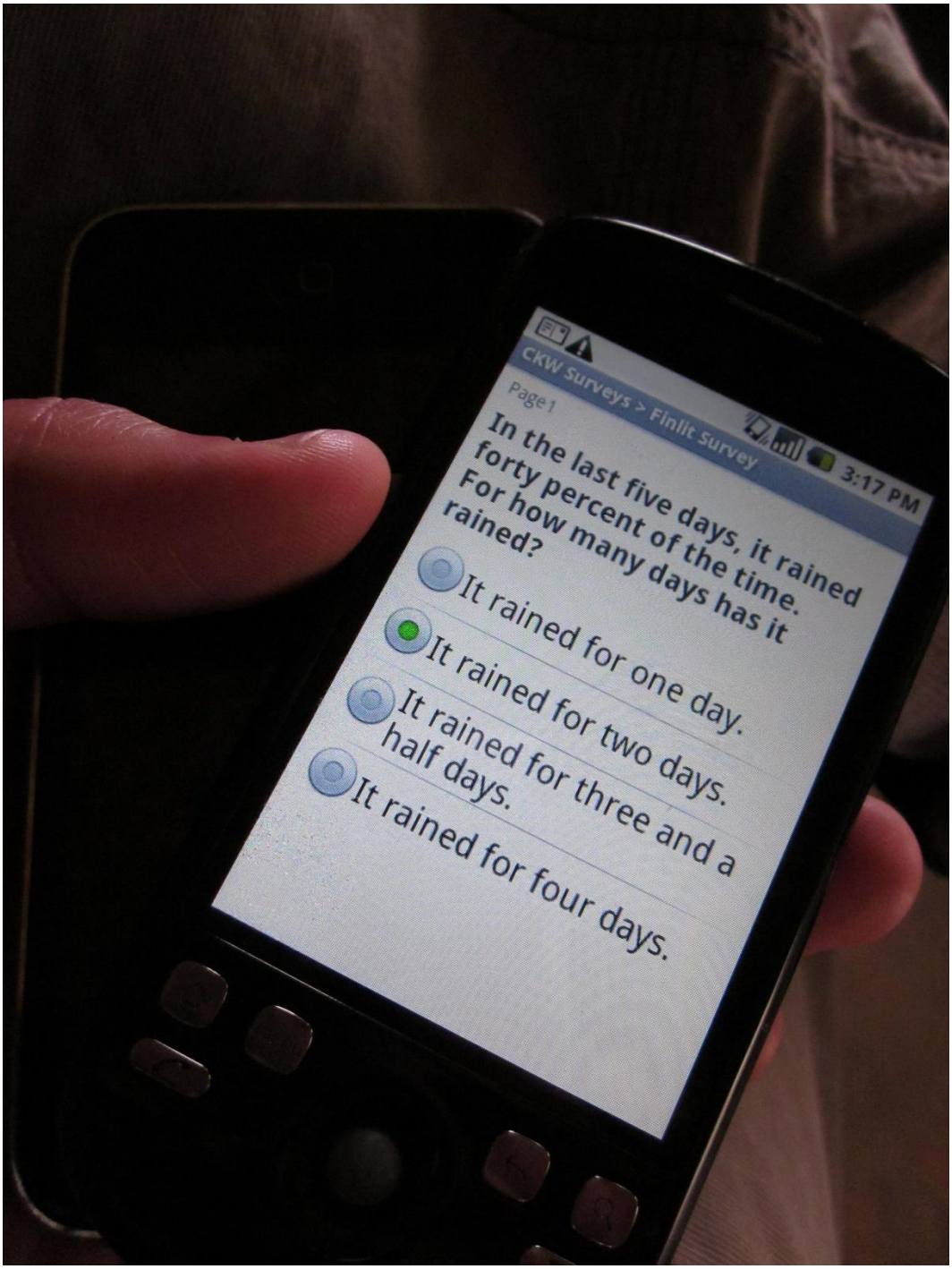
Google provided over 3,000 IDEOS smart phones for the survey.

Though the framing effects of the in-person interview questions were difficult to anticipate and de-fuse, these effects in the context of the smartphone survey methodology were even harder to examine *ex ante*. In particular, the absence of a human researcher asking questions meant it was difficult for some respondents to feel at ease asking for clarifications or rephrasings of the question – for this reason, "I don't feel comfortable answering" and "I don't understand the question" options were always available. However, it is possible – and likely, given the large number of respondents (3,000+) and questions posed per respondent (243+) that some portion of the answers provided was not fully consistent with my intent to prevent framing biases. For instance, in some financial questions the same scenario would be worded in terms of a gain or a loss in attempt to prevent these inconsistencies due to cognitive bias, but some of the mathematics involved may have been sufficiently complex to confuse some respondents; in cases where a significant rise in "I don't understand the question"

replies was observed, I either rephrased/simplified the question at issue or replaced it in later surveys with a less arithmetically-demanding variant. Still, appreciating that these simple inversions of gain and loss (or other simple safeguards) are not sufficient to fully overcome the biases mentioned in the literature,[96] a variety of changes were made iteratively, attempting to standardise questions (rather than varying or experimenting) when it came to probabilistic outcomes. Occasionally, scale in the technological survey method was varied to test the effect of large versus small losses, though the range of values that could be (credibly) tested was relatively narrow, given the capital constraints of the businesses being studied; still, in some cases, variation of a factor of ten was possible, whereas in rare cases variation of a factor of one hundred was reasonable. In general, effects of varying scale were not significant in terms of the participants' decision-making while some effects of increased certainty or gain versus loss were highly significant. As these were not the core aspects being tested in this research, I treated these aspects as primarily calibration considerations for the broader research inquiry rather than as the primary thrust of the research itself.

These variations were made both to calibrate the survey tool itself and to test respondents' reactions to questions. The more complex a question, particularly quantitative questions, the longer responses took. Basic numeracy questions were occasionally interspersed with more complex questions to check each farmer's mathematical ability and to build a coefficient (indicia coefficient) of reliability to be used with that particular farmer's answers to quantitative questions.

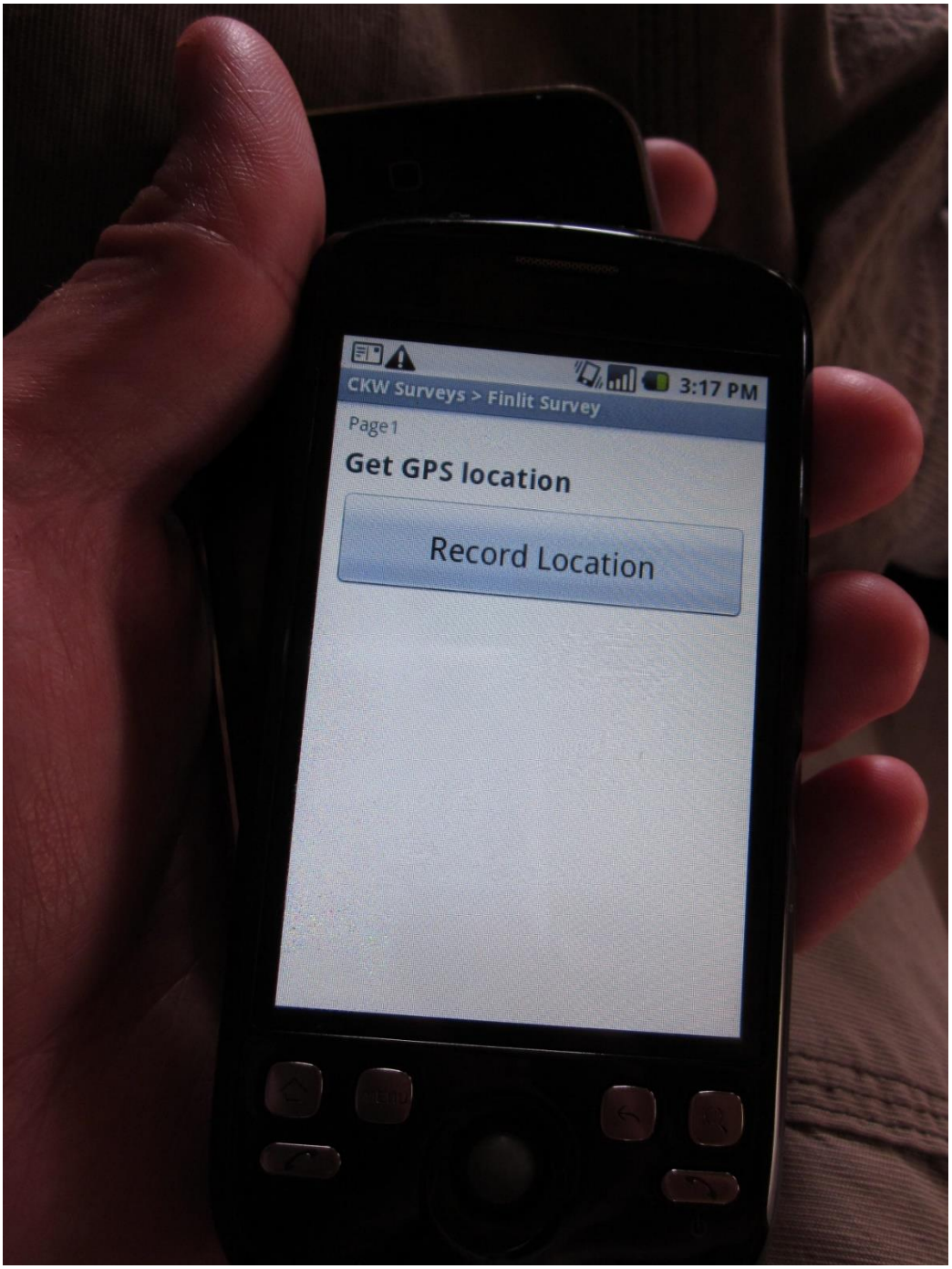
[96] *See generally* A. Tversky & D. Kahneman. *The Framing of Decisions and the Psychology of Choice*. Science vol. 211, pp. 453–458. 1981. doi:10.1126/science.7455683. PMID 7455683.



My phone displaying a basic numeracy question from the financial literacy database.

Most questions demanding a photograph were responded to within the hour; examples include “take a photo of the bar codes on the seed bags you planted this year” or “take a photo of the head of your healthiest chicken, rate how healthy the chicken is using the scale below.” The first question, about seed bag bar codes, was easy for farmers to

answer because most farmers in Oyam and Kapchorwa have stacks of seed bags dating back years – the idea is that a farmer may want to purchase (or avoid purchasing) the same seed type the next year and this will be difficult without the bag itself; my bar code question exploited this habit of keeping seed bags as a way of gathering precise information about the crop and varietal being cultivated (rather than having to estimate from plant performance or leaf-and-stem taxonomy, both unreliable) on each farm (the bar codes were translated to crops through a photo-to-UPC piece of software). The second photo was a spot-test of the farmer's familiarity with the husbandry of chickens; the most common problem for chickens in Northern Uganda is a type of avian influenza that causes light green discharge from the upper beak area of the chicken – if a farmer identified a chicken having this discharge as healthy, it was a good indicator this particular farmer had limited experience or expertise in raising chickens (I assessed this manually, as it could not be automated easily).



My phone displaying the “get location” feature used to gather GPS data on farm size.

Questions demanding a GPS/GIS fixed location often took a few hours, as the farmer might receive the message when he or she was not at home, or when he or she was busy (despite my efforts to send such questions in the first hour after dawn, which farmers told me was the best time for them to pause and answer a question). The average response time for a request like, “Walk to the northeast corner of your farm and

press the button" was about three hours. By contrast, the answers to more complex accountancy questions often came one to two days later, and often at dusk (presumably the time farmers could sit with their ledgers and figure the sums). This function was also used to gather other data, such as where farmers bought and sold items, and over the course of a year sixteen GPS-related questions were asked (including duplicates of the "corners of your farm" questions to confirm these coordinates).

Over time, I observed that many farmers began to respond to the survey questions as they would text messages from friends, waiting until either the lull late in the day or the first light of morning to reply. I often asked entrepreneurs whether they were comfortable receiving the messages, if they found the interface on the phone easy to use, and if they had concerns. Overwhelmingly, the largest concern was keeping the phone charged, as almost none of the entrepreneurs in the survey (<2%) had reliable access to electricity. Most charged the phones when in town or, alternatively, from 12v car batteries kept in their huts. When I asked 90 days into the study, at the Macho Dwogo market in Oyam, what problems farmers had, the overwhelming answer was charged phones.

cim-cing ki mac	Literally: Phone with flame (or phone on fire). Translated: The term "cim-cing" (pronounced "shim-CHING") is an onomatopoeia of the text message alert noise on the Nokia 6160, one of the first popular mobile phones in Uganda. "Mac" meaning fire or flame is often used, across Nilotic languages, to refer to electricity, a

	usage stemming from colonial British wiring often being operated without modern switching, hence a spark would shoot from lead to lead each time a connection was made.

I attempted to combat the electricity scarcity issue by running dual batteries in my own truck (the alternator on my truck would charge both batteries, allowing me to exchange batteries with entrepreneurs) and often swapping them with entrepreneurs when we met. I would also deliver batteries from town which I'd bought charged and take back dead batteries from villages; I attempted to undercut the delivery fee charged locally for this as a way of indirectly encouraging entrepreneurs to charge their phones, but did not perform the service free of charge so as not to invite abuse.

The mobile phone charging centre in Kamdini, built in 2012.

During my time in Uganda, charging centres were built at some major crossroads and in major towns. The charging centre is a simple building. It is a wood-frame structure, often raised from the ground on cinderblocks, holding a dozen 12v car batteries that are exchanged with passing trucks, exploiting the trucks' alternators to keep batteries

charged at all times. There is often (see photo, *supra*) an area for people to sit and talk while they wait for their phones to charge and, in some cases, an agreement or partnership with nearby refreshment stands or newsagents. As few subjects in my study lived near charging centres, most depended upon passing trucks for battery exchanges or local shops or kiosks in town with reliable 240v grid power.

Perceptions / Misperceptions of Technological Rewards for Participation

I made clear the phone was a piece of equipment used in the survey process, but it was difficult to hide that interim use of a phone was part of the compensation for the entrepreneurs' participation – whether or not this was intended. At an early meeting, a farmer asked me whether he could send text messages and emails on the phone and I told him that I preferred he use this phone instead of his normal phone and that he could use it exactly as he normally used a phone, including sending text messages and emails. Another participant at the same meeting protested that he might be called a *lakwor* by his neighbours, as the phone was very fancy and he could not afford it (this was at a time when touchscreen phones were rare in Uganda).

lakwor	Literally: Thief. Translated: A very strong word,[97] a noun that includes in it an accusation. Bordering on profanity in some contexts.

[97] Interestingly, other Nilotic words are closely related to lakwor, which once meant simple thief (perhaps even as innocuous as the English "pickpocket") but has grown to be something far more sinister. Referring to someone as a lakwor without direct evidence is grounds for a physical confrontation. The "kwor" in lakwor traces its origin to the ancient word "cor" meaning to exceed a boundary or border, to trespass. This embraces, in a sense, the early English legal concept of trespass to chattel. The word lakwor is closely related to the words lacor (a vandal, a person with no respect for property) and lako (to inherit chattel property from a deceased person or, in the strictest sense, to steal property from the dead).

This brought objections from two men with Apple iPhones who stood to be heard and threatened the first man for, by implication, suggesting they were either too poor to afford a touch-screen phone or were in fact thieves for having one.

As tempers escalated, the first man said quietly, “pé atwero cim-cing nee.”

pé *at*wero cim-cing nee	Literally: I cannot afford your phone. Translated: This was the end of the argument. In essence, he was saying, “Well, *I* cannot afford this item,” removing any sense that he had insulted the wealth or honesty of others.

It was decided by this group and other groups that I would explain the phones were being lent to the entrepreneurs (even though I had no intention of taking them back after two years), as this avoided the question of who owned the phone and explained why farmers didn’t know the phone’s retail price. I used the verb “bed”[98] when describing the phone’s possession by the farmers, stressing its temporary-ness and that the phone was merely “staying with” the farmer rather than being owned by him or her. All Nilotic words for lending or loans have a strictly pecuniary meaning, so it was not appropriate to say I’d “lent” the phone to the entrepreneur for this particular period.

Throughout the study, I received (approximately monthly for the first year) requests to join the study (to which I replied it was not possible to join the study, which was already underway) or requests to report for someone else (often an older farmer already in the study). In both cases, I replied this was not possible. Asking around in town, I learned a

[98] To stay, sleep, rest, or linger.

major motivator for the interest in the study (and the interest in joining the study) was access to more advanced mobile phones than were commonly available locally. After the first year of the study, requests to join the study tapered off, though it is not clear whether this is most attributable to local farmers knowing late entrants in the study were not allowed or most attributable to an increase in "smartphone" mobile phone availability in Uganda (the iPhone became relatively common in Northern Uganda in late 2012) or driven by some other factor.

Some farmers voiced resentment over not having been chosen for the study; in these cases (less than ten), I explained the people had been chosen from a long list (the CKW database) and that the people were chosen randomly, not within a system of favouritism or patronage. Many responded they did not believe me, or that they were not chosen because of *yiir*, or that the phones were stolen using *ywayo*.

yiir (sometimes anglicised "yir")	Literally: No English equivalent. Translated: "Yiir" specifically means using evil spirits, or sorcery, usually to sabotage another's victory or windfall.

ywayo	Literally: No English equivalent. Translated: "Ywayo" is a very particular kind of stealing that usually involves random processes. It is the use of magic to win a dice or card game, for instance.[99]

[99] While Westerners are often calmed by the fact that a process is random, in the northern Ugandan context all random processes are vulnerable to "ywayo," wherein a thief interferes with chance, or *kom*, and reallocates the winnings that would have flowed (*cway*) to another to him- (or her-) self.

	Coin flips are not always trusted because they can be manipulated by “ywayo,” thereby making the person choosing on the basis of the coin flip make the wrong decision, benefiting the “ywayo” user.

Some stated out how much of an advantage people with the better phones enjoyed over competing farmers (an assertion that was never supported by evidence or specific examples) and that I was introducing unfairness by giving some (but not all) farmers phones.

I observed some reactivity effects surrounding use of the phones. For instance, though I assured entrepreneurs it was fine to use the phone as they would any other phone, I found subjects reluctant to send personal text messages on the phone (preferring often to do this on other phones, even older phones with traditional numerical keypads which made it much more difficult to type messages). Even when I would text some farmers directly on the phone that had been provided, they would respond from a different phone (with a different phone number). I can only attribute this behaviour to a conscious or subconscious defence of their perceived privacy interest in their communications or a reactivity (Hawthorne) effect where subjects, knowing they are the subject of a research effort, alter their behaviour as a result. Though some subjects preferred to use two phones, this was a minority preference exhibited by less than 10% of participants (my estimate). This may have been an observer-expectancy effect in some sense, in that my stressing (particularly at in-person meetings) that the primary purpose of the phone was to respond to survey questions and perhaps some subjects

interpreted this as the primary purpose being at the exclusion of other purposes (not my intention but not an unreasonable interpretation given the context).

Two farmers voiced concerns that the phones I distributed might be monitoring them in unanticipated ways (such as through the camera on the phone). In each case, I provided a roll of black electrical tape to cover the phone's camera except when it was being used as part of the research tool, which put these farmers at ease. In neither case was the issue of GPS monitoring raised, or other kinds of monitoring, despite my having discussed this monitoring in detail during each initial orientation meeting.

Several farmers asked whether they would receive advertisements from Grameen or the Gates Foundation or other NGOs through the phones. I assured them my research was separate from my commercial or charitable affiliations and that the phone would not be used for advertising (phone advertisements are common in Uganda). A few subjects, by contrast, remarked on the lack of advertising on the phones as being unusual. Each time I delivered phones (including replacement phones after phones were stolen, broken, or lost), I did so in my personal vehicle to further distance myself from Google, the Gates Foundation, or other entities that might otherwise be seen as being affiliated directly with my research or with the phones themselves.

This is further discussed in "Ethical Considerations and Concerns," immediately *infra*.

Ethical Considerations and Concerns

The most immediate ethical considerations I had was the perception that I was paying entrepreneurs to participate (to talk with me) and the perception that I was a representative of some larger entity, either a former employer, a present employer, or some other organisation that would reward entrepreneurs for giving desirable answers.

As an example of the "desirable answers" problem, a few weeks before I arrived, the World Food Programme had hosted a seminar near Oyam (a WFP granary is located between Oyam and Gulu, near Kitgum Road) and distributed straight edges (made of plastic in the recognizable United Nations shade of light blue) that was marked at various distances from zero with pictograms of various crops. On the obverse, the crops were marked according to the depth in the soil at which they should optimally be planted; on the reverse, the crops were marked according to their optimal spacing from one another. Though these optimal depths and distances had been proven out over decades of agricultural research, Ugandans doubted the accuracy of the markings (which often conflicted with prevailing local practices) and preferred to use the straight edges to measure the water and fuel levels in containers, especially jerry cans. Yet, whenever I asked a local entrepreneur about the straight edges distributed by the World Food Programme, the reception of the straight edges was erroneously described as popular and enormously helpful. Only when I challenged Willy Okello, a local entrepreneur I knew and trusted, did he admit the falsehood: "We are taught to tell the munu[100] that the munu's efforts are fruitful, no matter how much they fail." After this experience,[101] I was cautious to ask further questions about the classification of things, particularly when it was a foreign intervention being characterised; the situation with the straight edges also made me focus my questions more carefully: "What would you change about X," "X would be more helpful if…" and so on.

Taking the second concern, *supra*, first, despite constant protestations and assurances that I was an individual performing research, my subjects would occasionally ask for favours, assistance, or introductions that I was (or, more often, was not) in a position to

[100] "Munu" is a local Acholi and Lango abbreviation of the loanword "mizungu," taken from the Bantu word and with a similar meaning (outsider, particularly a light-skinned or light-eyed outsider).
[101] April 3, 2011.

provide; the only exception I made in offering this assistance was transport, as it would have been a serious breach of local etiquette otherwise and would have poisoned my relationship with my subjects. So, for instance, if I were departing Oyam's weekly Macho Dwogo market on a Thursday at 13:00 (as I normally did), I would announce to those I knew by name that I was departing and that my vehicle had three spare seats and enough room for a few boxes of produce and that I would be happy to drop off people along the way back to Gulu Town; nearly always, every seat was full. I refused to travel in NGO vehicles that were marked as such (arriving in a World Bank vehicle, for instance, immediately affiliated everyone aboard with the World Bank – even those who had not personally witnessed one's arrival, as word spread quickly) and would often remove the (magnetic) signage from the vehicle's door before making use of it.

The first concern was a more difficult one. In order to deploy the mobile-phone-driven portion of my survey methodology, entrepreneurs required smart phones, which many did not already have. Yet, it would be difficult to discuss the phone itself – a valuable item in Uganda – without its appearing to be payment for participation. For a number of reasons, when Google.org provided the phones for this research free of charge, I insisted the phones be provided "unlocked" (allowing entrepreneurs to use their existing SIM cards and retain their telephone numbers) and provided with some small initial amount of call and data credit (the data credit, which was crucial for submitting survey forms but not something farmers would typically purchase in any quantity, was particularly important). This exacerbated the perception of payment for participation, as entrepreneurs were familiar with the cost of phones, airtime, data packages, and so on. I tended to push this discussion toward Google when pressed, saying Google had taken an interest in this research and provided the phones free (a truthful, though simplified, statement) and that it would help my research if they carried the phones everywhere to receive new surveys and send up-to-date GPS readings (also true).

Finally, I had concerns about my position as the wealthiest person in the village. I understood that the motive for asking me for loans or gifts or assistance was not exploitation but – more often – convenience. The fact that I could give a participant in my research a chicken or a Coca-Cola with no impact on my quality of life was remarkable for many, and I sometimes had to reject a dozen requests in the span of one week, some of them truly trivial (less than one dollar in value). As Philippe Bourgois writes of his subjects in America,[102] the fact that a participant in one's research will "hustle"[103] the researcher for money if given the opportunity should be seen as an enterprising trait in a competitive environment, not as a strike against the participant's moral fabric. I often thought that, were our positions reversed, not only would I be overly shy to not ask for assistance from someone like me, I'd be a fool, as the expected value of even a 1% anticipated success rate would almost certainly be a positive value figure worthy of risking offending a foreigner outside one's social network.

Respect for the privacy of farming methods or "trade secrets" on a relatively primitive farm may not seem an enormous concern from the Occidental observer's standpoint, but it is a real one from the perspective of the agricultural entrepreneurs I researched. Dozens of times, I was told that a certain farming method could be demonstrated to me but that it should not be disclosed (particularly tilling methods, superstitions around time of day or phase of moon[104] during planting, or mixtures of fertilisers). Other times, I

[102] "[The researchers] had to learn … not to take their petty financial manipulations personally, and to refrain from judging them morally. Otherwise, we could not have entered their lives respectfully and empathetically. With time, we realised there was nothing substantially different between how they extracted money from us and how they hustled everyone else in their network who had more resources than they at any particular moment." P. Bourgois. Righteous Dopefiend. University of California Press. 2009. At p. 6.

[103] Bourgois's term.

[104] The moon, or "dwe," is an important indicator in Acholi and Lango culture. It serves as a way of counting down to the end of the dry season, but also allows the scheduling of Western interactions; for instance, the first payment British American Tobacco arrives at the end of March, the payment being "ciling ki munu dwe adek" (money accompanying the third white man's moon).

was told of secrets about neighbours' habits, marital infidelities, and other semi-private gossip unrelated to this research. Though I valued the frequency and type of these disclosures as a barometer of how close (or trusted) an acquaintance I had become to the subject involved, I have kept these – largely irrelevant – items to myself and excluded them from this document, as requested. Interestingly, no subject was private about his or her income – most were quick to boast of good harvests and discuss poor harvests publicly, too. Throughout my research, I continued asking whether it as okay to ask a neighbour about comparisons of harvest yield or to discuss incomes, but after a few months I became accustomed to always hearing the same reply. As I learned during my research, advertising one's prime harvests and financial windfalls was a key part of a farmer's efforts to locate in the social strata and publicise his (or her) skill.[105] Throughout the document, "entrepreneur" and "farmer" are used interchangeably, as a person with more resources or skill than what is termed a "subsistence farmer" in the literature but not enough to qualify as a "lapur ma dit" or farmer who farms professionally on an industrial scale.

A final ethical consideration worthy of discussion is my own description of my role and my research. When I had travelled the region before, I had been both a researcher and

[105] The use of "skill" here is intentional. While farmers realise they cannot control the weather and that floods or droughts out of their control may destroy crops, farming is seen primarily as a skilled profession and an application of knowledge to a craft. Though there is superstition (as among European farmers) and a recognition of the role of luck, there is a steadfast and universal commitment to the concept that the most hardworking, knowledgeable, skilful farmer will succeed. Being a farmer not only encompasses the actual cultivation of plants, but also the creation and maintenance of inventories of suppliers, allies, equipment, practices, and so forth. Every time I asked farmers in Lango subregion when they decided to become farmers or knew farming would become their "work" (their primary source of income), the reply was, "An onywala ame abedo apur," meaning, "I was born a farmer." This does not simply mean they were born on a farm or knew they would be farmers, but that they have worked their whole lives to build this knowledge and skillset that allows them to perform well raising crops in a challenging environment. Often, when I asked what a "lapur" was, people would suggest that a person is a farmer because of what he knows and what he can do (knowledge and abilities) rather than how he spends his day. A learned farmer who is well-equipped to do the work is known in the community as a farmer even if he now mostly manages his mobile phone store in town. *See* author's fieldnotes regarding who is considered a farmer in Oyam Town. 2012.

an insurance salesman for Grameen. In this context, I had memorized my basic pitch but was not yet close to fluency. I would explain that I sold insurance and that it would pay out if there was not enough or too much rain.

giwilo insurance me goko gi pe okato kot-centimetre abic.	Literally: I sell insurance that pays if the rain is not five centimetres.

Often, I had to explain that this concept of conditional payments linked to an indemnity contract was called insurance.

kilwongo “insurance”	Literally: They call it insurance.

And sometimes I would need to actively separate my past work as an insurance researcher (and salesperson) from my current research.

kom bedi ni abedo ariaga gulu; in waka 2010, abedo ca wilo insurance. a tye ka kwano kit me cato wil a pinlango.	Literally: I stay (present tense) in ariaga [near] Gulu. Back in 2010, I was selling insurance. Now, I study the buying and selling of the Lango subregion.

The most common question I received during my first month living full-time in Uganda was, by far, *i timo tic ango?*, to which I would reply *atiyo tic ma cato wil ki kwano cato wil a pinlango*, which helped stress I was a participant in the local marketplace and not just a *munu* voyeuristic observer.

i timo tic ango?	Literally: What kind of work do you do?

atiyo tic ma cato wil ki kwano cato wil a pinlango.	Literally: I buy and sell and study buying and selling in Lango subregion.

African Econs and Not: Domain Specific Decision-Making in Three Cases

The concept of "econs" predates the use of the Chicagoan[106] abbreviation. Professor Thaler speaks of "econs" and "humans" not to disparage "econs" as inhuman or to categorise "humans" as more human, but as a shorthand[107] for two general decision-making architectures. To quote a recent Washington Post piece[108] on Thaler's research,

> "[This framework] breaks down the world into two sorts of people: Econs, the artificial constructs of how people are supposed to behave. They are perfectly rational, have great self-control, calculate like machines and know exactly what is best for themselves. Then there are Humans, who do all of the things that traditional economic theory suggests they should not. They react emotionally, lack patience, fail to consider consequences and seem to be flummoxed by mathematics. They are filled with all manner of biases and judgment errors."

Though there are certainly "edge cases" where a behaviour might be difficult to categorise between "econ" and "human." For instance, exceeding the speed limit while driving might be reasonable since the time saved on a commute for an average worker

[106] I attribute the widespread use, or popularisation, of the term "econs" to Richard Thaler at the University of Chicago. His work with Cass Sunstein on decision architecture is one (admittedly one of several) of the primary sources of this term's popularity and current meaning. In the separate, but very much related, context of the political economy and political science literature, Thaler's colleague John P. Balz has contributed to the term's popularity.
[107] For more on the history of this taxonomical system, *see* R. H. Thaler. Misbehaving. W.W. Norton Co. 2015.
[108] Barry Ritholtz. "You're Only Human." *The Washington Post*. June 27, 2015.

might exceed in value the fine associated with speeding multiplied by the probability of being caught speeding, so "econs" might speed,[109] but "humans" might simply enjoy the thrill of traveling faster (or breaking the law) and hence might also speed. In other words, in the case of speeding, "humans" may act indistinguishably from "econs," but for different reasons. Hence, speeding would not be a good test area for whether a given subject was behaving more like an "econ" or more like a "human." Meanwhile, situations where the effects (preferably in the context of some quantitative measurement or ledger) of the behaviour can be critiqued against some benchmark level of efficiency make good experiments to test whether the participants are behaving more like "econs" or more like "humans."

Here, in my research, the concept of "econs" versus "humans" is focused on a very specific question: Do farmers in Oyam and Kapchorwa optimise decisions around maximising efficiency of, and hence net revenue from, agricultural operations? I study three cases in three different areas of business operations management at the same businesses: transport and logistics, capital-and-labour allocation, and human resources management. I find that in two cases the entrepreneurs studied act in generally expected, predictable "econ" ways but that, in the third case, the same group overwhelmingly favours choices that lead to operational inefficiency and drag on the enterprise.

The First Instance: Transport and Logistics

[109] Speeding is an interesting example, as Google's robotic cars – robots perhaps being the epitome of the "econ" image – are programmed to speed (slightly) to keep up with traffic and increase efficiency.

There are enormous logistical challenges facing agricultural businesses[110] in Northern Uganda and the fundamental research question of this chapter is whether entrepreneurs behave more like econs or humans[111] in how these costs are anticipated, negotiated, estimated, and paid. I find that, in the context of transport and logistical costs, farmers behave as would be expected in liberal models, or roughly as econs would behave.

To sort between econ behaviour and human behaviour, goods-to-market transportation costs are examined to determine to what extent and how farmers near markets compete on price. Estimates of transport costs are made and compared to crop choices. The paper offers a hypothesis that firms subject to higher goods-to-market transport costs tend to focus on crops that have a higher margin per kilo, such as tobacco or coffee. This is a correlation not explored in the extant literature, unlike relationships between gender and crop choice,[112] for instance, which also has been observed here.[113]

Decision theorist Douglas McGregor wrote that "every managerial act rests on assumptions, generalizations, and hypotheses – that is to say, theory." [114] How is management negotiating with counterparties and forming alliances with potential competitors to meet these logistical challenges? Are the choices made reliable,

[110] It is important to note that, unlike in India and Kenya and other commonly-studied regions, none of the entrepreneurs studied here has a commercial mortgage, land note, or other debt related to his or her land. All of the businesspeople studied have fee simple absolute ownership of their land, or a paid-in-full leasehold interest equivalent for all practical purposes (for instance, a 99-year lease already paid and renewable at no fee). This distinguishes these farmers from the rural people in India discussed by Drucker & Jonker, for instance. P. F. Drucker & K. Jonker. *Rural Development Institute, Case #7*, as it appears in Drucker's Management Cases, 2009 Edition. Case prepared in 2004-5 and published by Stanford University in 2007, after Drucker's passing; case copyright and subsequent publishing rights held by Stanford. 2007.

[111] R. A. LeBoeuf & E. Shafir. *The Conflicting Choices of Alternating Selves*. Working paper. Warrington College of Business. Forthcoming.

[112] *See*, *e.g.*, IFPRI Discussion Paper 01003 (currently under revision, first version released July 2010).

[113] Gender skews exist in the regions studied here – for instance, few men in Oyam would choose to grow rice, which is seen as a feminine crop – but that is not the topic of this chapter.

[114] D. McGregor, The Human Side of Enterprise (New York: McGraw-Hill 1960).

predictable (based on observable inputs or factors), and consistent? If so, then these entrepreneurs are behaving more like econs than humans.

I find executives running small agricultural businesses in Uganda behave similarly to those running small enterprises in the industrial and post-industrial economies: they organise cartels to operate at scale with partners when needed, they attempt to negotiate even when there are few alternative providers or high switching costs, they adjust outputs and production choices according to anticipated costs, and they integrate expectations about upstream costs into their calculations of net profitability per class of good produced.[115] My perspective and observational lens (and type of question-asking) in this study is at times similar to that of an investor conducting due diligence visits.

In discussions with Ugandan agricultural executives, I often spent a substantial portion of an informal or semi-structured interview session discussing the difficulty of transporting crops and materials. Unlike in America or Britain, light trucks in Uganda are rare, expensive, and often poorly-maintained.[116] One-tonne trucks or trucks of capacity equal to or greater than a Toyota Hilux or Toyota FJZ79 are items so expensive even renting them for a matter of hours would wipe out the profit of a small farm.

As a result, crops are often moved in the following ways:

[115] The finding that frameworks within these companies are not radically different from those in more familiar contexts – and hence vulnerable to similar analysis – is consistent with recent research on entrepreneurship in emerging markets and investment in emerging markets, as in Darragh & Aman. L. Darragh & N. Aman, *Impact Investing in Emerging Countries – Insights from the Due Diligence Process*. White Paper. University of Chicago. 2012.

[116] Even at NGO pricing, as via the Red Cross's vehicle purchase programme (pricing sometimes available to agricultural entrepreneurs through World Food Programme and other pricing schemes), a Land Cruiser 70-series pickup with a rating of one tonne is about $27,000 or half a lifetime's wages for many Ugandans. Toyota, which dominates the market in Uganda's light truck sector, does not keep records of how many used vehicles from the Japanese domestic market are exported to Uganda, but demand easily outstrips supply, with many Ugandan companies on waiting lists for months or over a year to obtain a vehicle suitable for their needs.

- Farmers pool their resources to rent a truck for a matter of hours, moving between 1.1 and 4.5 tonnes[117] (total) of production to market in a heterogeneous shipment. This does not work well for products like cattle, but works exceedingly well for high-value, heavy yields like dried beans – or for time-sensitive or particularly perishable shipments like a series of 50kg bags of mangoes vulnerable to rotting in the hot harvest season sun.
- Farmers individually, and with their children, move yields to market using bicycles. Steel-framed bicycles, such as the Raleigh IIA or Raleigh Champion (two models favoured by Ugandans), can carry two bags weighing up to 60kg each at a time, lashed together. In two journeys, a bicycle can move 200kg. This is not so far from the pickup truck payload, as a farmer may only be able to share in 250kg to 300kg of a truck's total payload once the truck's carrying capacity is split four or five ways. Farmers ordinarily own, rather than rent, bicycles.
- Farmers individually or in pairs rent a cart that can be pulled behind a draught animal. This is uncommon in all areas I visited except the eastern periphery of Kapchorwa, where the topography is so challenging that bicycles are less useful as freight carriers. The carts vary in construction, quality, durability, and cost. The most desirable are old aluminium carts built by Land Rover for the British military (so-called "Sohill Carts" in Kapchorwa, a reference to the "Crafted in Solihull, England" labels that often still adorn the tailgate), but wooden carts in the Sudanese style are common, as are disembodied bed sections of long-deceased pickup trucks.

[117] The rated payload of most trucks in Uganda is around 1 tonne, but this is often exceeded by up to 50% - meaning a truck making three journeys in an afternoon can move up to 4.5 tonnes yield.

Costs vary from near-zero (in the case of using one's family to transport yields via bicycle) to substantial (the cost of hiring a truck can be 15-20% of a farmer's net margin on his crops for the season, even if the highest margin calculation – setting labour costs to near-zero – is used). Hence, it is interesting to examine whether these costs adjust the decision-making framework of the executives subjected to them.

Using GPS/GIS information on the location of individual farms within the dataset and data on bicycle use, we see farmers farther from market are less likely to use bicycles to transport their crops (even if they do use a bicycle daily to transport themselves or their children).[118] We also see that executives whose businesses are located in regions offering particularly challenging topography, such as eastern Kapchorwa, are not as likely to use bicycles. Neither of these findings is surprising, as a four-wheel-drive pickup truck or an ox with a cart in tow are both better-suited to these scenarios than a man pushing a very heavy bicycle for multiple journeys in ambient temperatures near 40 degrees Celsius.

What is more interesting, however, is that remoteness of one's farm from the market appears to have a significant influence on one's crop choice.

If a farm is more than 2 kilometres from the central market in Oyam, or more than 1 kilometre from the central market in Kapchorwa, it is more than twice as likely to cultivate a higher-profit-per-kilo crop. The highest-margin crop that grows with any certainty in Oyam is tobacco, while the highest-margin crop that grows with any certainty in Kapchorwa is coffee. The two are within 5% of each other in terms of the value of a 50 kilo bag, with tobacco usually being slightly more profitable.[119]

[118] The dataset reveals which entrepreneurs have invested in the purchase of a bicycle and which have not. However, a look at total crop output and how a subset of observed farmers transport their yields to market reveals that many of these yields are too great in size or weight to be transported efficiently by bicycle. It is unsurprising, then, that many of these farms subcontract a vehicle to transport yields to market.

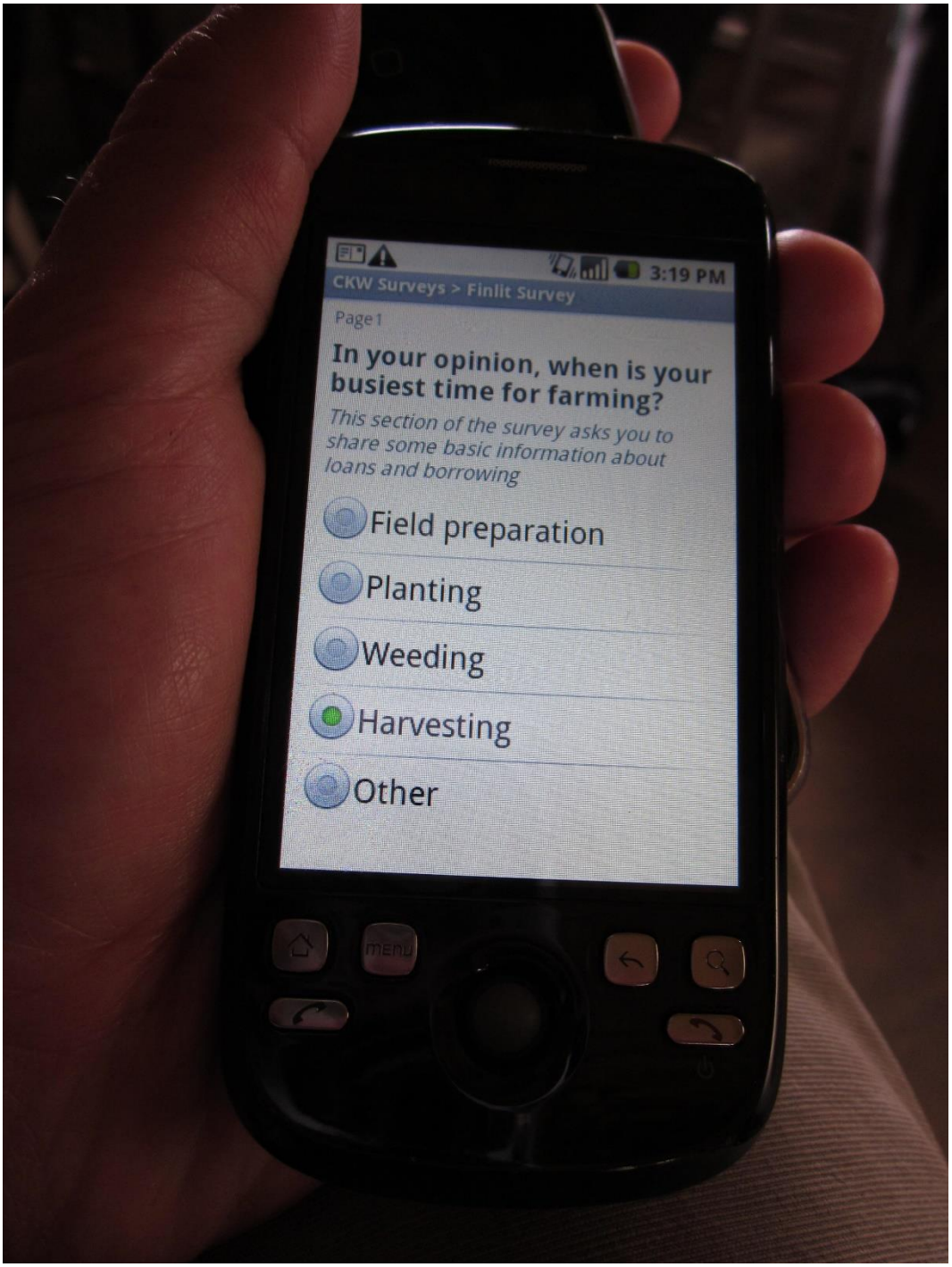
[119] "Usually" in this context means in four of five observed market seasons 2011 to 2014.

In both regions, the highest value crop per unit of weight is cotton,[120] but crop failures with cotton are shockingly common and pest control is difficult, if not impossible, with traditional methods. To create a full bag of cotton with a typical Northern Ugandan yield would require a farm with remarkable success and (very likely) more than 2 hectares of arable, cultivated land with nearly 100% of that land dedicated to cotton. Hence, I do not include cotton in this calculation, as few farmers I encountered were growing it in quantities large enough to affect their logistics-to-market planning. Further, cotton grew so unreliably during the time period studied (with three crop failures, one major crop shortfall, and one acceptable season in the observed five market seasons), that I do not include it here in my calculations. Also, the price of cotton (raw picked, untreated) fell during the time period studied, so it became a less-and-less attractive crop in this region between 2012 and 2014.[121] [122]

[120] This is not unusual, it is also true in Pakistan and in the American state of Georgia.

[121] The observed price per common negotiable unit (CNU) of cotton fell from around 38USD to around 29USD over the course of my observations from early 2012 through early 2014. This was the largest negative change in the market price of any common crop in northern Uganda during this time and the second-largest change in price of any common crop in northern Uganda during this time (the increase in the price of beans, a crop that had been cheap and plentiful in early 2012 when my first observations occurred, was slightly larger).

[122] Also influencing the attitude toward cotton were common and exploitative strategies by Indian firms that would use radio advertising to encourage farmers to grow cotton, mentioning windfall sums to be paid at harvest time. When these farms reached harvest, the amounts on offer were often 50% to 75% lower than what had been advertised on the radio – with no other buyers in sight, farms were forced to trade at these low prices. This phenomenon, prevalent during the late 2012 season in particular, diminished farmer interest in cultivating cotton. Further information bolstering this theory of cotton as a distinguishable crop was gathered in a series of semi-structured interviews conducted at a major market with Tom Kirk (postgraduate research student, LSE Department of International Development) present.



An inquiry into the most labour-intensive time for farming was put to 3,000+ farmers.

When asked what the most labour-intensive part of farming is, from an operations management standpoint, “weeding” was overwhelmingly the most popular answer in my survey of over 3,000 agricultural entrepreneurs at the decision-making level. However, weeding is often done by children as young as six or seven and is not a task done by hired

labour or capital. When, in the interview context, I asked these decision-makers what cost worried them the most (I defined "cost" as a monetary expenditure), transporting crops to market was often the main concern. When I asked how managers protected their businesses against these large lump sum demands on their meagre treasury assets, a common answer (though there was no majority answer) was that they would try to grow higher-crop-value-per-unit-of-transport-cost crops.

The total pre-transport profit (net of inputs but not net of transport) from a typical farm cultivating a mix of maize, soybeans, and tobacco (a high-margin, relatively reliable mix) would be approximately 1,200USD per season.[123] The cost of renting a pickup truck can be as high as 300USD when demand is high at the height of the harvest-to-market season. Even if a farmer splits this cost with three friends, the cost is substantial – and each person with whom the cost is shared invades the available payload of the vehicle.

[123] For comparison, if the crop mix were a more conservative allocation among beans, sunflower, and sesame, profits for a season would typically be closer to 850USD or 950USD.

A Toyota pickup truck with a “shorty bed” in Oyam, Uganda.

A Toyota “shorty bed” offers a covered carrying space of only 1.9m x 1.4m x 0.7m, but a total payload of over 1 tonne, making it well-suited to heavy payloads like lumber or coffee or sunflower oil (or heavy consumer goods that should stay hidden from the sun, like auto batteries). A long bed Toyota FJZ79 offers a larger bed, but far less total payload at 0.72 tonnes, making it well-suited to payloads like dried tobacco or shucked sunflower seeds, which take a great deal of volume but are not heavy.

There is an enormous cultural prejudice against wasteful behaviour in both Oyam and Kapchorwa (so much so that the word sometimes used for waste is derived in part from the word for bad or evil, “*rac*”). People running farms at the decision-maker level are seen as having a responsibility to prevent waste, including the spoilage of foods at harvest time

whenever possible (the phrase for spoiled food is conceptually similar to the word for starvation, so closely are the two linked in the public consciousness).

This creates pressure to adopt modes of yield transport that are efficient in the low-waste sense, even if they are financially expensive or inefficient in the strictest economic sense. This cultural prejudice has always existed, according to people I interviewed, but was amplified by recent years of war, scarcity, and infighting that destabilised social relationships and hierarchies; during this period, waste was seen as conspicuous consumption or frivolous behaviour. The focus on material things and worry about others' stewardship of their resources is relatively new, but not culturally-alien; Lango has only two words commonly used for water but has nine words for types of envy, many of them relatively new (post-colonial) in linguistic terms.

Because waste is so (culturally-) unacceptable, farm executives will occasionally decide to make what seem like unwise (un-econ) decisions from a total profitability standpoint. For instance, it is not uncommon in Oyam to take beans or maize to the World Food Programme granary site even though the granary pays only 80% of what bulk buyers at the market will pay only a few weeks later.[124] Nearly every entrepreneur with whom I spoke had a story of rats or weevils or other pests getting into their crops, or another story illustrating how vulnerable crops are and how difficult they are to store, preserve, or save.

In one of countless illustrations of the difficulty of translating the deeper meanings within interviews correctly, I incorrectly translated one such story in my early interview field notes, where a farmer talked about a rat – *anyeri* – being attracted to his stored harvest of maize. While the term *anyeri* refers to any large rat in most lower Luo Nilotic languages, I learned that *anyeri* refers in Oyam to a rat that is large enough to eat. Hence the story,

[124] Informal interview with Willy Okello in Oyam between harvest seasons, conducted at his farm with Tom Kirk (postgraduate research student, LSE Department of International Development) present.

told by the farmer with little emotion or meaningful inflection that I could appreciate at the time, was one of luck (as he stated, and I wrote down, but did not understand) wherein he got both a good harvest and an extra meal of rat.

anyeri	Literally: A particular kind of rat that grows to the size of a housecat. Translated: A delicacy in Oyam and a lucky thing to find without hunting.

gum maber pa cam	Literally: Good luck regarding food. Translated: A culinary windfall.

Recognising the problem of premature or low-value transactions, the World Food Programme introduced special storage bags in Oyam in 2012 as part of a pilot programme. These bags breathed better than the traditional bags, provided better pest protection, and preserved crops better in the mid-day sun (most yields are packaged in the morning and transported at the hottest time of day, between 12 noon and 16:00). However, even though these bags were free, adoption rates were low and quickly rumours (conspiracy theories) spread that they were meant to increase spoilage and drive prices up, or that only World Food Programme sites would accept crops packaged in the bags, or that the bags trapped too much moisture and made the crops inside unacceptable for granary intake. Almost all reasons not to use the new bags revolved around this culturally-ingrained phobia around waste or spoilage.

Executive decision-making sometimes focused on a minimal-spoilage optimisation rather than a profit-maximising optimisation. As a result, one might expect executives to use lower-cost, higher-margin transport methods to move less perishable crops like cotton

and tobacco while using high-speed, expensive transport methods to move perishable products like mangoes and bananas. Many expatriates, including World Food Programme employees and former employees, seemed to believe this was the case. However, this is not true. The net margin on a given yield of mangoes or bananas (and particularly bananas) cannot justify the high cost of hiring a one-tonne truck or even a portion of it. While executives prefer to minimise spoilage, they also prefer to make a profit on each journey to the market (or to the granary or to other buyers). In general, looking at profit per truck was the primary mode of decision-making. In this sense, all entrepreneurs to whom I spoke regarding profit-per-truckload behaved as econs, even if they claimed to be behaving as humans and attempting to minimise waste at all costs.

Executives anticipate and estimate transport costs based on volume and weight, often being willing to show me the underlying arithmetic in their notebooks. High-weight, low-volume loads, all agreed, can be moved by bicycle or by truck. High-weight, high-volume loads are best moved by truck. Low-weight, low-volume loads are almost always moved by bicycle or, if below 30kgs, on the back of a man with a carapace-style bamboo or eucalyptus makeshift framed rucksack. This seems simple, but the enormous jump in logistical costs from a bicycle to a truck makes the cut-off between the two transport types sometimes difficult to calculate. This is further complicated by the temporal chasm separating the initial transportation negotiations and the actual harvest date (called the "viability date" or similar in some of the agricultural literature, particularly when discussing seeds – such as sunflower seeds – or crops with secondary outputs, such as oils[125]).

[125] Viability dates are discussed at length in the USDA annual reports available at portal.nifa.usda.gov. In-depth reports on viability by season and latitude are released in similar format by the World Food Programme on a periodic basis, generally biennially.

A standard cultivation season in Uganda is 13 weeks, followed by a three-week harvest season. These are preceded by a burning or clearing session, a levelling or pre-tilling session, and the planting period – the last day of the planting period is typically considered to also be the first day of the cultivation season (in Oyam, this day is called "*cheng pio*," literally "the first sun"). Because transportation arrangements made late in this cycle are dramatically more expensive, farm executives will generally plan transport arrangements no later than the fourth week of the cultivation season. This is around the time of the first weeding and around the time when a competent agricultural executive can estimate roughly how many seeds have translated into viable plants (though many of these plants will be mere inches in height); the fourth week is also when coffee plantations inspect their trees for nodes and buds that will become coffee berries in the course of the season.

Often the estimate is made in groups, with farmers who trust each other comparing notes and arguing as to who has the best estimate. I was present and observing at one such meeting when it began to rain, prompting yells of "*kot opoto! mak kweri!*" from a nearby group.

kot opoto! mak kweri!	Literally: Rain is falling! Hold the hoe! (alternatively: Grab your hoe!) Translated: The season has begun, there is no time to waste.

The phrase was less an actual call to action (no one grabbed a hoe or ran into the fields) but more a reminder that time was of the essence in the coming negotiations, as the rains had come early and transport would only get more expensive now.

Once the estimate is received, negotiation begins. All else being equal, all executives would choose to move their yields by truck. It is fast, relatively reliable, and easy to load

and unload; there is no worry about the condition of the roads and only a limited worry about weather during the transport process. It is not uncommon for those renting trucks to begin giving extraordinarily high quotes to farms in the third, fourth, or fifth weeks of the cultivation season – sometimes as high as $550 for four hours' rights to a full truck bed.[126]

The quotes, though they often seem arbitrary, are not simply drawn from thin air. I spent several days with the operators of a Toyota FJZ78 pickup truck and rented my own truck (primarily as a research exercise, rather than a revenue source) to farmers in both regions. One of the most difficult questions – given the civil war, then statehood, then uncertainty in South Sudan during the time of my fieldwork – was the availability of fuel. Because fuel shortages were not uncommon during this period, fuel would often be hoarded by truck operators and stored (in jerry cans or drums). Prices for one litre of fuel near Kapchorwa varied from $2.40 to $4.90, depending upon how close one was to the South Sudan border and upon whether the fuel was "fresh" or merely "available" (meaning it had been stored 30 days or more). The FJZ78 with its three-litre inline six-cylinder turbo diesel struggled to get seven or eight miles per gallon with its damaged head gasket, non-EFI engine, and ill-chosen rear gear ratio (many rear axles have been upgraded to 1:5.13 Hilux gears, providing more pulling power at the expense of fuel economy). The six gallons of fuel we used to move crops up the lesser Elgon slope to market in Kapchorwa, equal to twenty-three litres of fuel, cost nearly $75, or fully one quarter of the total cost of renting the vehicle. So estimates that account for peak fuel costs are not outrageous on their face.

When I used my own Toyota truck (running 4.88 gears with an engine in good repair), which struggled to move uphill on 10% muddy grades, I experienced better fuel economy, but it occurred to me that spares are often unobtainable and expensive. Seeing

[126] Actual quote provided to farmer during the early 2012 season.

overburdened trucks that have been damaged or disabled during the harvest season is not uncommon. If one adds the cost (in repairs and lost business) of a potentially season-ending vehicle failure, one quickly realises the rental rates on offer may be reasonable.

What agricultural operations, then, would justify the use of expensive hired trucks?

Looking at the cargo carried by such trucks (I visited the market every week, often several days per week, while on fieldwork), the yields justifying such expensive transportation fall into two categories: very perishable loads like fresh fruits (particularly pineapples) or very valuable yields that needed to reach a customer on the same day, for instance when a major bidder offers supply contracts for coffee to fill a shortfall (as Starbucks did in 2013).[127]

But there is yet another layer of complexity: Few farms produce only one crop. So an entrepreneur planning to hire a truck for his two bags of tobacco may figure he will also use his (or her) share of the truck to transport his maize, beans, sunflower seeds, or sesame seeds. Predicting the yield of a crop, the market price of that crop, and the transport price of that crop together with any accuracy is nearly impossible.

But I enjoyed the luxury of being privy to the range of estimates farmers were producing and checking them against the actual profitability of shipments to market. This indicated strongly that the farmers were both anticipating like econs and behaving like econs.

It is important to first consider the tools with which the management of these farms might build frameworks. While these managers are rich in anecdotal knowledge and even

[127] Posters in and around the Mt. Elgon area, including Kapchorwa, advertised very attractive supply contracts on offer from Starbucks during the mid-year months of 2012. These kinds of contracts offer peak prices to entrepreneurs who sign up as suppliers, but often contain punitive terms for suppliers who are even one or two days late in delivering the specified quantity of coffee. The first supply contracts of this type in Uganda were offered near Oyam in the early 1970's and were primarily offered by British American Tobacco. In Oyam, such contracts are called "manok manok," meaning "never enough." Many entrepreneurs who tried to meet British American Tobacco's supply terms went out of business in the process.

historical knowledge (particularly regarding crop success and failure during the past thirty to fifty years), they are generally not well-educated in the conventional sense. Most have not had more than eight years of formal schooling and many have not had more than five years of formal schooling. Numeracy beyond basic arithmetic is rare, though basic debit-and-credit accounting exists and rudimentary bookkeeping is relatively common.

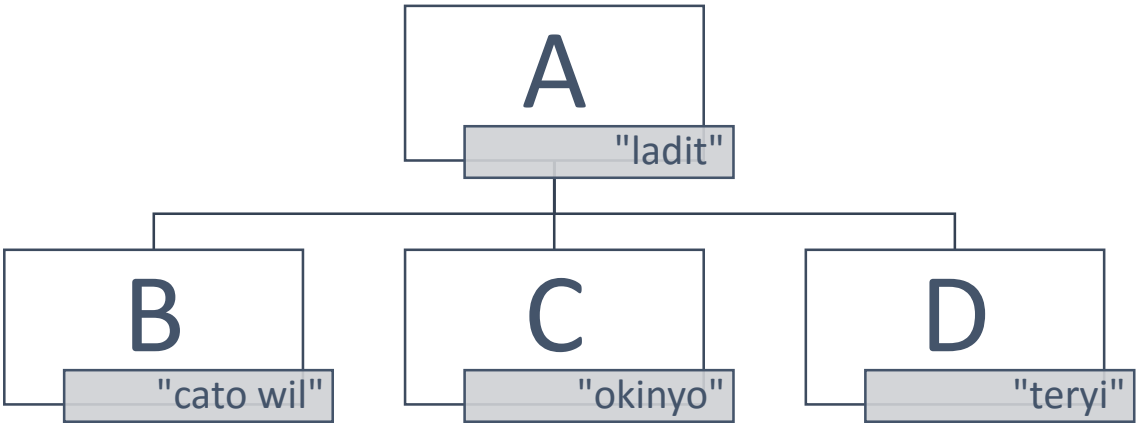
With these limited levels of financial literacy, the estimates being made (and acted upon) by the farms' managers are not (and cannot be) strictly financial calculations. While there is a concept of expected value (the value of a thing multiplied by the probability of that thing), this is not a calculation done often or taken seriously. Much more common is a concept that the organisation is variable in size and that informal partnerships and arrangements may distribute risk in desirable ways. For instance, it is common for friends to rent a truck together both because no single farm produces enough to use the truck's maximum payload in one day, but also to enforce agreed-upon prices or to act as witnesses to oral agreements between the parties.

In this context, the decision-maker can be seen as both an individual company (farm)'s leader but also the collective decision-making ability of a cartel of decision-makers. It is interesting, then, to observe what the differences in decision-making frameworks might be between the individual and the cartel. Most cartels contain four men – it is difficult to organize larger groups for many reasons. Pertinently, the advantages of forming a cartel diminish if the farms are too far apart in distance, too far apart in harvest season, incompatible in transport needs, or dissimilar in financial resources. The structure of a typical transportation bargaining cartel observed in detail during the first harvest of 2012 in Oyam is shown here; the names of these men have been replaced with alphabetical variables, as they are unimportant to the instant analysis. Below each letter is the phrase

used (usually in a friendly manner) within the cartel; I have kept these intact to provide a better picture of who these men are.

The leader, A, is called "*ladit*," meaning the big one, and is an imposing man ten years B's senior (and with a son the age of C). The negotiator is B, he is the second most senior and has the most literacy and numeracy – he is a hustler ("*cato wil*" means buying and selling) and can rattle off the many businesses he's involved with, from selling mobile phone airtime cards to selling small single-serving sachets of liquor in the market. C is a young man with a skin condition similar to vitiligo, causing white spots on his dark brown skin ("*akinyo*" means spotted, especially if spotted with white, but is usually used to describe animals, here the masculine prefix "o" has jokingly been added, as though "*okinyo*" is his given name) – he cannot read, but has basic numeracy skills and looks up to B, whom he sees as a successful village businessman, and A, whom he sees as an elder. D is the youngest and self-conscious of his lack of seniority in the group; his nickname derives from the word "*eteryi*," which literally means the item on the bottom of the stack (a slang word used by Langi men to mean the least important person).

Chart I.



I met the cartel at *Lacan Pe Nino* and conducted the first of several long interviews on their organisational strategy, points of alignment, negotiation style, and financial arithmetic. Here, I will give brief biographies of the four men involved, as I feel this cartel is typical of others I observed during my time in Uganda and the interpersonal structures built between these men are important in making culturally-sensitive observations as to the organisational behaviour of the cartel as a unit. The demographic data included here is drawn from the survey dataset as well as my field notes. In the case of C, or "okinyo," there is a discrepancy in his age between the dataset and my interview field notes, so I use the age I recorded in my field notes; many men of C's age do not know their exact birthdates or ages due to the disorganisation and deterioration of wartime recordkeeping of births, so this is not a discrepancy that caused great concern for me in my audit of the dataset.

To start the meeting, I send a text in Lango announcing that I have nearly completed my walk from *Ariaga* near Gulu Town; I ask if they are ready for the "*kacoke me lapwur*" (meeting about farming issues). A texts me back immediately that all but D have already

reached *Lacan Pe Nino*. Prior to meeting the cartel at *Lacan Pe Nino*, I have had at least two one-on-one semi-structured interviews with each of these men; I recount pertinent learnings from those interviews here as a subsection prior to discussing the cartel itself.

A is forty-six years old and clearly the leader of the group. A man of old age in the harsh environment of Oyam, his arm and shoulder cause him consistent pain. He cannot swing the "*kwere*" (hoe) as vigorously as he once could, he notes, asking me to place my hand over the wing of his scapula as he makes the motions of farming, letting me feel his joint struggle not to pop out of place. He has been HIV positive for several years, though he is not sure how long. He receives anti-retroviral treatment from the local "*daktar munu*" (white doctor) but he feels his health is deteriorating. I ask him how it feels to be HIV positive in this environment. "*An ki cena*," he replies (I have been cursed).

I ask A how long he has been farming and he replies that he was "born a farmer." To elaborate on that, he lists a long list of chores that he was responsible for on his father's farm, mixing his own experiences with those of his children and grandchildren as he recounts what a child of a given age is capable of contributing to the business of agriculture. I ask about a variety of other topics, including the logistical challenges of moving crops to market. He explains that ox-carts were once very common, but that the advent of affordable light trucks from Japan changed that. Now, he says, a person would be foolish to try to move things with ox-carts when pickup trucks are available. However, the men with the trucks are better negotiators than A; he worries about the ability of his family to negotiate for the trucks directly, which is why he recruited B to join the cartel. I ask about B's reputation and A immediately replies that B is a very good negotiator. Asked about how he and his neighbours managed negotiations with the truck men in the past, he pokes at the soft dirt floor with his toes. "*Gutimo ma rac*" ("they did it badly") he replies, without further explanation.

Asked whether he considers himself B's boss, A is hesitant to create a hierarchy like the one I've drawn, *supra*. However, he establishes that money flows to him (A) and that it is divvied up among the others, including B. He (A) states the most difficult part of the process was not engaging B, but deciding how B would be compensated for his efforts to negotiate on behalf of the cartel.

The traditional (I use "traditional" loosely here, as this "tradition" is only a decade or so old, according to most people I talked to, including A) way to compensate negotiating on one's behalf is to estimate the maximum you are willing to pay and then to subtract the negotiated price from that, with 50% of the difference being the commission for a successful negotiation. So, if one is willing to pay $100 to rent a pickup truck but the negotiator is able to reach a price of $80, then the person for whom the negotiator is working would pay the negotiator $10, or one half of the savings. This has several problems, including the notorious unreliability of self-reported or self-projected willingness to pay for a future transaction, but seems to work well in this context.

Some negotiations, like the negotiation of coffee prices in Kapchorwa, are appraised relative to their mean – an inferior methodology, as the starting bid-ask spread in these markets is often fancifully large. Under this system, if the person is willing to sell coffee beans at twenty but the prospective buyer is only initially offering to pay ten, then the negotiator is rewarded for "beating" a price of fifteen. In a market where transparency is scarce and collusion by negotiators is abundant, this arrangement makes little sense for anyone but the middleman. Still, it is common enough that A and others mentioned it in the course of our conversations.

Negotiator compensation is something that has proven difficult to analyse, as the now-famous Ertel article illustrates.[128] Ertel's paper, the result of over twenty years of analysis

[128] D. Ertel. *Getting Past Yes*…. Harvard Business Review. 2004).

of business negotiations, contains a quote that seems particularly poignant in the context of the Ugandan business cartel's efforts: "The crux of the problem is that the very person everyone thinks is central to the deal—the negotiator—is often the one who undermines the partnership's ability to succeed. The real challenge lies not in hammering out little victories on the way to signing on the dotted line but in designing a deal that works in practice." From the work of Ertel or Leary et al.,[129] one might think the use of "amateur" negotiators with limited literacy, numeracy, and experience like B would be a recipe for disaster. But the secret of this cartel's success is not in the negotiation (as Ertel points out), but in the alignment of B's interests with the cartel's, as he is both a negotiator for hire and a member of the cartel.

My first interview with B began at his brother's home, which is on the north eastern side of Oyam, less than ten minutes from A's farm on foot. I expect him to identify his profession as being a farmer, or running his farm, which he does initially, but then I ask again (it is common to repeat a question to invite elaboration or to ask for clarification). He responds that he is in the middle of the buying and selling.

I ask how B is compensated by the cartel for his negotiation abilities. He affirms that he has been given a base number by A[130] and that he will get half of the margin by which he "beats" that number. Asked whether this is enough compensation for his efforts, he replies that everyone saves, since part of the money he is saving in the negotiation is his own money.

I ask what other factors affect the negotiation and he brings up a factor not discussed in the prior literature – that he negotiates differently according to the value of the cargo and that he adjusts the crops he's growing according to how far he is from the highest-paying

[129] Leary et al. *Negotiating with Emotion*. Harvard Business Review. 2013.
[130] In negotiations, this is called the "*cwer*," literally meaning the root, the lowest point.

markets. In other words, an estimate of future transport cost is baked into his calculations of profit maximisation when he chooses which crop to grow, he negotiates as one might expect an econ to negotiate. Not only is this more sophisticated than the kinds of decision-making discussed in much of the literature, but it suggests a stability of local markets (and transport or logistical capacity) that did not exist in this region only a few years earlier, as in Finnstrom's work.[131] The ability of managers like A and their senior reports like B to work together on negotiation strategy is often limited and these collaborations can be difficult, as recognised by Aguilar,[132] for reasons of principal-agent theory as in Moffitt & Bordone[133] and due to changes or shifts in incentive alignment. During my interviews with B, I notice two patterns: 1) he negotiates better or harder on behalf of cartels where he is also a member, which is unsurprising, and 2) in years where he will endure higher transport or interim logistical costs, he grows higher-risk and more lucrative crops, which is something not observed in prior literature in this region. During 2012, B knew as early as December 2011 that he would have at least two people with whom to share costs, and chose to grow a relatively-safe crop mix from a cultivation risk perspective. Two seasons later (one year post), the cartel was weaker and B worried whether he would be able to share a pickup truck with others. As a result, he negotiated (not as well) on behalf of a cartel of which he was not part and moved his crops (which were lighter in weight, riskier in cultivation, and more valuable per kilo) to market by bicycle with his two brothers. In a market where margins are slim and transport costs are high, it is interesting – though not wholly surprising – that crop yields and (estimated prospective) margins adjust to retain profitability net of logistical costs. This displays a level of agility (possibly due to low switching costs) that has not historically been observed in this region. This organisational

[131] S. Finnstrom. Living With Bad Surroundings. Duke University Press. 2008.
[132] F. J. Aguilar. Harvard Business School Case Study 191058 (Negotiations). Harvard. 1990.
[133] M. L. Moffitt & Bordone, eds. Handbook of Dispute Resolution. Jossey-Bass. 2005.

agility and relative indifference to the other characteristics of the crop being cultivated is the most unusual characteristic of farm- and cartel-level organisational behaviour.

In contrast to the relationship between A and B, which is managerial, the relationship between C and D is fraternal. The two share a grandfather and have known each other for much of their lives – they've also known A since childhood. Of the truck's usage, A and B together would use about two-thirds of the payload. C and D would split the remaining capacity, with C (who generally grows crops that are heavier per unit of dollar value) feeling more strongly about using the truck than D. Both approve of B's negotiation ability and do not have an issue with the cartel's delegation of negotiation responsibilities.

The 2012 negotiations with the man with the truck, whom I will call X, begin in the third week. D knows of someone with a truck, too, but the truck belongs to an NGO and the man (referred to as Ojok, which means magic one, a name often used for people who survive a troubled or difficult birth, but whom I will call Y), is offering it on the side. Because it is not his truck, he can offer a lower price, but the other men in the cartel do not trust Y or his borrowed truck. Hence, X is the only supplier of logistical assistance from the beginning. The only alternative to X is moving the yields by bicycle.

In the second week, prior to negotiations,[134] the men meet at Macho Dwogo (an open clearing in Oyam that was specified as a safe place during the war – its name means "the fire returns" and refers to a specific commander during the war who kept Macho Dwogo safe from raiders and soldiers who attempted to interrupt business in the area). I attend this meeting, which happens on a Thursday after the village market day.

Their preparatory process focuses first on the total payload and agreeing that the four contributors, no matter how plentiful their harvest, will not exceed the payload of the

[134] Author's field notes, Q1/12.

truck thrice (only three trips to the market are possible in the time allotted by X for the truck rental). Any excess yields must be transported by bicycle or some other means; the cartel will not extend or alter the rental agreement under any circumstance. Then costs are discussed and it is decided that each bag (approximately 50kgs) will be counted as a share of the truck's payload. If a person contributes ten of the fifty bags, then he will pay one-fifth of the transport cost. The contents of the bags or the differing value of various crops will not be considered in the calculation of one's share of the costs.

The boundaries and parameters of the negotiation are that no one is willing to pay more than 30% of his otherwise-net profits on a given harvest in transport costs. Further parameters are that no one is allowed to have other business relationships with X between the fourth week and the harvest, that all bags will be stored and counted in the raised area (an old chicken pen) at B's farm the night before transport, and that all four men will be available to work (loading and unloading) on the day of transport. It is agreed that no men will be hired from X except the driver (whose fee of 20,000UGX is customarily included in the cost of the truck). Finally, the men in the cartel agree they will be responsible for any yields transported but not sold at market – in other words, the truck will not be loaded or used to take anything back from the market that goes unsold.[135]

Once these matters are settled, the men discuss negotiation strategy. Interestingly, this discussion follows the framework proposed by [Cormack 2005] and has four distinct stages, the latter two of which are discussed in the following section.

1. Preparation
2. Designing the process
3. Engaging in the negotiation

[135] The lone exception to this is that if any member of the cartel arrives at a barter agreement with a buyer, he would be allowed to transport the fruits of that barter back to B's farm.

4. Closing the deal

The men recognise they cannot let X know he is the only provider of logistical assistance. They send C to discuss transport with Y, obtaining a quote, in the hope that he will talk with X and spread the word they are comparison-shopping. They gather information on X from his neighbours and associates, learning the truck is reliable, that he owns it outright, and that he can make price concessions on his own authority. They also learn he often is drunk and has a short temper and that offering a "lowball" price is not an option; he has a history of walking away from negotiations.

The cartel then shares their estimates of what they believe the transport will cost in total (not on a *pro rata* basis). Interestingly, their estimates of transport cost scale well with the value of their yields. Computed at later observed market prices per kilo, the estimates of transport cost are highly[136] correlated with value of the farmer's yield cargo. This was also true across other cartel groups of farmers I observed, albeit to a lesser extent.[137] Asked whether they had chosen crops in accordance with anticipated transport costs, B replied, "Men who grow cassava[138] do not hire trucks." The men agree that they adjust their crop mix to make sure they can afford transport, which they now consider part of the cost of the harvest; A notes that even a decade ago, trucks were rare and reserved for special tasks – now, they're increasingly a necessary harvest-time tool.[139]

[136] .85.
[137] .68 overall (inclusive).
[138] Cassava is a cheap, starchy staple of low value.
[139] The necessity of trucks is a complex evolution with many causes. First, markets have become more centralised and have increased substantially in size – today, farms are a greater distance from markets than ever before. Second, the fragmented post-conflict social organisation of many agricultural areas of Uganda means there is less informal collaboration between farms to move yields to market; when collaboration exists (e.g. transport cartels), the arrangements are formal, temporary, and specific to a given service. Third, the availability of trucks and the soaring cost of cattle has made it less desirable or affordable or practicable to use ox carts and more reasonable and (comparatively) affordable to use motorised vehicles.

The cartel discusses strategies for bargaining, none of which is integrative in the classical taxonomy put forth by Walton & McKersie.[140] Of the distributive bargaining strategies contemplated, most centre on comparative argument (drawing on prices others are paying in the area, or have paid in the past) or on negotiated longer-term supply contracts. B suggests that the cartel could get a better price if they were willing to purchase X's services for two or three years rather than just once. A balks at the idea of a three-year contract, noting that three years is six growing seasons and that there is no guarantee X will be able to perform, or that his truck will be in working order, or that he will be anywhere to be found in three years' time. A, C, and D agree that a two-season or three-season (18-month) contract is possible, but that anything longer is unreasonable. A also notes that these longer-term arrangements are only preferable if they result in lower first-season logistics costs and better relationships between the cartel and X going forward; I discuss this later with A and he outlines a sort of pre-emptive attitudinal structuring scheme in which he hopes X will be less combative and more cooperative, which seems consistent with the liberal (econ) concept of attitudinal structuring in negotiation.

The issue is (rightly) raised that the cartel has limited bargaining power, but also that X's truck is not subject to infinite demand. The concept of power is not elaborate here, but limited to the idea that at some price X is willing to rent the truck and that the cartel has limited power to push the price down to X's actual marginal cost of providing that service. A raises the inverse of my earlier observation, that X may ask what crops are being transported. A suggests the cartel should be very hesitant to divulge this information, as it will let X more accurately appraise how much the cartel can afford to pay for transport. B notes that X lives less than two miles from A, B, C, and D, and could easily investigate

[140] R. E. Walton & R. B. McKersie. A Behavioral Theory of Labor Negotiations. New York: McGraw-Hill. 1965.

which crops were being cultivated by each if he cared to do so; B suggests there would be more goodwill in the negotiation if the cartel were honest about the yield cargo and stated a price – he notes that while A, B, C, and D think of transport as part of the harvest, the truck they plan to hire does not cost more to operate if it is carrying diamonds rather than maize. The others agree.

The negotiation occurs the following Monday and I visit A's farm. I later text and visit with B, C, and D. B is proud of his work, but admits the price is still steep. A is relatively unhappy, while C and D accept that transport costs are high due to the cost of diesel fuel and other factors. All say they will still agree to use X to transport their crops to market. Six weeks later, I travel to *Macho Dwogo* to sit with A, B, C, D, and other farm entrepreneurs with whom I've been meeting. Many have hired X on various days to move their crops and his tired green pickup truck moves slowly across the market grounds, making deliveries. Like the cartel studied here, farmers who live far enough from the market to require a hired truck but cannot afford or justify the cost of a truck for their yields alone, are many – and most of those I interview mention they have chosen crops that will, even with a yield shortfall, ensure they can cover their transport costs.

Beyond the one cartel of A, B, C, and D, I examined my larger dataset of over 3,000 farms. There is a strong correlation[141] between transport costs and crop choice, with transport cost estimated on a linear per-mile basis beyond one mile.[142] Farms that are more than two miles from the nearest marketplace seem to compensate for their higher transport costs by growing higher-margin crops, as one would expect from econs negotiating in a relatively efficient market. This is particularly true of rarer (more expensive) types of beans and tobacco in Oyam and of coffee in Kapchorwa. The theory that farmers might

[141] 0.32.

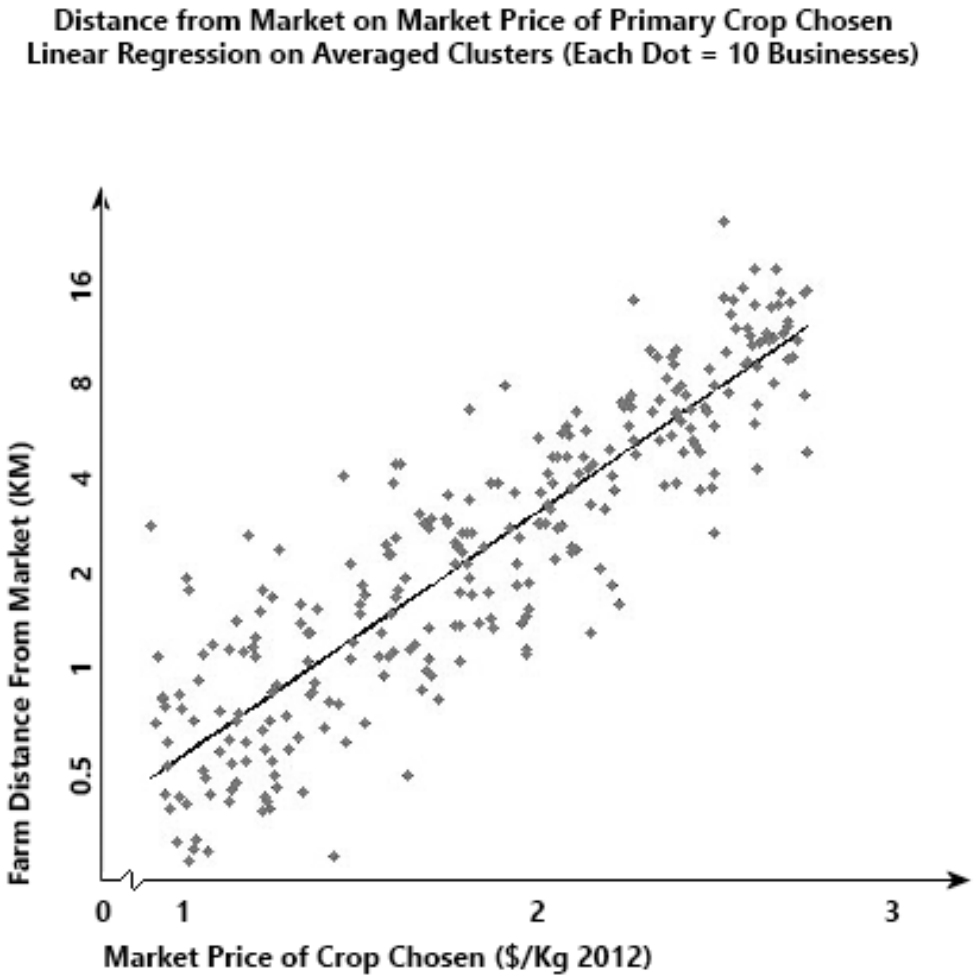
[142] x being an arbitrary cost coefficient where m is miles-to-market rounded up and x = m - 1

choose plots far from town to grow large quantities of lucrative crops does not hold because the sample is controlled for farm size. Likewise, because the sample is controlled for household income of the principal, the speculation that farmers might be wealthier on the periphery of these areas and be better-able to afford to cultivate high-margin crops is not supported.

The correlation between crop choice and distance from market is most striking in the case of tobacco, the highest-margin-per-kilo crop in Oyam. Though tobacco is light when it is dried and processed, it is bulky, heavy, and often moisture-laden when it has just been picked and is not yet processed. As a result, it is nearly as difficult to move as beans or rice and as vulnerable to moisture as hard charcoal. This means it is precisely the type of crop a person would not want to transport more than two miles by bicycle. Looking at the six largest markets near Oyam, one sees the GPS locations of farms growing tobacco are almost always more than 1.8 miles from the nearest market. In fact, in a sample of nearly 1,800 farms near Oyam, only forty farms within 1.8 miles of a market have chosen to grow tobacco (a high-margin, but finicky crop that experiences total crop failures in wet years). The correlation holds in the more mountainous region around Kapchorwa (it is worth noting that, due to the winding, steep roads of this region, two miles “as the crow files” might be four miles by road).

In the cartel studied here, A paid 18% of his otherwise-net profits to X for transport. B paid about 15%, while C and D paid around 16% each. With similar kilo yield in maize and soybeans, A would have paid nearly 35% of his otherwise-net profits to X. Transport to market is a substantial, and often-overlooked, cost for agricultural entrepreneurs bringing product to market in developing markets. For farms operating over distances where the nearest market falls outside the practical range of a bicycle or oxcart, motorised transport (and, in particular, the one-tonne pickup truck) has become a

necessity. Because seeds are purchased each season and switching costs are low, farmers operating farther from market move toward higher-margin crops to attempt to prevent their margins from being eaten by logistical costs. The following chart illustrates the major groupings of farm businesses (92% of sample included in circles illustrated) by price-per-kilo of crops chosen and distance from the nearest market. Price-per-kilo is highly correlated with crop failure risk and the number of entrepreneurs self-reporting using a market other than the one closest to the farm was very low.[143] This was confirmed using GPS records from farmers' phones.



[143] <0.03.

One sees there is a considerable effect of the distance from market on crop choice. Farms farther from the nearest market tend to choose higher-value crops (or attempt to choose higher value crops, as price information is far from perfect pre-harvest). Each dot represents ten businesses located very near each other (according to GPS/GIS coordinates) and growing the same crop; this cluster aggregation was done to make the chart more readable and has a negligible effect on Y-axis position of any single datapoint illustrated. Note the Y-axis is superlinear 2:x. The X-axis is denominated in kilos per dollar at 2012 dollars on observations made in UGX with a consistent exchange rate used of 2475UGX/USD, which is very close to the observed retail average rate over the period studied. Worth noting, too, is that a truck carrying one metric tonne of the more valuable crops (coffee berries of Starbucks supply 1 grade, SBUX-SS1, for instance), would be carrying nearly $3,000 worth of cargo – or sometimes more than the truck is worth. The majority of the data points plotted in the upper right of the chart are farming operations in the Elgon foothills maintaining mature coffee trees a substantial distance from the eastern Kapchorwa market grounds; the others are tobacco farmers near Kitgum Road who travel to Macho Dwogo or similar markets in Lango subregion.[144]

This correlation,[145] combined with the observations made during fieldwork in Uganda, suggests the distance from market is a substantial factor in crop choice and that this relationship stems primarily from the high transport costs of moving crops to market. It further suggests that, in the context of agricultural transport and logistics decision-making in Northern Uganda, in both regions studied, the entrepreneur behaves as one would expect an econ to behave: maximizing revenue from each shipment even at the expense of wasted or rotten portions of the harvest, despite strong local normative

[144] Particularly *Cuk Macho Dwogo* and *Cuk Dokolo* and *Cuk Kole*, all of which were once attended by, or sponsored by, British American Tobacco's buyers.
[145] R2 = 0.44.

pressures to sacrifice maximisation of revenue to achieve minimum wastage of yields. Even farmers who were interviewed and claimed they had starved as children, valued food above all else, and would do anything to prevent food being wasted (which was the popular and "politically-correct" thing to say) actually optimised around maximum profit per shipment at harvest time, even letting food rot (albeit generally out of sight) if it was not the most profitable commodity to fill that portion of the truck.

Accord, The Second Instance: The Procurement of Capital Equipment

The Ugandan small commercial farm is a typical small business in its labour and capital substitution behaviour, with the exception of its sources of labour. Elasticity of substitution between capital and labour continues to face identification challenges in the economics literature. As a result, I merely attempt to classify as more-econ or more-human the substitution decisions made in a large-scale survey and in fieldwork visits to Ugandan agricultural small businesses. Using this rich new dataset, I find unexpected results in the purchasing of two major pieces of capital equipment, ox ploughs and bicycles, but find the behaviour observed to be generally profit-maximising and econ-like rather than human-like, despite social (including historical) local pressures to substitute toward labour. These normative pressures stem from large-scale male unemployment in the region, the perception that those operating supersubsistence farming businesses are wealthy and miserly and able to offer employment but do not, and appeals from family members to wealthier older generations requesting employment even if the employment is minimal in scope and suboptimal in industrial contribution (from a marginal product of labour standpoint or using any reasonable estimation metric of industrial contribution).

Because hiring labour from adjacent farms is unusual and culturally-discouraged (with the important exception of harvest season), most increases in the persistent labour

force depend upon the fertility of the farm's owners rather than the unemployment rate of the surrounding area.

I divide labour from capital in this, second, section (labour referring explicitly and only to labourers on the farm) and then deal with the human resources question of a "labour pipeline" in the third section. I classify the labour pipeline issue as focusing chiefly on the production of children for the purposes of providing a downstream labour pool.

With regard to capital, the two key capital investments available to an agricultural entrepreneur in Uganda are the ox plough and the bicycle. The ox plough does the work of several men during the tilling-and-planting phase, while the bicycle allows a single individual to move 120 kilos of crops to market, more than three men could move any substantial distance on foot with improvised rucksacks.

After compiling data on 3,000 farms in two separate – and very different – regions of Northern Uganda, I find the patterns of ox plough and bicycle ownership are not fully-explainable by their contributions to farm productivity alone, but are generally in line with the econ-like behavioural expectations laid out in the general hypothesis. Further, I find that the mountainous topography of one region, which should discount the utility of the ox plough and discourage use of bicycles, does not in fact discourage these capital investments to the degree anticipated, even when considering plot size and income. This (slight) over-adoption of capital over labour may suggest there are other reasons to invest in these items, and I offer alternative theories to explain the investment allocations of farmers who (slightly) favour capital investment to an unexpected degree.

This research begins at the centre point of Ugandan small business, the low-technology farm, where the notion of a substitution curve connecting labour and capital is an alien

concept. Beginning with Allen,[146] technological progress is examined in a mixed methods approach, integrating the anthropological realities of the farm with the economic realities of its operation.

> He saws wood with a saw, knits with some needles, or spins with a distaff. He has but two hands to work with. He can not [*sic*] work two saws at once, with any precision at least…
>
> Allen [1891] at p. 261

In later revisions to his manuscript, Allen attempted to integrate the comparative accounting that would be needed to tease out the factors that contribute to a primitive farm's mechanisation (or choice not to mechanise). He categorised fertilisers and other inputs as capital spending and segregated capital expenditures by examining the adoption of specific implements, as I do here, *infra*. Some things have not changed in the roughly 125 years since Allen's manuscript, including the difficulty of attacking this labour and capital substitution issue as a matter of precise accounting.

> This [capital spending calculation] applies to garden truck, vegetables … as well as the corn and grain consumed by his [live]stock. … Suppose we allow twenty per cent for this [cap ex]. … Ten per cent would probably be a fair allowance for depreciation in value of farm implements. We will not consider the cost of fertilizers because, first, their value is not exhausted in one year. Then there is a vast amount of fertilizing

[146] E. A. Allen. Labor and Capital: Containing an Account of the Various Organizations of Farmers, Planters, and Mechanics, for Mutual Improvement and Protection Against Monopoly. Reprint Monograph from the University of Michigan Library. University of Michigan Press. 1891.

> materials created each year by the live stock, which if supplied to the land, represents an actual value created of which no account was kept.

Hence, I do not take an accounting approach, though it or the financial diaries approach of Collins was noted and tempting to pursue.[147] With this large sample and the financial illiteracy of many of the businesspeople involved, however, it was impracticable, even with over one hundred researchers with able arithmetic skills at my disposal. Rather, I adopt a chiefly anthropological frame, quantitative to the extent possible, examining and attributing the economic consequences of these decisions in a labour and capital framework. Because few avenues for industrialisation are available to small-plot farming businesses, I focus on the ox plough (which has one purpose) and the bicycle (a multipurpose piece of capital equipment).[148]

Unlike the Asian economies observed by Popkin[149] and others, Anglophone east Africa did not undergo a Green Revolution of agriculture or an "efficiency push" in the 1970's. In fact, Meredith[150] notes, citing World Food Council statistics, Africa was the only region of the world to see a food-production-per-capita decline in the 1960's and 1970's, of 7% and 15% respectively, per decade. The farms I studied are supersubsistence farms but, even in the best of years, operate only at a tiny surplus relative to subsistence levels in gross terms (in percentage terms, the "supersubsistence ratio" difference is more substantial, output being 300% to 1200% of what the farm consumes when both

[147] For quantitative analysis of Ugandan rural peasant savings behaviour along the lines of Collins's Portfolios of the Poor, though substantially less empirically-rigorous, *see* work by Mpuga and others.

[148] Though frameworks exist for multiple attribute decision-making analysis in firms with capital allocation data, the labour data is quantitatively unsuitable here, as most of the labourers are children where it is difficult, if not impossible, to categorise them by marginal product of labour or marginal contribution. For a summary of analytical frameworks for this research design that were considered, but discarded in favour of a more holistic mixed methods approach, *see* Yoon [1995].

[149] "Peasants often are willing to gamble on innovations when their position is secure against the loss and when a success could measurably improve their position." Popkin, *supra*, at p.21.

[150] M. Meredith. The State of Africa. Simon & Schuster Inc. 2005.

consumption and gross production are reduced to pecuniary values). By definition, supersubsistence farms are operated for profit, as businesses, and are not family gardens operated merely for survival – hence, firm-level decisions about labour and capital allocations are relevant for every farm studied.

It is important to understand and appreciate that the farms I study are commercial farms and that the people operating them are not peasants, but businesspeople managing a firm – this is particularly important in the context of the labour-and-capital decision-making each entrepreneur contemplates.

To understand why my subjects are distinguishable from the peasants in much of the early development studies literature, one may look to Scott's[151] definition of a peasant in The Moral Economy of the Peasant:

> Most definitions of the peasant include at least two features. First, he is a rural cultivator whose production is oriented largely toward family consumption needs; this defines his central economic goal. Second, he is part of a larger society that makes claims upon him and this, in a sense, defines his potential human antagonists (or collaborators) in attaining that goal.

The entrepreneurs I study are from a generation whose parents likely were peasants, meeting both qualifications of the Scott definition. However, until the last ten or fifteen years, little or no improvement in crop yields was possible due to warfare, non-war local conflict, scarcity of capital, limitations of non-improved crops, and unavailability of capital inputs like fertilisers and modern ox ploughs.

[151] *See* Scott, *supra*. *at* ch. 6.

The productivity of the farms studied scarcely improved during the Twentieth Century. The tools discussed, though primitive, were unaffordable to prior generations. Until the advent of the cheap Indian (and, now, Chinese) imported bicycle, the only strong bicycles available were Raleigh models imported by British officers. The ox plough, though possible to construct with local technology, was not widely adopted until very recently, in part due to the lack of metals appropriate for ploughshares (and fine tines, in the case of turning ploughs) and the lack of local knowledge in metalworking. The primitive ox ploughs adopted from 1960 until present were mechanically-inefficient and hence would tire even strong oxen in a fraction of an afternoon.

Only recent advancements have made adoption of these capital goods worthwhile. With the adoption of these technologies came increased harvests, increased (supersubsistence) revenue levels, and better access to markets.

The labour and capital trade-off in agriculture on the micro or single-firm scale has faded from the minds of many economists as the massive industrialisation and mechanisation of farming has progressed, particularly in Asia and South America. In much of the world, the labour inputs per harvested tonne of a given commodity crop have plummeted from dozens of men in the late nineteenth century to a single-digit number today. Combined with widespread aggregation of land holdings, creating both the largest farm sizes in American history and some of the largest contiguous productive areas in the modern history of Europe, this has created agricultural efficiency of an unprecedented order.

However, in the emerging markets of underdeveloped Asia and Africa, much agricultural work is still done by hand. Firm sizes (in dollar revenue and market share terms) and farm sizes (in acreage held and tonnage output) remain tiny in these regions. As my research focuses on typical small-holder farm sizes of under two hectares, an amount of

land often owned and worked by two or three generations of a single family or patrilineal group. I posit, based on field visits and interviews with farmers, the following:

- The primary source of additional labour is the fertility of the farmer's household.
- There is a ten-year "lag time" before children are useful labour.
- The size of farms is both small and difficult to revise upward.
- Mergers with adjacent farms or purchases of nearby farms are exceedingly rare.[152]
- The non-farm jobs market in these areas is tiny and not particularly lucrative.
- In areas that are relatively flatter and drier, bicycles are more useful.
- Less extreme grades and less extreme rainy seasons make ox ploughs more useful.

I will explain, in detail, how and why these determinations were arrived at and how they are important to – and inextricably intertwined with – the conclusions drawn thereafter.

Every time I asked farmers in Lango subregion when they decided to become farmers or knew farming would become their "work" (their primary source of income), the reply was, "*An onywala ame abedo apur*," meaning, "I was born a farmer."[153] Asked why, I was told of the expectations that children would help on the farm from an early age. In Oyam, the concept of *odoko dano* (almost certainly borrowed linguistically from upper Luo) is prevalent: that a child born to farmers is not a full person until he or she can be of use on the farm. I received similar replies in Kapchorwa, both about being born to

[152] I explain, *infra*, reasons for this rarity. In addition, even in perfect conditions, it may be difficult for local entrepreneurs to calculate or estimate the gains from a merger, as this calculation would be deceptively complex and easily under- or over-estimated by an order of magnitude. For a review of the considerations in such a calculation, *see generally* P. Bogetoft & D. Wang. *Estimating the Potential Gains from Mergers*. Journal of Productivity Analysis. 2005.

[153] This is a strictly literal translation, as "*apur*" is not a "profession" in the same sense it is in modern English; "I was born a farmer" fails in English to communicate the entirety of what being a farmer means in Acholi and Lango subregions.

work on the farm and of adulthood being measured by agricultural utility, though the words used in the east vary widely. In both regions studied, the usefulness of a child as farm labour is seen as a gradient from zero usefulness to being fully useful (Lango: *bedo dano*), not a binary determination. Perhaps no event (other than the birth of one's children[154]) is more important to evidencing one's maturity in Northern Ugandan societies than becoming useful as labour on the family farm. Children would even refer to their parents (albeit sometimes jokingly) as their bosses in the agricultural context (Lango: *ladit ti ca*), recognising that agriculture is the family business and that they are the enterprise's junior employees. Often, their status as "full employees" hinges on their ability to supervise certain work or use certain implements – particularly, in both Oyam and Kapchorwa, the hoe and the axe (Lango: *kwere*, *latong*).

For a variety of cultural and economic reasons, hiring farmers away from nearby farms is not realistic for small-holder farmers in either region. In Lango subregion, it is frowned-upon for men to do the work of women (for instance, picking rice), so even though part of the labour force is unused during these early harvest periods (men drink[155] in town while women pick rice) men often will not swallow their pride to partake in activities that run counter to social norms. It is generally forbidden in both regions for a child to work for wages on a nearby farm if there is any work at all remaining to be done on his own family's farm. Due to the gruelling nature of work during the tilling, planting, and weeding stages (not to mention the harvest stage only nine weeks later), there is little time or energy or daylight to spare in most families. Because most equatorial semi-annual food crops are roughly synchronised, there is no way to easily distribute labour

[154] Noted by Girling and countless subsequent anthropologists and ethnographers. F. K. Girling,. The Acholi of Uganda. Her Majesty's Stationery Office. 1960.

[155] Alcoholism is a recognised and growing problem in both regions studied. For more contextual information regarding the environment and the contributory factors that may drive alcoholism and other worrying trends, *see* S. Finnstrom. Living With Bad Surroundings. Duke. 2008.

between farms through the exchange of labour; all farms in a given area are busy at the same time. This is true in areas with many semi-annual harvest crops (Oyam) and areas with a tendency toward annual planting (Kapchorwa); farmers in both regions complain of the synchronisation problem and its effects on labour surpluses and shortages throughout the year.

The size of farms has an effect on the use of labour and capital as well. Farms in Oyam are measured in *okori* (a stick used by Acholi and Lango farmers to measure their plots in precolonial times that is about two metres in length), while farms in Kapchorwa are measured in *am katala* (a type of reed that grows in the lowland areas and naturally blooms or terminates its ascent at about 2.5 metres). One *okori* (here used as a measure of area rather than as a concrete noun meaning a stick) is 8 meters by 16 meters measured using the stick.[156] The *okori* and *am katala* are very similar in shape and likely derive from the same ancient measurement, a long-lost versatile basic agricultural unit to estimate grazing and planting space. The resulting measures are roughly double one another in area, however. Other words for the measurement include *katal* (Acholi), *kac* (a shortening of *katal* in Lango), and *puti* (a crude transliteration from Kiswahili). In both cultures, areas flooded by water are not counted, unless they are seasonal rice fields, and not all plots are oriented in one particular cardinal direction. Triangular spaces between plots are not unusual and their ownership is often disputed or unresolved. For the purpose of this work, I assumed that an acre was slightly more than thirty[157] *okori* or twenty[158] *katala*. Given that specific-yield-per-arable-unit or other precise agricultural calculations are not at issue, this estimation is adequately precise for the purposes of this discussion.

[156] Conversation about farming methods with Willy Okello, 27 October 2013.
[157] 31.6.
[158] 20.2.

Because the bulk of wealth in both regions studied is moved intergenerationally through patrilineal land grants, bequests are often made in a mixture of *inter vivos* and dying declaration settings (gifts made in the moments before a person dies or, in Lango subregion, euphemistically, as the person is disappearing, *rweny*) involving one's sons (or through, much more recently, more formal holographic[159] conveyances[160] but never documents so formal a British solicitor would term them "wills"). Sons are said to see or visit (*neno* or *limo*) the land in Oyam when they have witnessed the land they will someday hold, while in Kapchorwa the son "waits on" land he will someday inherit.[161] Regardless of the translation, it is relatively clear in the vast majority of cases who will inherit what. What is equally clear is that landholdings of almost all families will be diluted. Few daughters marry well enough to offset the dilution of landholdings through the inheritance of their brothers; many families have tried to marry beyond ethnic boundaries to gain access to more land, even if it is distant.[162] The birth rate is very high and the arable land divided is often suboptimally partitioned, particularly when harvest season transportation or future irrigation improvements are considered.

There is little or no land for sale at any given time in Oyam. There is even less land for sale in Kapchorwa, as many are holding out in hope that Starbucks or another large coffee company will acquire another set of properties through long-term leases. Of the land available in both regions, transactions tend to occur just before the first planting

[159] The term holographic, in British law, refers to documents signed by a testator.
[160] Trained as an attorney in common law jurisdictions, I often asked men with substantial land or cattle how they planned to dispose of their assets upon their deaths. I would often receive replies detailing promises they had made, things they had recited to children, and so forth. Written wills were rare, but not unheard-of.
[161] Clan-based land registries have been proposed, but none is active or used currently. For a sketch of how a northern Ugandan clan-based land registry might work, *see* Atkinson [2007].
[162] I've translated the word "distant" from field notes. Distant in this sense could actually mean "nearby" but always means "non-contiguous." The underlying translation is that I used "*kany*" to mean adjacent or contiguous, "*kenyo*" to mean nearby but not contiguous, and "*kwica*" to mean far away and hence not contiguous. While this is only a rough translation, I did occasionally ask farmers to walk me to the piece of land they were referencing to verify this translation.

season. The primary reason for selling is poor planning for the off season or inadequate savings.[163] The odds that a neighbour will sell to his neighbour are no better than that he will sell to a stranger in either region; hence, few adjacent plots are reunited once they are split.

With shrinking plots, many are turning to other businesses –as a hedge against poor harvests, because farm size is not large enough to provide income at current efficiency levels and yield ratios, or because of fears about the fluctuation of agricultural commodity prices (which has been more violent in the past decade than in decades previous). These businesses usually involve setting up a small stand in town that sells mobile phone airtime, popular packaged products like soap or alcohol[164] or cooking oil. The profits from these operations are not comparable to agricultural operations in the vast majority of cases,[165] but do supplement household incomes somewhat.

The topography of a region shapes the usefulness of both of the common equipment investments among farmers in Uganda: bicycles and ox ploughs. Each of these items has received substantial attention in the literature, whether in Africa or in Southeast Asia. Both bicycles and ox ploughs are substantially more useful in areas with relatively flat terrain. In equatorial weather, cattle tire after only two to three hours pulling a single-yoke cross-beam ox plough.[166] While Oyam has a more moderate (and longer) rainy season and gently rolling fields with little topographical character, Kapchorwa has

[163] Harvest variability – yield variance – for farms using unimproved crops is substantial, at roughly 20%. This is consistent with other empirical observations in the literature from farms using unimproved seeds and primitive methods, *see*, *e.g*. Chayanov at p. 137, citing a 20% variance in Russian peasant harvests per hectare. A. V. Chayanov. On the Theory of Peasant Economy. 1966.

[164] Here, I'm referring to small plastic sachets of 50cl to 75cl of over-proof alcoholic beverages.

[165] Data on this aspect are quite robust and confirmed by site visits and discussions of farmer ledgers; few farmers in either region studied are receiving more than 25% of their incomes from these small-scale supplementary retail efforts.

[166] Interview on farming methods with Willy Okello, 10 Nov. 2011.

violent rainy seasons and steep grades where most major roads turn to mud and are impassable in the rainy season.

If farmers are econs, given generally similar farming methods, plot size, and household income levels, bicycles and ox ploughs should generally be less valuable and less popular where they are less useful (areas with significant grades and violent rainfall).

I looked at capital investment in bicycles and ox ploughs. Here, there were significant interregional differences. Though the cost of bicycles and ox ploughs is similar between regions,[167] with little difference in cost across the six products surveyed, consumption patterns vary.

Oyam*	Brand New	Lightly Used	Needs Repair
Single Ox Plough	250,000	230,000	150,000
Sturdy Bicycle	270,000	200,000	100,000

Kapchorwa*	Brand New	Lightly Used	Needs Repair
Single Ox Plough	270,000	225,000	150,000
Sturdy Bicycle	300,000	275,000	125,000

Oyam	Brand New	Lightly Used	Needs Repair
Single Ox Plough	46	42	28
Sturdy Bicycle	50	37	18

[167] I surveyed bicycle and ox plough prices myself, as well as asking farmers what they'd paid.

*Kapchorwa***	Brand New	Lightly Used	Needs Repair
Single Ox Plough	43	36	24
Sturdy Bicycle	48	44	20

* Price in 2012 UGX.

** Price as a multiple of in-sample in-region farmer mean daily income (2012).

One interesting trend found in the literature (e.g. Popkin's observations in Vietnam) and in my observations in Uganda is that larger families tend to specialise. This specialisation often makes the purchase of a bicycle desirable. For instance, the bicycle can be used to deliver goods to nearby customers or to move back and forth from a business in town. A sturdy bicycle[168] can move crops or people substantial distances, but it requires a rider (for light loads that fit in a rucksack) or an escort (for heavy loads that make the bicycle a cart, rather than a ridden vehicle). As expected, as household size goes up, bicycle ownership goes up, with a correlation (.10) across the dataset (.0698 in Kapchorwa and .1797 in Oyam.). Looking only at adult household size (household size less children), a decreased correlation is seen, which is unsurprising, as it is often children who are tasked with moving themselves and goods (or chickens or water and so on) by bicycle.

To check whether any substantial portion of bicycles is being used to "commute" to town to run a shop or peddle goods, I compared the diversification of a household's income to its bicycle ownership. I found, consistent with my interviews with farmers,

[168] Older steel British bicycles are preferred in Uganda and seen as the high watermark of bicycle craftsmanship. These, particularly the Raleigh Champion II model (imported by RAF officers in substantial numbers), can move 80 kilos of cargo with a pedestrian alongside. Indian bicycles made in the 1980's from thick-wall aluminium tubes are seen as the next-best, followed by cheap commodity bicycles made in China (which are not considered sturdy).

that merely commuting to and from a shop in town is not considered a good use for a bicycle; this correlation was negligible across the sample, the two major subsamples, and random populations. Bicycles are more valuable as a way to transport agricultural inputs and outputs, or as a way to transport heavy household needs, such as jerry cans of water. This is particularly apparent in Kapchorwa, where 9.4% of farmers who have only farming income have bicycles, while only 5.6% of farmers who have a shop in town or a similar source of supplemental income.

I also wanted to examine the impact of household income diversification on ox plough ownership. While the two are seemingly not related in Oyam, they are related in Kapchorwa, where 20% of farmers who report most of their income coming from farming also report owning an ox plough (while less than 10% of farmers who report significant other sources of income report ox plough ownership). Even when we compare subsamples containing only farmers who control plots of nearly-identical size, these differences remain. This is unsurprising as the ox plough represents a very substantial investment in capital equipment and hence not an investment made lightly if one's primary business is not agriculture.

Finally, it is worth exploring the connection between crop choice and ox plough ownership. One would expect that farmers with plots well-suited to long ranks of relatively shallow plantings would favour ox plough ownership. This is true. In Kapchorwa, the crops traditionally planted in long ranks are the ones with high correlations to ox plough ownership, namely beans (0.19), peas (0.22), Irish potato (0.22), and sweet potato (0.26). In Oyam, the same is true, with maize (0.21), sim-sim (0.17), and sunflower (0.22) being the popular local crops that grow best in long ranks of shallow tilling. These correlations are quite strong and robust within sub-samplings for each region. This is not surprising, as ox ploughs are difficult to turn and the yoked

animal has to be driven a substantial straight distance for the process to be worthwhile. Hence, long narrow tracks that can be tilled into ranks of substantial length are ideal.

The relationship between topography and ox plough ownership seems to show up in both topography and farm size. This makes sense, as only farmers with larger plots of relatively flat land find it useful (and economically justifiable) to have an ox plough rather than tilling by hand.

There is also a significant negative relationship between household size and ox plough ownership across the entire dataset and in discrete analysis of each region, suggesting a trade-off between having more children and letting oxen do the tilling. Of course, oxen cannot perform other tasks (like weeding or bringing items to and from the market), so they are not substitutes for children in these areas. Oxen are also simply superior to even a very strong human in the ability to till an area quickly. From my observations on farms in both regions, it takes nearly thirty men to till the area an ox plough can till, if either men or ox had been given an afternoon. There is even a local saying in Oyam putting this ratio between the hoe (*kweri*) and ox plough (*kweri dyang*, literally a hoe for a cow) at twenty-five.

In Oyam's flatter topography, it is unsurprising that more farmers have an ox plough and an ox with which to pull it (16.1% of sample in Oyam vs. 12.2% in Kapchorwa) and also unsurprising that more people in Oyam have ploughs who do not have draught animals – it is easy to hire a draft animal and the tilling or planting season is a bit more than a week long. As small plots can be ploughed in a single afternoon, the ox plough can be rented to several other farmers before the season ends – for a mechanised analogy, imagine a farming town in England where engines and tractors move about independently; some own tractors and borrow engines while others have engines and borrow tractors.

There are also more general wealth and class effects, even among the very poor, when it comes to anything having to do with cattle – including ox ploughs. Of course it is unsurprising when people with a draught animal purchase an ox plough or that people with an ox plough acquire a draught animal (0.22). But one might be surprised that the correlation between people who own cattle and people who own bicycles is quite strong (0.25). What explains this? This seems to be a general wealth and class trend. Wealthy people tend to own cattle, which are a status symbol, a store of value, and offer interim utility (in milk, muscle, and meat). A single healthy, young Ankole bull is worth about 140 U.S. dollars in Oyam as of 2012 (price in Kapchorwa unknown, but likely similar), making it one of the largest inflation-proof stores of value available in either region short of motor vehicles and real estate (both of which suffer from substantial liquidity disadvantages when compared with cattle).

The topography of Kapchorwa does not discourage ox plough or bicycle ownership to the degree one might anticipate from the literature or from field experience with the difficulty of the weather (particularly during the rainy season) and the terrain of Kapchorwa. This suggests that either bicycles are more useful in Kapchorwa than would normally be presumed or that some farming equipment – bicycles in particular – might serve another purpose.

In Kapchorwa as in Oyam, wealth and class effects obtain. In addition to other stores of value, wealthy people also tend to have bicycles – hence, ownership of valuable animals like cattle and goats is correlated with ownership of bicycles (correlations of 0.25 and 0.28 respectively), much as people in England who have healthy bank accounts are more likely to own jewellery or other signs of wealth. At the time of this research, a healthy cow of unremarkable pedigree was worth a bit more than one hundred U.S. dollars or sixty British pounds in the regions studied, making one cow about equal to a new ox

plough or bicycle in value. It is important to note that most farmers in the study did not have even a single cow and that many, despite having between one and two hectares of land, did not have pasture space upon which to graze animals larger than goats without risking trampling crops. In other words, a cow, bicycle, or ox plough would each have been aspirational items to own for the median farmer in either region.

For more evidence of a wealth effect contributing to bicycle ownership – rather than only a bicycle's contribution as equipment in an agricultural business – I look to other indicators of the wealth of bicycle owners. Perhaps Ugandans purchase bicycles even if they do not strictly need them, much as Americans purchase sport utility vehicles and pickup trucks for a one-person commute to work carrying only a briefcase. I began to examine proxy variables for the wealth of people who own bicycles.

In interviews with farmers, I consistently heard (and observed) that Ugandans invest the majority of excess revenues in home improvement. The Ugandan farmer's life is spent at home or near home, so investing in the quality of one's house is sensible. Examples of home improvements common among wealthier Ugandan farmers include the use of corrugated steel roofing material, the installation of flooring or a concrete partial slab (rather than dirt floors), the installation of windows, and electrification. Of these, the roof is generally considered the first or highest-priority improvement (thatching a traditional roof twice per year takes valuable human resources away from the farm in time and labour), followed by flooring and a door (most huts are initially built without doors, as any door that offers a legitimate degree of security for the occupants or their belongings will often cost as much as the entire construction budget of the hut). After the door is installed, some owners will install windows (though many wealthy men with many cows still live without windows), and electricity is seen as a final and lavish improvement.

After examining these variables, I chose to use the condition of the housing stock of bicycle owners as a proxy for their household wealth, since the latter is difficult to estimate for a variety of reasons. I compare bicycle purchasing to level of housing repairs. During the survey process, evaluations were made of the quality of the primary housing unit (main house structure) on each farm.

The classification[169] was as follows (low point totals correspond to better condition housing units):

Housing Unit	1 Point	2 Points	3 Points	4 Points
Electricity?	Yes	No		
Roof Material?	Good Condition	Fair Condition	Poor Condition	
Floor Material?	Good Condition	Fair Condition	Poor Condition	
Windows?	Good Condition	Fair Condition	Poor Condition	None
Main Door?	Good Condition	Poor Condition	No Door	

To get a simple estimate of a housing unit's quality, I simply summed the number of points from the above categories. Hence, the lower score corresponds to the higher quality housing unit. For example, a family with no electricity and fair condition roofing,

[169] This classificatory scheme is a gradient housing dimension approach loosely based upon, for instance, the multidimensional poverty index proposed in *Where Do the World's Multidimensionally Poor People Live?*. OPHI Working Paper No. 61. Oxford. and similar indices.

flooring, and windows with a poor condition main door would receive ten points total; a family with electricity and good condition roofing, flooring, windows, and main door would receive only five points in total.

This simple addition creates a quick proxy for at-home living conditions and, by extension, the household's financial resources, since all of these improvements must be purchased and cannot simply be manufactured on-site from naturally-occurring materials on the farm. This method also prevented my having to make nuanced judgements that would require local knowledge, like judging the quality of one farmer's roof thatching versus another's.

Each farmer I asked agreed that in 2007, prior to my time in Uganda, it became common to rent ox ploughs in Oyam but not in Kapchorwa. Initially, prices were very high. Due to the weak rule of law and resulting unenforceability of contracts between renters and those with ox ploughs for rent, the rents needed to take into account the cost to replevin or replace an ox plough after attempted (or successful) theft. Information costs (and information disparities) were high (common) because people often needed to rent ox ploughs from people with whom they had no prior or other business. This made it hard to value promises to return an ox plough on time, for instance. As Coase famously observed in 1960, "[w]hen parties know each other well, they suffer less information asymmetry about the value of each other's promises, so a conflict is less likely."[170]

Around late 2008 (during the second growing season according to several interviewees), several diesel Steyr tractors in Oyam that had been available for rent became inoperable. This likely included two of the four tractors, only one of which is in

[170] Coase. *The Theory of the Firm*. Manuscripts in Law and Economics. Chicago. 1998.

serviceable condition today (the second working tractor was cannibalised for parts in late 2008).

By the time I reached Oyam in 2010, the ox plough rental scheme had vanished, but had been replaced with people willing to plough for money (supplying a supervisor, an ox plough, and a draught animal). During the three seasons observed, prices for ox ploughing services were steady at between 1,250 UGX and 1,400 UGX per *katal*. As a *katal* is only roughly 200 square metres, this means hiring a ploughing service is a significant cost, at roughly 27,000 UGX per acre (20 *katal*) or over 66,000 UGX per hectare (50 *katal*), though substantially cheaper than the 90,000 UGX per acre it costs to rent a tractor and a tractor operator. The ox plough can normally only cover two acres in the intense heat of the early season per afternoon, due to the draft animal's fatigue, while a tractor can cover up to six acres in the same afternoon.

To put these costs in perspective, I asked a farmer in Oyam about the cost of ox ploughing and tractor services. His reply was:

"I have said [the cost is acceptable] because from first ploughing to harvest cost you 180,000 UGX. When I do maize on an acre provided no [unexpected weather events] occur that season I expect about 1,000-1,200 kgs of grain and that fetches […] 600,000-720,000 UGX."[171]

One can visualise four distinct levels of ploughing allocations. The first is to plough by hand with one's brothers and sisters and children. The second is to rent an ox plough. The third is to rent a tractor. The fourth, distinguishable from the other three, is to purchase an ox plough.

[171] Conversation about farming methods with Willy Okello, 28 October 2013.

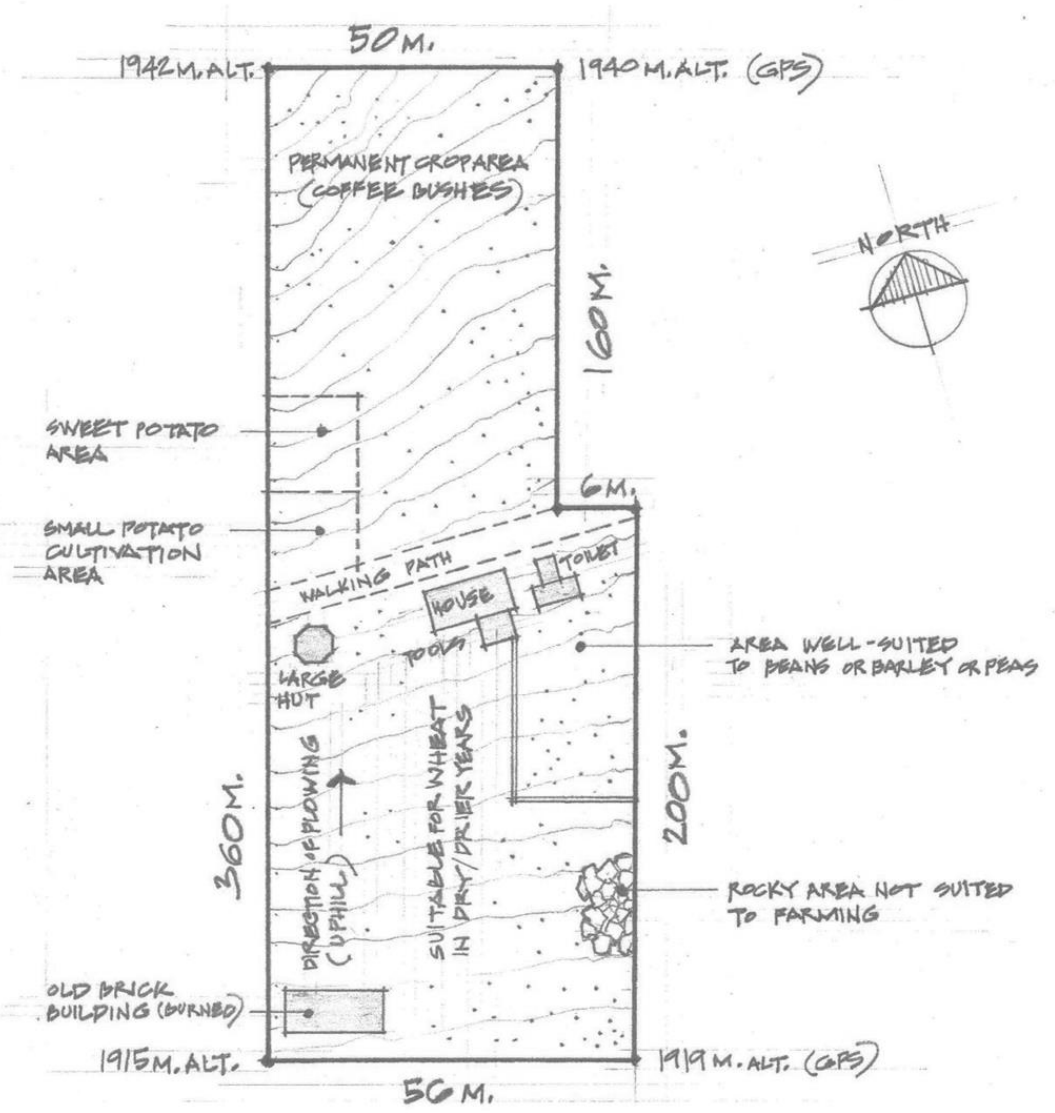
I see the penetration of ox plough purchasing one might expect, plus a slight increase I attribute to the wealth or status effects of having the equipment. A draft animal can only be worked two to three hours and cannot be worked in the morning and the afternoon. It is difficult to work an animal on subsequent days in the heat of Oyam, but more reasonable in the weather of Kapchorwa. As the ploughing time begins, it normally rains about a third of the days in both region. Ploughing must occur in a ten-day window and cannot occur on days when it is raining (but can occur on a day immediately after a rainy day).

As a result, it is unsurprising to see ox ploughs and draft animals owned by roughly one-eighth of the residents of Kapchorwa with slightly higher adoption rates in Oyam, suggesting that these implements are either in use by their owners or rented by their owners' neighbours on nearly every ploughing day of the year. Because the sample contains only small-plot farmers whose farms are surrounded by other small plots, it seems reasonable to assume that all plots in these areas can be ploughed in an afternoon. It is more surprising that a leasing business for ox ploughs has not emerged, but this likely results from 1) the high cost of the capital equipment itself, 2) the enormous local interest rates that would need to be built into capital leasing agreements,[172] and 3) difficulties in contract enforcement.[173]

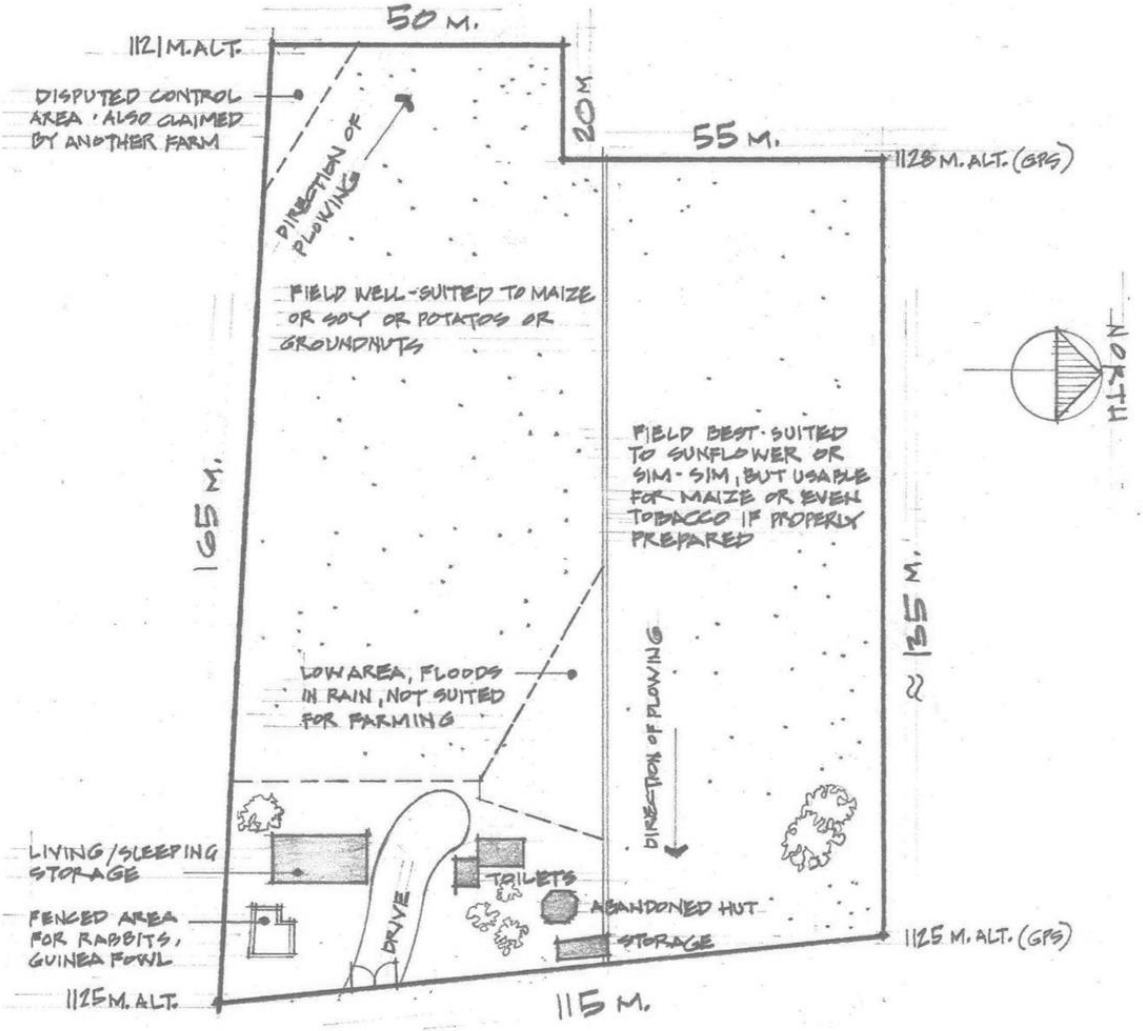
Additional satellite photography reviews of the area, along with the GPS data from farmers' self-surveys, confirm this. From this combination of GPS data, field measurements, and satellite photography, architectural plan drawings were produced of select, typical farms. Two of those farms appear here. One shows a typical Sebei farm, oriented primarily east-west with the lengthwise segment traversing up- and down-hill.

[172] At the time of this field research, capital equipment leasing agreements for items like diesel on-site generators were often computed using an effective interest rate of more than 19%.
[173] A weak local legal system and other Coasean problems create inefficiencies (and costs).

The other shows a typical Lango farm, oriented primarily east-west with the typical two (or, occasionally, three) distinct areas requiring ploughing. The farms illustrated appear in the AC_vFinal version of the stacked and cleaned dataset at horizontal entries designated ln. 241 and ln. 1746.



- ALSHA SHABAN FARM
KAPCHORWA, UGANDA
- 4.1 ACRES (1.65 HECTARES)



- WILLY OKELLO FARM
  OYAM, UGANDA
- 4 ACRES (1.6 HECTARES)

These plan drawings are generated from field notes, sketches, photographs, and satellite/GPS measurements, and satellite photographs taken in February and March of 2013.

In size, orientation, elevation, and arable portion Alsha Shaban's farm is typical of farms in Kapchorwa[174] and typical within the dataset. Hence the architectural drawing illustrates the locus of small-holder entrepreneurial (super-subsistence) agriculture in the region. Located in the (unfortunately-named) parish of Moron, the farm is considered a desirable plot in the region.

The farm is primarily oriented north-south and on a south-sloping hill, providing plenty of mid-day and afternoon light for wheat in dry years. Its slope is substantial, with its highest point at 1942 metres and its lowest point at 1915 metres with only 360 metres of running distance in between, meaning the grade is too steep for the trench-and-fill gravel irrigation traps that are increasingly popular in the region. This creates natural drainage dynamics for the upper (north-northeast) portion of the plot, however, where relatively new coffee plants have been installed.[175]

The small house is in the middle of the plot on a deteriorating concrete slab likely built for a prior structure that has long since been removed or washed away in flooding (or mudslides, which are common in the region). The house has no electricity and the household owns neither an ox plough nor a bicycle.

Though an ox plough could be afforded on the household's income, coffee trees are permanent crops and do not need ploughing twice per year. While a small south western rectangular area could be ploughed more quickly than it can be worked with

[174] *See* stacked and cleaned dataset at line 241.
[175] Drainage dynamics are important, as coffee plants have delicate roots that will stiffen and rot if water does not drain away from them.

the hoe, the area is small and the household's nine children and four to five adults can tend to the area's care, as evidenced by the six hoes, hand tools for weeding, and four buckets stored in the tool-shed that abuts the house's southern wall; the tool-shed also holds an assortment of jerry cans in various states of rust or disrepair along with four yellow NATO plastic Scepter-style jerry cans of more recent vintage. When there is no ploughing or weeding or coffee berry picking or other work in the fields to be done, the children are sent to gather water and perform other tasks in support of the household. It takes the household as a group two full days to till the land toward the southern end of the property and to turn over the beds in which potatoes and beans are customarily planted near the property's midsection.

Alsha suggests the bicycle would be useful in the dry season, as long distances are precarious to walk downhill with heavy sacks, but this is outweighed by the bicycle's substantial cost, its uselessness during the wet season, and the unavailability of spares in Moron at reasonable prices. The 300,000 UGX price of a bicycle at the two shops in Kapchorwa is intimidating, equal to the cost of sending six of the household's children to school for one term. When I inquire how large the investment would be, Alsha cites that the size of the house could be doubled by local builders for the same amount.

Like most in Kapchorwa, Alsha owns the land free and clear of loans, liens, and encumbrances, but does not have money to improve it or to expand onto neighbouring plots. In a very good year five or six years ago, Alsha attempted to purchase a contiguous plot to the north, but the farmer who owned it refused to sell. Alsha now estimates that plot, if added to the farm and planted with coffee, would double the farm's income.

Asked what task should be automated, Alsha's complaint is a common one: The plough may turn the land, but turning the land is not the most labour-intensive piece of the farming process. Rather, in the highlands of Kapchorwa, which sit in the shadow of Mt.

Elgon and stay damp longer than other farms elsewhere in Uganda, weeds are the primary problem. Weeding is the busiest time on the farm, with children as young as five trained to crawl through the still-damp dirt twice during each season to identify and remove weeds – at a young age, they weed the potato beds, eventually progressing to the southern rectangle of the property, which is approximately the width and roughly twice the size of a football pitch, meaning weeding is a task requiring both commitment and patience.

Alsha keeps livestock, including a cow, two goats, and half a dozen chickens of various types. If there were to be a disaster or time of hardship, Alsha would sell the livestock, eat less, and reduce expenditures. Total non-food, non-farming expenditures for the household are less than £20 per month and the family already subsists on near-minimum caloric amounts, particularly given their high degree of physical activity. Even if eating less were a good savings strategy, because most of the food consumed by Alsha's household is produced on the farm or obtained in barter for agricultural outputs, eating less is unlikely to save any significant amount of money. Therefore, selling the animals would be the primary coping mechanism, with the cow worth approximately £60, the two goats taken together worth half that, and the very best chickens worth £5 to £10 apiece. The livestock live in the southwest corner of the property near a burnt-out building of colonial vintage, with the exception of the chickens, which are allowed to roam near the toilet and sanitary vault but are prevented from roaming into the bed where beans are cultivated. My questions are difficult for Alsha to answer and she finally comments that, "If I had an ox plough or a bicycle, I would sell them. I need money more than either."

The other diagram is an architecture plan illustration of Willy Okello's farm.[176] In size, orientation, elevation, and arable portion it is a typical farm in Oyam and typical within the dataset and hence useful to illustrate the locus of small-holder entrepreneurial (super-subsistence) agriculture in the region.

In local terms, Willy is a wealthy farmer – he is in the top quintile of the sample in Oyam in terms of his income as reported to me. However, his farm is typical in size, shape, and usage, likely because much of the income others might spend to expand their farms (or to buy different farms) has been spent on school fees for his children and taking care of his ailing father who requires expensive medical care. Unlike Alsha, Willy sends all four of his children to an expensive school that costs 70,000 UGX per term. Soon, his eldest child, a daughter, will be old enough to attempt to attend a prestigious secondary in Kampala. If she is admitted, it will cost 180,000 UGX per term.

Willy's farm is almost identical in area to Alsha's farm but is flat and nearly square in its plot orientation. The exception is an area toward the eastern edge of the plot, which is depressed and acts as a small drainage pond several metres in width during the rainy season. Edges of the southern piece of the land have not been well looked-after and the soil has lost some of its quality, though Willy hopes to fix this. He recently reached an agreement with the neighbouring farm about the property line and erected a fence to cement the substance of the agreement, though a dispute remains as to a small area in the southwest of the plot. I ask who the people claiming the area are and he replies they are *lakwor*, or thieves.

Willy lives in a large formal colonial style house. It looks like the sort of house that might have electricity, if it weren't for the absence of power lines for miles in all directions. Willy explains that his father built the house with his cousin before the violence and that

[176] *See* stacked and cleaned dataset at line 1746.

many people have taken refuge in it during times of trouble. The house is situated north-south and the sun beats down on its roof making it inhospitably hot during the dry season, despite its many doors and windows. Its least-windowed side peeks cautiously to the east, confronting whoever passes through its gate and approaches up the drive. The compound is far more formal than Alsha's plot, built for security and to enforce claims over every pebble within its curtilage.

Willy owns a bicycle. He shows it to me and it is a Raleigh Deluxe II. It is black with a yellow stripe and the label that once read "Made in England" is still visible if one uses a keen eye and a liberal imagination. He is very proud of it and explains he paid 80,000 UGX for it, which was a fortune at the time years ago, but it has lasted, while his neighbours have had to buy three Chinese bicycles in the same period of time. He estimates he could sell it for 150,000 UGX today or more. I ask whether he would be willing to entertain an offer at that price today and he demurs. He looks at the bicycle and says, "It is worth more to me than the money."

Willy's flat farm with two clear rectangles makes it ideal for ploughing. But it is slightly too big for an ox plough to be the appropriate tool. I ask about ox ploughing and he says he has no cattle, so he cannot simply rent an ox plough, he must also rent the oxen. By the time he rents men, the ox plough, and the draught animals, they arrive only to have the oxen tire by mid-afternoon with the job only three-quarters complete. Now he pays slightly more than he would for the two days of ox ploughing for two hours of time with a modern (modern by Ugandan standards, I estimate this tractor was built in the early 1970's) red Massey Ferguson diesel tractor that I've noticed in town, a MkII 2400 Series with an old Perkins diesel that optimistically manages fifteen horsepower in the persistent heat of the tilling weather, but even this is superior to a tired ox.

Willy's children wake early in the morning, sometimes at four, and begin the walk for water before dawn. Once they return, they run (often literally) to school. Neighbour children, whose parents cannot afford to send them to school, do work on Willy's farm, especially during the weeding periods.

Willy is beginning to harvest in higher quantities, due in part to genetically-improved crops and in part to better agricultural practices. This presents a problem, however. He has considered purchasing a second bicycle, but cannot find one of comparable quality. The Raleigh can reliably move two bags at harvest of forty kilos each with a man walking alongside. With the increased harvests, Willy cannot move all of his produce to market. He has been hiring a local pickup truck, an eggshell white Toyota Hilux 22RE owned by his wife's cousin, but this is expensive and cuts into his profits on the additional bags. Sometimes, Willy notes, "once I hire the truck I lose an entire bag in profits." Asked what he would do with additional money, he says he would not buy a pickup truck, but would prepare to send another child to a better school in Kampala.

Alsha's and Willy's situations are examples of the fundamental problems in their regions: the ox plough is an enormously helpful device, but it alone does not solve all allocation issues and, even if it did, the need for turning the land is not the entirety of the demand dynamic for labour (as other labour-intensive land stewardship tasks exist that are not as easily mechanised, such as weeding).

Asked what Willy's priorities are, he quickly answers: To show that I am a good farmer, to make money, and to show everyone that I am rich. I ask him how he shows people he is rich and he points to his Raleigh bicycle, smiling, "There is no sign of wealth greater than a bicycle that is not in use," alluding to the fact that only the wealthiest farmers can afford to have capital equipment sitting idle.

This is a good point at which to pause and consider one interesting "non-finding" within the dataset. As part of the research design, farms were excluded from the dataset if, in the course of the study, at either a formal survey visit or a periodic "audit visit," the farm suddenly fell outside the range of acceptable values on any given characteristic. During the study, six of the entrepreneurs being studied died and one disappeared (the farmer being present for further interviews thereby being a violated constraint). Also, some farms went beyond the income limits laid out for the study, either returning to subsistence farming (thereby abandoning entrepreneurial farming focused on profitability) or exceeding the income ceiling (often by shifting to subsidised crops, particularly tobacco subsidised by the British American Tobacco Co.). However, one breach of the specified sample characteristics never occurred during the study: no farm became too large to be included in the sample. Each time farmers were interviewed, or each time I or a Community Knowledge Worker from the Gates Foundation would visit, the farmer would be asked a series of questions. Sometimes similar questions were posed via mobile phone. This included changes in livestock inventory, changes in family composition, and items like home improvements and major purchases. It also included a boundary update – "have the boundaries or sizes of the plots that make up your farm changed at all and, if so, how?"

Remarkably, not a single farm – out of a sample of three thousand – increased in size during the nearly two years I resided in Uganda. Not only did farms not increase in size enough to be too large to fit the sample's criteria, farms did not increase in size at all. Even the farms of the entrepreneurs who died did not change in size, with the exception of one, which was split roughly equally with a cord running between two mango trees, a demarcation to be later replaced with a fence to illustrate it had been divided between two sons. This lack of growth in farm size is attributable in large part to the Northern Ugandan real estate market which is characterised by a low transaction volume with a

bipolar distribution by size (rarely do plots of more than 0.25ha but less than 5ha change hands). This resembles pre-reformation Europe in historical observations made by Berman and other work on land tenure, cultivation, and transactions in environments with weak legal structures.[177]

In exploring labour and capital trade-offs on small farms, it is worthwhile to consider why such an overwhelming number of commercial-yet-small farms exists in the first place. The reasons for the lack of farm size changes (particularly increases) despite seemingly obvious reasons for farms to grow through acquisitions and strategic industrial aggregations is more complex than land law or level of agricultural technology adoption, though both of these are factors.

The landscape of Northern Uganda was in the process of an agricultural mergers-and-acquisitions revolution in the late 1960's, with investors (primarily of sub continental Asian, and particularly Indian, descent) buying parcels that could be aggregated into farms of roughly seven to ten hectares (this is the typical size of a coffee plantation in northern Kenya and, not coincidentally, the size of many plantation-style farms in Southern India). The rise of Idi Amin set in motion the exile of these Asian investors and the voiding of their land titles, leading to a re-parcelling of many areas of Uganda (including the areas studied here). During the so-called post-purge in April of 1972, about 5,700 Acholi and Lango men[178] disappeared from the area around Oyam (one of the areas studied here) and Southern Ugandan troops were told to take down fence-lines, destroy markers at the corners of land tenure areas, and destroy paper land records, creating chaos in the northern region. In the vacuum that followed, land was

[177] H. Berman. Law and Revolution, vol. II. Harvard University. 1986.
[178] This statistic is recited by local people as fact, and is consistent between local residents, but is impossible to empirically verify.

slowly re-partitioned, some of it according to the memories of local community leaders and some of it by informal auctions held in market squares.

This repartitioning favoured plots of approximately 1.4 hectares and plots were generally distributed in ways that exacerbated regional monoethnic land allocations that had been the norm under British colonial rule. Land reforms of 1977 – the year in which Amin declared himself Conqueror of the British Empire and voided the diplomatic credentials of the few remaining British diplomats in Kampala – included separate provisions in the north of the country that not only voided extant titles belonging to Asian landholders, but created penalties for selling land to whites and made all titles transferred to whites void *ab initio* (these titles had previously been voidable, but not void). The land that had been transferred between April of 1972 and June of 1977 was left in the hands of local leaders (so-called LC1 and LC2 officials in villages) to use their own methods of recordation. This led to some titles being recorded by oral ritual, others by written deed, and still others by the old British registry and counter-registry system (which, while far more reliable, required higher levels of diligence and literacy).

Following the violence of the Lord's Resistance Army insurgency in the north, many of the oral history chains required to reconstruct chain of title were broken. As a result, there are substantial questions as to the validity of title for many plots in Northern Uganda. In addition to these problems, there are concurrent chains of title that run in parallel. Parallel chains of title in Commonwealth jurisdictions are normally resolved through the registration of conveyancing (in which earlier registrations follow the rule of primacy) for *inter vivos* or arms-length transfers and through the guidelines of The Land Transfer Act of 1875 in the case of real property passed by bequest. This is not, however, possible in Northern Uganda, as various, conflicting options exist for both the delivery and recordation of real property.

As a result, though returns to scale are likely substantial (as can be seen in the Indian context and, more locally, the Kenyan context,), the legal difficulties in closing transactions, transferring title, and finding outside investment (or mortgage capital) make these mergers and acquisitions rare. Because returns to scale are geographically-specific, acquisition of a second plot is not particularly desirable unless the second plot is contiguous with, or at least local to, the first plot (as costs like ploughing are difficult to amortise over distant plots). This leads to pairing dynamics, with price premia assigned to near plots and little marginal utility associated with remote plots. As a result, an entrepreneur in a given plot is likely to only be interested in purchasing plots in extremely close proximity to his first plot.

The stability of farm size in the other direction illustrates this issue. In the dataset, several farms were partitioned between brothers during the study. It was the norm for one brother – usually the one more skilled at farming or equipped with fewer skills useful in town (like literacy or knowledge of merchant life) – would buy out the other brother's interest, in essence defeating the partition of the farmland. In this sense, the partition vanished before it occurred, *ab initio*, as the first brother would essentially exercise an option to defeat the partition. While purchasing the other half of the plot from his brother to maintain its size is sensible preservation of farm size, further increases in scale would require a similar transaction of coincidence on a neighbouring property (e.g. an owner of an adjacent plot happening to die contemporaneously, with heirs willing to sell, with a neighbour equipped to be a cash buyer).

Due in large part to these accidents of history during Amin's rule, poor and heterogeneous recording of conveyances, the weakening of the Ugandan judicial system, and the scarcity of capital, land transactions generally remain rare. Those transactions that do occur are primarily motivated by preservation efforts to reverse

partition among siblings or unusual opportunistic transactions involving nearby or adjoining lands. The velocity of transactions remains low; transaction size remains low; and the general liquidity of the real property market remains low. It is in this context that entrepreneurs in the agricultural sector make their labour and capital allocations, knowing their farm size will likely be fixed for the duration of the enterprise.

As I expected from early field notes in 2010 and early 2011, more farmers opt to own the "complete system" (owning a draught animal and an ox plough) in Oyam than in the more mountainous Kapchorwa. This is likely in part due to topography and in part due to the mudslides, coffee plantations, and other unique features of Kapchorwa creating labour demands that cannot be met by an ox and an ox plough (repairing a drainage ditch or pruning coffee trees must be done by people, not oxen).

Somewhat counterintuitively,[179] ox plough ownership and household size are positively correlated.[180] In other words, ox plough ownership does not come at the expense of additional members of the household, but rather alongside additional members. This is likely driven by a series of factors, including that ploughing using draught animals frees up the people to perform other tasks, like weeding beds or gathering water or improving buildings. Hence, in both environments (mountainous and flat), it might be argued that the plough and ox have an amplification effect, making human capital more useful.

One of the things farmers are doing with substantial frequency is operating a shop in town. This shop might sell their produce or might sell something else that is bought on the wholesale market, like mobile phone airtime cards or liquor. It seemed as though farmers who specialized on farming would focus their capital investments on farm

[179] Note that, while wealth is not an included variable, wealth is assumed to be relatively uniform across this sample.
[180] These are significant correlations, at 0.222 overall, with a correlation of 0.212 in Kapchorwa and 0.222 in Oyam.

equipment like ox ploughs while farmers who needed to divide their resources between the farm and the shop in town would be less likely to acquire “optional” farming capital goods like ox ploughs.

This held true in Kapchorwa, where ox ploughs are less useful (due to the terrain) and clearly a luxury item rather than a necessity for biannual plantings. In Kapchorwa, 20% of farmers who derived most of their income from farming owned an ox plough. On the other hand, only 9% of those with substantial other (non-farming, non-agriculture-related) sources of income owned an ox plough. It would be interesting to know how many who owned ox ploughs rented them to neighbouring farmers and included this indirect profit from nearby farming activities in their self-reported “most of my income comes from farming” determination. I was only able to follow up with a statistically-insignificant handful of farmers, but most farmers with whom I spoke who owned ox ploughs did rent the ox plough at least once per planting season to a neighbour – though this is better-classified as anecdotal evidence than representative sampling.

Because most of the shops in town are run by adult family members who are both proprietors and shopkeepers, and because transport on *boda-bodas* and buses is expensive, I theorised that farmers who also kept a shop in town would be more likely to have a bicycle for the commute to check on the shop, but this was not true. In Kapchorwa, where shop keeping is more common and where statistically-significant correlations are found across the regional sample and within random sub-samples, 9.4% of farmers who had mostly farming income owned a bicycle versus only 5.6% of those with other (in-town shops, etc.) sources of income. This suggests that shopkeepers either are using other forms of transport to reach the shops or allocating resources toward things like shop inventory and retail rent rather than commuter transport; linkages between economic progress in agricultural communities and investments in

other sectors like retail are not unique to the Ugandan context, *see*, *e.g.*, Haggblade & Hazell [1989]. Part of this may be explained by regional "car-pooling" which had begun to take hold around this time, which allows people from a community to commute to town by automobile while sharing petrol costs (a means of transport more weather-independent than either *boda-boda* or bicycle).

With these relationships established, I then returned to the possibility that a bicycle is both a status symbol (like an automobile in Western Europe, China, and America) and a source of transport utility. To examine this further, I compare the condition of the farmer's home to bicycle ownership. The condition of homes was observed in each case, in person, by Community Knowledge Workers from the Gates Foundation who were familiar with housing stock in the region using the scoring sheet shown here, *supra*. Note that due to the point system, "negative" correlations are "positive in this context" (*i.e.* a low score means a house of high quality).

The correlation between quality of housing – normally the first thing a family will invest excess income in both in Oyam and Kapchorwa – and bicycle ownership is statistically-significant across the sample[181] and regionally. In other words, as farmers acquire liquid wealth and use it to improve the quality of their homes they also purchase bicycles. It is worth noting that it is very difficult in either region to barter for bicycles (unlike home repairs, which can often be purchased in exchange for crops or chickens or goats), so only farmers with access to ready capital will be able to obtain bicycles. It is also worth noting that ageing parents in both regions often fail to maintain the housing compound (there is even a phrase for this in Lango, "*pio gang*," literally "the first house" but meaning colloquially the older generation's home which is decaying or damaged), so the

[181] Correlation is 0.212 across the interregional sample.

young farmer's initial home improvements may be repairs meant to check the house's decay or return the house to the state it was in during his or her childhood.

There are factors specific to the Northern Ugandan geography that skew the labour-capital substitution calculation. These contextual factors, which are geographically- and ethnographically-unique, drive the labour and capital substitution decisions seen in the observed Northern Ugandan sample.

The degree of substitution toward capital is *higher than might be expected of econs*, in a sample of this type. The frequency with which some pieces of capital equipment sit idle is an indicator of the overadoption of capital. Some other simple pieces of arithmetic also point toward a superoptimal skew toward capital, for instance, where D is the number of useful days for the implement and F is the number of farms (including the owner's farm) to which that implement could be made ready in an hour's time and T is the amount of time it takes to plough the average farm within the distance driving F, one would expect (D x 10) / (F x T) to be roughly equal to the number of ox ploughs in a given area, but the number of ox ploughs (through an empirical census and through self-reporting) seems to exceed this substantially. I theorise the reason for this oversubstitution toward capital is that capital equipment represents a rare, relatively inflation-protected store of value and that some social status is achieved by owning (and, perhaps, underutilising) expensive items like ox ploughs and bicycles. Still, the size of this effect is small and only influences the overadoption of capital slightly in ox ploughs and slightly more substantially in bicycles (it was more difficult to gauge the degree to which bicycles are in use or idle, but many readily admitted purchasing bicycles both as a piece of farm equipment and as a status symbol – in the words of one farmer I interviewed, "*ento pe mero wot*.").

ento pe mero wot	Literally: However, I would not rather walk. Translated: Given the choice, who would rather walk than be seen on a bicycle?

Unlike labour, the ox plough is limited in its utility, in that it cannot weed or perform other tasks[182] that contribute to the labour requirements of a non-mechanised farming operation. Second, the ox plough is so expensive that it often must be rented to others and cannot through its own productivity on one farm alone, justify its purchase price. Finally, and perhaps most interestingly, children are not ready or perfect substitutes for the ox plough, as they can only do the heavy labour of turning the land for half a dozen years between their childhoods and their marriageable ages. This last observation leads to the question in the final paper: family planning strategies are popular in Northern Uganda, but how well do these strategies maximise farm output?

In sum, the adoption of ox ploughs, in particular, is slightly higher than would be expected of econs. The adoption of bicycles is also slightly higher than one might expect.[183] However, this slight surplus of each is likely attributable to the use of each as a status symbol, the variety of utility a person may extract from a bicycle (harvest time transport, transport to town, local prestige, an investment with low risk of depreciation,

[182] This limitation of capital application is, obviously, not unique to Uganda.

[183] Both of these effects are small. In the case of ox ploughs, two more ox ploughs than one might expect would be "optimal" might reside in a community of fifty farms and five or so more bicycles than one might expect might be found in the same area. However, sharing bicycles is more common than sharing ox ploughs, bicycles are seen as an investment, bicycles are a prestige item and a stylish way to travel to town, and bicycles are less predictable in their use pattern (so it is harder to predict or schedule when a neighbour's bicycle might be available to rent or borrow). These factors mostly, and taken together likely nearly completely, explain the surplus of these items relative to an econ's ideal levels. When one adds the sentiment that idle equipment is a way of showcasing wealth or passively bragging, this seems to explain much of the balance of the variance observed.

etc.) likely explaining its slight advantage in adoption relative to the ox plough. There may also be unseen collective cartel or collective plenary effects, such as a community having within it a few extra ox ploughs in case a few are inoperable or unavailable at the height of the tilling season. Taking into account these factors, I conclude the adoption of ox ploughs and bicycles as capital equipment on the farms studied is relatively predictable and near-profit-maximising, even if the equipment occasionally sits idle. In short, the adoption of capital equipment on farms is more econ-like than human-like in its overall profile.

Contra, The Third Instance: Labour & Human Resources Decisions

> "The rational choice approach can only explain what people do. It can explain why people might institute a norm and might then enforce it, but it cannot explain why they should change their values[]" between seemingly adjacent domains.[184]

In the prior two domains, the logistic decisions and the capital equipment procurement decisions made by Northern Ugandan entrepreneurs, the entrepreneurs act essentially like econs – though acting on imperfect estimates and sometimes imperfect contemporary information, the actors attempt to behave in profit-maximizing ways. They do not rent more truck capacity than is needed or unreasonably overpopulate areas with ox ploughs. However, though farmers appear to display deliberative, surprisingly-accurate System 2 thinking in the context of their supply chain planning and capital spending decisions, farmers seem to do precisely the opposite in the case of their labour and human resources decisions. This third section describes the decisions made around labour supply on farms in Oyam and Kapchorwa. Unlike in much of the industrialised world, labour on these farms is drawn primarily from family members and,

[184] A. Heath. Rational Choice and Social Exchange. Cambridge: Cambridge University Press. 1976.

particularly, from the farmer's children. As a result, the production of children (driven by the virility of the entrepreneur and the contraception decisions – which are often business decisions – made on the farm) is the primary determinant of the labour supply. I find the production of children is substantially superoptimal on most farms, far above what one might expect from an econ farmer.[185] This contradicts the econ-conforming decision-making noted in the prior two sections.

Prior to discussing the production of children on Ugandan farms, one must first examine the availability of birth control methods and eliminate the scarcity of contraception options as a cause of Uganda's high birth rate. The World Bank's study of contraception availability[186] in Langi areas (and Lango-speaking areas, the study is not entirely clear in its geographic scope) includes a variety of contraception and family planning options, but concludes that a plethora of no-cost options (provided or facilitated by NGOs) is available, from condoms to oral contraception to barrier-based birth control of various types to contrafertility procedures for women. Vasectomies and intra-uterine devices are not commonly available, but this is largely due to the lack of local surgical staffing, the lack of surgical theatres wherein vasectomy procedures might take place, and the lack of confidence in gynaecological follow-up visits required or recommended by intra-uterine device manufacturers. Women's health services availability and quality of care continues to improve, particularly around the issues of family planning, reproduction, and childbirth.[187]

[185] On the concept of these expectations and how they might be fluid rather than fixed, *see* J.W. Payne et al. The Adaptive Decision[-]Maker. Cambridge. 1993. *See also generally* S. Plous. The Psychology of Judgment and Decision[-]Making. McGraw-Hill. 1993.

[186] Connor et al. *Availability of Family Planning Options in Northern Uganda and South Sudan*. The World Bank. 2011.

[187] *The Uganda Reproduction Health Voucher Project*. Press Release and Attached Documents. The World Bank. 2014 (introducing a programme through which women are given vouchers that can be used for a variety of women's health, reproductive services, and birthing costs).

Since the advent of contraceptive pharmaceuticals in the 1960's (which were quickly deployed in Bangladesh and elsewhere as part of aid-agency-funded population control initiatives) there has been a keen interest in family planning activities, incentives, and behaviours in the developing world, initially in peasant studies and today in development studies and development economics. This section examines the family planning decisions of farmers in Northern Uganda from economic and ethnolinguistic perspectives using a new, unique dataset and a mixed-methods approach, applying quantitative measures (e.g., birth rate) and viewing these data through an industry-specific lens (e.g., observing the productivity and contribution of workers of different ages) as well as a culturally-specific one. This is a mixed-methods approach focused on clarifying and properly interpreting survey data gathered specifically to address questions of human capital in this agricultural industry context.

In discussing my findings, first, I examine a new dataset of roughly 3,000 households and consider only the production of children by these households.[188] I then look at the labour-intensiveness (or non-intensiveness) of various crops and the production of children, as well as comparing the production of children to other factors, such as the wealth of the family, the diversity (or concentration) of income sources for the household, and the family's perceived risk of future problems or disasters. I explore why households have economic incentives to continue producing children after the first child.

Second, I examine the cultural context of the two regions studied, but particularly in Oyam, and suggest that other factors not visible in these data may contribute to

[188] These questions were isolated at the time of collection to avoid pitfalls surrounding the perceived interrelatedness of survey questions. Though demographic data, such as children per household, were available from other sources and could have been subjected to secondary analysis, I thought it better to survey each household and collect fresh data simultaneously, as much of the data in extant sets was pre-2009 and hence already stale. This avoided some of the issues of mismatch in secondary analysis and allowed perfect matching between individual households in the final dataset.

differences in the production of children and family planning strategies. I also look to the question of the desirability of children for non-labour purposes (for instance, for prestige or to demonstrate virility or to create a future carer or source of remittances). Finally, I examine the linguistic context for children specific to the Acholi-Lango region near Oyam (roughly half of the sample) where I have some measure of linguistic expertise.

The complexity of evaluatinfirm labour on small farms is generally underestimated, in part because family planning as labour supply is rarely segregated from broader discussions of fertility rates and public health. While there has been discussion of human fertility and human capital in this tandem context at least since Becker and Murphy's paper[189] on the topic, the discussion normally focuses on education and child development in the academic context (i.e. the preparation of children to become workers) rather than the creation of children to satisfy firm labour demand, which is the thrust of my examination here. The complexity of firm labour needs – and specifically labour demand from a specific firm, cyclically and absolutely – is poorly described purely as a qualitative or quantitative exercise, and hence is well-suited to a mixed-methods analytical approach. The constraints on labour supply in Northern Uganda are substantial – biologically and practically – and worthy of exploration as they require the entrepreneur to plan fundamental aspects of workforce size a decade or more in advance.

The question of family planning at the business strategy level leads to an examination of both strategy (whether child-bearing maximisation is actually a solution to the problems of understaffed small businesses in Northern Uganda) and the *status quo* (the current situation and whether it is suboptimal from an econ's perspective). This section explores optimal and observed family planning patterns as a labour supply for the small agricultural

[189] G. S. Becker et al. *Human Capital...* Human Capital: A Theoretical and Empirical Analysis… (3rd Edition) at pp. 323-50. NBER & The University of Chicago Press. 1994.

firm. In addition, the paper provides an analysis of the underlying business decision-making and the challenges posed by the iterative nature of those decisions. I conclude that children are vastly overproduced, with the number of children far exceeding both the optimal levels for workforce replenishment and the levels seen in economies that are similarly agrarian, similarly developed, and similarly mechanised.[190]

The research design focused on examining data from farmers on childbearing and cross-referencing this data with other data on the same farmers' landholdings, crop choices, and capital assets. The goal of this research is to isolate and examine the production of children relative to the "ideal" or "optimal" production level for children in terms of agricultural productivity and prosperity. Further, the goal is to examine farms that perform particularly well from each of the two regions studied and to examine optimisations that may be dependent upon a particular family planning methodology.

The sample, while homogeneous on the dimensions alluded to *supra* and some others, is not homogeneous in its geography. It is divided between two regions, as in the two earlier sections: part of the sample represents Oyam, a Langi village situated on an ancient floodplain slightly north of the Kamdini, while the other part of the sample represents Kapchorwa, a Sebei village in the mountain foothills of Mt. Elgon National Park and not far from the Kenyan border. The substantial differences in the climate, topography, and crops of the two regions are useful in examining the child production (and hence labour) optimisation behaviours of owner-managers in these agricultural firms and in ensuring the observed behaviour is not isolated to one village or tribe.

Each of the individuals studied is a supersubsistence producer running a family-owned business. The human resources and labour allocation decisions made by the chief executive of a business are among the most important decisions, especially in labour-

[190] *A Report on Child Labour in Farming and Mining*. The World Bank. 2013.

intensive industries like low-technology agriculture. While recognising that cultural skews may exist, entrepreneurial agribusiness in the developing world is generally thought to be profit-maximising and decision-making is evaluated primarily in that light, the fundamental hypothesis being the econ nature (rather than human nature) of the decision-making patterns; it turns out, however, that decision-making in this domain is more human than econ. This section attempts to explore and explain why.

Traditionally, in the literature, there is a suggestion that African men are maximizing child production for reasons of pride or an obsession with demonstrating virility.[191] There are no doubt cases (in Uganda and in the United Kingdom and elsewhere) where men oppose birth control or dislike condoms or interfere with their wives' attempts to limit pregnancy risk.[192] If it were true that Ugandan men only desired to maximise production of children, the child production rate and total number would be far closer to the biological maximum. Instead, children are thoughtfully (not randomly) spaced at a consistent and predictable rate following the birth of the first child. This observation, combined with information gathered in interviews, suggests to me family planning is being used to create a specific pattern of child production, rather than a maximum birth rate.

Suppose one looks at the decision to have an additional child as a discrete choice within an iterative framework.[193] Suppose further that a person or couple, faced with the family-planning question of whether to produce children, faces a situation where transitivity of

[191] *See*, *e.g.*, S. W. Baker. The Albert N'yanza: Great Basin of the Nile and explorations of the Nile Sources. Macmillan Publishers of London. 1866. *See also* S. F. Nadel. *Witchcraft in Four African Societies*. American Anthropologist, Vol. 54, No. 1. 1952.

[192] For an interesting recent paper on this, *see* Ashraf, Field & Lee, *A Working Paper: Field Experiment Regarding Birth Control and Couples in Zambia*. Department of Economics, Harvard University. 2014. In this paper, a control group merely receives information while two experimental groups receive both vouchers and plans for long-term birth control medication of female partners. In one experimental group, the vouchers are handed to the woman, while in the other group, the vouchers are handed to the men. A disparate adoption rate for birth control is observed, with fewer of the vouchers handed to men eventually used (preliminary results, working paper under review, paper not yet published).

[193] Throughout this example the variable C represents number of children produced.

preferences is interrupted by the fact that there are intervening cycles of strict preferences: a farmer knows he or she will need help on the farm, for instance, which requires that we set the number of children, C, at some future time to $C > 0$.

Suppose, however, that there are strict preferences seemingly in conflict with one another. Suppose that for every C you prefer to have (C + 1) children to C for every $C \geq 0$, but also would strictly prefer to produce 0 children to 12. This concept of self-discipline problems is not new, but illustrates the problem of short-run payoffs versus strict long-term limits. Because the production of children is iterative, a sequence of irreversible production decisions often leads to an outcome that violates the latter (ceiling) constraint. Much has been written on violations of transitivity in iterative decision-making, none of which I modify or advance here. However, this concept is important to raise as it is relevant to the iterative decision-making of farmers who often end up producing more children than they originally intended (or than would be optimal).

I find farmers tend to overproduce children relative to the economically-optimal quantity C for nearly all sizes of farm studied; many farmers complain their teenaged children do not work as hard as they once did (though the supposedly-underperforming teenaged children often noted in interviews that on a small farm there is only so much work to be done). I attribute this overproduction of offspring primarily to two fundamental estimation errors and secondarily to an overestimation of the longevity of the farmer studied or the intergenerational continuity of the business enterprise. The estimation errors, explained in detail, *infra*, are an overestimation of infant mortality rates[194] and an overestimation of the amount of labour the firm requires for successful operations. The longevity or intergenerational error is an optimistic estimation of either the farmer's

[194] According to the World Bank's data, the infant mortality rate in Uganda fell from 54 infant deaths per 1,000 births in 2009 to 45 infant deaths per 1,000 births in 2012.

longevity (the length of time the farmer will stay alive and need children as labour for the business) or the level of cooperation between children as agents (the assumption that children will cooperate and continue to maintain the farming enterprise, despite conspicuous intraregional precedent to the contrary).

Like the vast majority of agrarian cultures around the world, the Lango and Sebei are generally risk-averse.[195] Children are seen as a hedge against problems that may be solved with manpower (like unexpectedly large harvests, in the positive, or failing irrigation, in the negative). The Lango and Sebei share a cultural narrative in which individualism is generally frowned-upon or seen as counterproductive, where individuals contribute what they can to the community and then die. In Lango, the phrase "*winyo ma li malo, dugu too ping*," meaning "even the high-flying bird will die on the ground," is known by anyone old enough to carry water.[196] The phrase is often invoked in explanations of why farmers do not think it is worth paying to educate their children even to a basic standard.[197]

In my surveys and interviews with parents, parents tended to vastly overestimate the rate of child mortality – particularly infant mortality – regionally and nationally, often tossing out statistics that had not been in the right order of magnitude for decades, if ever. Also vastly overestimated in interviews and group discussions[198] were the number of man-hours per acre it took to achieve almost any task,[199] from weeding to harvesting.[200] The

[195] Econs, by definition, are risk-averse but perfectly price risk and will take risks for which they are fairly compensated (fairly here not in the philosophical sense, but in the actuarial sense.
[196] An equivalent phrase combining the inevitability of death with the meaninglessness of *inter vivos* achievement, meaning literally "the vultures will eat even the smartest rodent," exists in Sebei.
[197] This suggests a production function similar to that envisioned by [Kutty 2008].
[198] Every two to three weeks, I would attend a group meeting of farmers to discuss their businesses, generally on a market day. These meetings gave me an opportunity to conduct one-on-one and group interviews and to understand challenges facing these small businesses throughout the growing season.
[199] I compared these estimates to my own observations on farms in each region; differences between crops were significant but differences inter-regionally were negligible.
[200] This is based on my own observations and measurements in addition to reference tables provided by Nadler [1949] and various local sources.

effect of these mis-estimations is reinforcing, in that it encourages a higher rate of reproduction than is probably necessary to maintain farm operations.

Year	1980	1984	1989	1994	1999	2004	2009	2013
Mortality/1,000 births	126	115	108	100	92	73	54	45

This table is based upon World Bank data on infant mortality rates in Uganda nationally from 1980 to present, illustrating the vast change in infant probability of survival during the past generation. As the World Bank numbers are computed nationally as an average, they likely both understate the degree to which infant mortality was a problem in the north and understate the degree of progress in northern infant mortality rates. In other words, though these data illustrate the dramatic fall from more than a 12% chance of one's child dying in infancy to a less than 5% chance within one generation, the difference may actually be even greater in northern areas that had essentially no access to modern healthcare in 1980 and enjoy far-improved access today. Neither the World Bank nor MSF nor UNDP or UNHCR keeps region-specific infant mortality data within Uganda. Parental estimates of infant mortality rates were, however, very close to the 1980 levels, in my experience – in other words, parents were attributing the infant mortality rate for their own generation to their child's generation, without accounting for better birthing practices and superior access to prenatal and maternal medical care. I suggest this overestimation of infant mortality contributes to the overproduction of children.[201]

Interestingly, parents also overestimate the distances (both as numbers of miles and as typical travel times) involved to major water sources, major markets, and nearby towns. I

[201] *See generally* W. Samuelson & R. J. Zeckhauser. *Status Quo Bias in Decision*[-]*Making*. Journal of Risk and Uncertainty, vol. 1, pp. 7-59. 1988.

do not believe, however, that this particular estimation error leads to the overproduction of children (even though the children do tend to take on the burden of transporting water, goods, and other items to and from these locations), as the correlation of distance-to-market to number of children produced is very low (and actually slightly negative in Oyam). To check this, I took the number of milliseconds (ping speed) recorded on cell phone transmissions[202] in the study from various places to the centre of town (the centre of town here determined as the cellular tower in the centre of each town). The answer to the question "do farmers with more children tend to be in more rural areas?" appears to be no, with very low correlations in the whole dataset and in Kapchorwa, and Oyam, separately. This is not conclusive, however, for several reasons. Setting aside the "near town" versus "far from town" variable, I further examined other cultural factors that might influence the production rate of children among Northern Ugandan entrepreneurs, including apathy toward education and attitudes toward marriage.

Due to a general apathy and suspicion surrounding the economic value of educating children, the 50,000UGX per term per child (typical in both regions) for formal education is rarely an expense included in the farm's budget. In one interview in Oyam, a farmer remarked to me that, "Even if my child is the best in the school and he becomes a doctor, how will that make [our family] any money? Uganda is overrun with white doctors educated at [places like] Harvard and willing to work for nothing. How would my educated doctor daughter make a living? She would need to return to farming, [agriculture] is the

[202] Ping speeds are reported alongside GPS data on most mobile phone networks, including MTN's network in Uganda, as many phones (including the Google IDEOS phones used in this study) check GPS data against mobile phone network geolocation. Measuring variation in ping speeds is a quick way to confirm the accuracy of the distance-to-tower calculations cellular geolocation systems depend upon. Ping test speeds on the MTN network are "discounted" and shown as a premium to the minimum technologically-possible ping speed at 80kb/s. This ping speed information shows up in the dataset as a suffix to the latitude and longitude estimate data. It is embedded in the string that appears in Column I of the stacked and cleaned dataset Excel sheet.

only thing Ugandans are allowed to do for money because the whites and the Chinese won't do it."[203] In a climate where these sentiments are widely held (albeit not frequently articulated), it is unlikely children will be educated to a high enough standard to have professional jobs in the city (in this case, Kampala) or elsewhere in the region. As a result, I assume nearly every child who lives to the age of five is labour for the agriculture entrepreneur parent.

Marriage and childbearing at the second generation[204] are also factors in agricultural business decision-making. Because young women typically leave the farm in order to reside in their husbands' families' compounds and because men typically begin courtship by the age of nineteen,[205] there is only a ten-year window during which children can be fully active on the farm. After this ten-year window, women are fertile and marriageable and bachelors generally find their own farms or move to towns. There are enormous social pressures for a male child of more than eighteen to engage in courtship and for a male child of twenty to be planning seriously for marriage. The weddings of any child, male or female, are a final cost for parents, often large enough to negate the productivity of the same child as a worker for the prior two to three seasons.[206]

Farmers seem to almost-unanimously believe that their sons will carry on cooperatively to keep the family farming business in order after the current generation perishes.

Children, unlike most workers in industrialised or post-industrial economies, have a predictable arc of output or productivity. In an industrialised economy with a mobile and

[203] This is paraphrased as closely as possible from my field notes from a market interview in Oyam on 12 April 2012.
[204] In other words, the grandchildren of the agricultural entrepreneur being studied.
[205] This is true in both regions studied.
[206] From interviews with both men and women, it seems weddings are slightly more expensive in Kapchorwa than in Oyam, but the incomes in Oyam are slightly lower, so as a percentage of per-acre income the two are similar. Because the sample is bounded by farm size, total acreage per businessperson is similar across the sample.

versatile labour pool, employers will replace workers on a regular basis to maintain certain characteristics of the labour force. An example is a warehouse in which heavy items are stored for distribution to wholesalers. As workers age or become injured or otherwise become unable to perform their duties lifting the heavy items, they are transitioned to other roles (such as office work requiring less physical exertion) or replaced with more able workers. Because Ugandan farms primarily depend upon the entrepreneur's offspring as the labour pool, they must be accelerated into maximum productivity as quickly as possible and then replaced as they retire from service due to injury, illness, marriage, relocation, or other causes.

Children on the farm are essentially a cost until age six and likely are not "break-even" until eight to nine years after birth, even with the lowest imaginable cost estimates for their maintenance. After the break-even point, the children begin to be productive, with most farmers agreeing that children are most useful to the business between the ages of eleven and nineteen and that boys, especially, are extremely useful in their mid-teens.

This does not mean that children are entirely useless, however, at young ages. During my time in Oyam, I saw children as young as four minding cattle or keeping an eye on rabbits. Some children as young as six in Oyam were trusted to *amak kodi* (sorting which seeds are kept for the next season, an important task) or to separate *gweno ki piyo* (angry chickens or chickens with an instinct to cause trouble). As long as a child can walk, he or she can learn to *coko pii* (fetch water); even small containers are used to begin training children for these tasks.

The skills needed for a child to become a productive agricultural worker are not difficult to learn and human capital specific to tasks develops quickly. Younger children may be tasked with dressing and disassembling rabbits and chickens. Butchering livestock and designing irrigation trenches that are resistant to erosion are the two most complex

tasks given to children, usually around the age of fourteen. Both are tasks learned by example and generally a child taught in the early weeks of the season will be expert by the close of that season. These investments are made over and over, though there is some management-labour delegation in that often these lessons are led by older children for the benefit of younger siblings.

There are two enormously labour-intensive times of the season: weeding and harvesting. To a lesser extent, ploughing is a major commitment of labour, but turning even large plots of land does not compare to the many painstaking hours required for weeding the same plots. Young children can be taught to weed; in both regions, children are generally taught to identify sprouts and sort them from weeds by the age of six. In some cases, where interim weeding is needed – as in the case of lowland rice, where weeding must be undertaken both in the third and sixth week of the season – children may be hired from adjacent businesses that are not growing twice-weeded crops, though this is rare due to the general liquidity constraints of the businesses involved and high opportunity cost for the agents in the labour pool.

The decision-making of the farming entrepreneur in Northern Uganda is cyclical in at least three senses. One can visualise each child as two ten-year cycles, first one of relative dependence (cost) and then one ten-year period of independence (profitability). On top of this, one can layer the cycles of additional possible children (assuming a mother survives childbirth, it is possible she could become again pregnant as soon as thirty to fifty days following the birth). And again on top of that, one can think of crop or growing cycles, which are either once per year or, more commonly in Uganda, twice per year (this is governed by latitude, altitude, and crop speciation).

The core problem facing agricultural entrepreneurs in Northern Uganda is not unique, nor alien to other industries. In the auto industry, for instance, a model might last five to

eight years. Financing cycles for selling automobiles might run thirty to sixty-six months, depending upon the relationship between the manufacturer, the dealer network, and the bond market. The median consumer might plan to replace a vehicle every thirty to forty months after a new car purchase. Auto industry planning, from an operational and finance perspective, considers these overlapping cycles in crafting product and corporate strategy. There are also iterative concerns, in that the success of a given model of automobile may be affected by the success of prior models or by the perception of the brand in the years prior.

In the production of children, Ugandan farm managers face an interesting and deceptively-complicated problem. They must optimise C for all times. This is, of course, impossible for the first ten years. I observed that young men in their twenties have substantially stronger bonds – and stronger tendencies toward industrial cooperation – than men in their thirties and forties. I suspect this is partly due to brothers working on each other's farms during this shortfall in child production or during the period when most of the brothers' children are too young to be useful as farm labour. As children grow old enough to be ready substitutes for the labour of their parents' siblings, the symbiosis between brothers is weakened and they retreat to their separate businesses.

Suppose a farm manager had a production and operations plan covering the coming twenty years (which no farmer in the sample, aside from perhaps small plantation coffee farmers, likely does). It would remain difficult to produce precisely the right number of children to provide adequate labour with no interim surplus during every growing season. But because the demand (and hence price) for various crops changes over time,

entrepreneurs often shift their crops; this also aids in maintaining the fertility of the soil through crop rotation and allows farmers to change suppliers at lower switching cost.[207]

Given the cultural and economic incentives discussed, *supra*, one might suppose that the manager of a farm would simply produce as many children as possible. In my experiences in panel discussions at universities when I raised this issue of cyclical and iterative decision-making, many economists were dismissive and (anecdotally) simply concluded that Ugandan entrepreneurs are not weighing (or capable of weighing?) these labour questions and hence were simply producing the maximum number of children possible. Besides, sex is fun[208] and perhaps Ugandan agricultural entrepreneurs were simply having as much sex as possible. While I doubted this was the case, this concept of simply maximising production of children was a possible strategy and this hypothesis is, hence, something to be examined before proceeding to the next stage of analysis. My findings are that Ugandan farmers do not simply produce as many children as possible. I arrive at this conclusion by calculating the production shortfall in children across the two sample populations. Conservatively supposing that children are available for production at age eighteen (and ignoring that some constituents in each sample began producing children before age eighteen), one can easily produce the following table showing maximum production horizons for a farmer and a wife or, alternatively, a farmer and a husband or, alternatively, a farmer and multiple wives. The table assumes that no persons are

[207] Not true in all cases, but true when dealing with Monsanto-controlled seed dealers, for instance, which have crop-switching penalties built into their multi-year supply contracts.
[208] While I question whether this statement requires a citation, Emily Oster. *HIV and sexual behavior change: Why not Africa?* Journal of Health Economics, Vol. 31, No. 1. Jan. 2012.

pregnant at month zero, unbounded fertility,[209] no twins,[210] that all pregnancies are precise full-term pregnancies, and that one supranormal menstrual cycle of 45 days elapses between birth and subsequent full-term pregnancy. The lines of the table are meant to be read as discrete and mutually-exclusive. In the case of two or three wives,[211] it is assumed the pregnancies will be alternating, in that the second wife will fall pregnant in the fifth month of the first wife's pregnancy; the same divisible assumption is made in the case of three wives, with each wife becoming pregnant roughly every one hundred days.[212] [213]

max. ***β'children***	10 months	20 months	30 months	40 months
Farmer + 1 wife	1	2	2	4

[209] This is an empirically erroneous assumption, as female reproductive structures are often damaged during primitive childbirth processes without access to modern medical care and the virility of males is often adversely affected by diseases like yellow fever and malaria, both of which cause fevers high enough to overheat the testes and surrounding tissues and, hence, have substantial spermicidal effects.

[210] In Lango subregion, twins are very common due to a known genetic condition. So common are multiple children per birth that Opio (Apio in the feminine) is one of the most common names, meaning the firstborn of a pair of twins. Other names related to the phenomenon are common, particularly Okello (Akello in the feminine) meaning the brother (sister) following the birth of twins. Twin births are generally difficult and often children die or are injured; a child who survives such a difficult birth is given the name Ojok (Ajok), referring to the magical survival of the birth (even the word used in Lango to describe the birth of twins translates roughly to "ordeal" or "trial").

[211] This type of polygamy is more common in Lango subregion than in Sebei regions.

[212] There does seem to be, unsurprisingly, an advantage in ramping up production of children by having multiple wives. This is seen in very strong correlations between adult household size and number of children produced, corr. 0.38 across the dataset with constituent correlations in Oyam and Kapchorwa of corr. 0.44 and 0.35, respectively.

[213] Here, consistent with industrial economics conventions, *β-prime* is used for production over time. All values are rounded down to whole natural numbers.

Farmer + 2 wives	1	2	4	5
Farmer + 3 wives	2	3	5	6

Even taking the most conservative assumption (that a farmer has one fertile partner), the actual production of children in both regions is far below the *max. β'* horizon. Also, if child production maximization were really the ideal strategy, one should see a substantial deficit in production in the dataset from female entrepreneurs who are biologically limited in their production of children in ways that men with multiple wives are not. One sees no handicap in production, size of farm, variety of production, or total value of quantity harvested when comparing female and male farm entrepreneurs.

Looking at the data, the children production shortfall (*max. β' - β'*) is very significant. The farmer maximizing child production with one wife above and beginning to have children at age eighteen would have sixteen or seventeen children on his thirty-first birthday.

Instead, I find that childbirth does not follow this pattern. In fact, the average age (x) of farmers with only one child is thirty-one in both regions (31.6 in Oyam and 31.0 in Kapchorwa).[214] The entrepreneur strategically maximizing child production would have an age-divided-by-number-of-children of 1.8 at age 31. Instead, this ratio is 11.0 across the dataset, with a slightly higher (11.2 vs. 10.9) ratio in Oyam (indicating fewer children per year of entrepreneur age). These data allow the calculation of the shortfall (*max. β' - β'*)

[214] Across the dataset ($\bar{x}$, C) = (31.2, 1).

which is 22.1 across the dataset (again, with Oyam having a slightly higher number at 22.9 vs. 21.6).

There is a history in the peasant studies literature of comparing farm size to children. Of course, it is important to recognise (which much of this literature does not) that work on the farm per acre is not a linear function. While farm size may be a useful variable, it is not isolated from – and, in fact, is inextricably intertwined with – the crops planted. To use an extreme example, it requires more effort to weed even a few rows of peas, for instance, than to rake and sweep the corridors of an entire grove of coffee trees. Unsurprisingly, in Oyam, where crops are generally similarly (and highly) labour-intensive, there is a significant correlation between number of children and farm size.[215]

Turning to distinctions by crop, the hypothesis that labour-intensive production profiles lead to higher production of labourers through fertility holds. Peas, which are enormously labour-intensive at every stage (tilling, planting, weeding, and harvesting), have the highest significant correlation to number of children.[216] Sweet potatoes, which require substantial levelling of beds, two cycles of weeding, careful harvesting to protect the meat of the potato, and rapid harvesting lest the potato rot in the ground, have the a correlation with number of children that is nearly as high as peas.[217] Another example, with only a very slightly lower correlation to number of children, is citrus fruits.[218] Citrus trees require constant care, since they are vulnerable to disease and pests (and require nearly daily examination and diagnosis) as well as to erosion and drowning in the flood season, and must be pruned aggressively after each harvest.

[215] Corr. 0.162.
[216] Corr. 0.065.
[217] Corr. 0.056.
[218] Corr. 0.052.

These three correlations are substantially stronger among farmers aged 25 and younger, suggesting that entrepreneurs investing in labour-intensive processes anticipate this need for additional labour and produce children more quickly. This is also consistent with interviews, particularly an interview with Solomon Okec on November 17, 2011.[219]

"There are certain crops I cannot *cekko cem maber* (make grow sturdily, cultivate successfully[220]) without *lotino* (more than one child). One cannot *pwuro* (dig, plant, till) alone forever and make money; age will *balo* (damage, retard, restrict) the ability to do this."

When I first interviewed Solomon, he was in the stage (a year earlier, at age 31) where his siblings were offering substantial, though sporadic, help with his farming business. By the time he was 32 and interviewed during the pig slaughter at Cuk Maco Dwogo, he was essentially alone, occasionally receiving help from friends. Once, I visited him on his farm and he was pulling a twenty-kilo half-share plough with his own shoulders,[221] a testament not only to his strength, but to the desperation of the labour shortage situation within the enterprise. When I asked how much it would cost to hire a man, he replied that the cost would cannibalise any profits. Pressed on the issue of how much he works to make a profit on the farm, he replied with a Luo phrase, *lacan pe nino* (the poor do not sleep).

The more I built estimated balance sheets and cash flows for businesses like Solomon's, the more I found that farming was likely to be often-unprofitable at this scale. Further research suggested a substantial number of these seemingly-agricultural businesses actually had subsidiaries in other sectors, from selling mobile phone chips to distributing

[219] Author's field notes, Oyam Pig Slaughter (Ringo Opego) Celebration at Cuk Maco Dwogo.
[220] Difficult-to-directly-translate phrases are shown with parenthetical definitions in the alternative.
[221] Author's field notes, 9 February 2012 visit to a variety of agricultural businesses in Oyam.

alcohol. I split the dataset into businesspeople with investments beyond farming and entrepreneurs whose investments were concentrated in the agricultural sector.

Each entrepreneur in the dataset (more than 3,000 respondents) was asked what share of his or her business's income comes from farming. The replies supplied were very little (suggested to mean 0% to 25%), less than half, half or more, or almost all (suggested to mean 75% to 100%). A substantial portion of farmers had a large amount of non-farm income, primarily from retail sector activities or door-to-door sales operations. In Kapchorwa, door-to-door sales activities are more prevalent, while in Oyam shops in town or by the roadside were far more common.

This distinction is important as the types of door-to-door sales activities in Kapchorwa tend to compete with farm labour, requiring someone of at least twelve or fifteen years of age. While some of these door-to-door operations are year-round business ventures that can be adjusted to compete less with farming activities, others are in direct conflict, as in the case of a group of boys I met in Kapchorwa who I estimated to be in their mid-teens. They were offering to re-thatch roofs, an activity requiring substantial physical strength and stamina (that is then not spent on farming) thus taking them away from the farm during the height of the planting season (the end of the dry season). Counterintuitively, these activities do not seem to draw higher birth rates or attract the interest of high-birth-rate entrepreneurs, perhaps because they are not seen as major activities. Even entrepreneurs who only generated 10% to 20% of their total net revenue from farming self-identified as farmers and referred to these other ventures, even if they were quite successful, as *me aryo yweyo* (literally a second wipe or second skim, meaning an ancillary source of income).

Some of these businesses, particularly the sale of mobile phone chips and the sale of informal lottery tickets,[222] tend to create large concentrations of net revenue per man-hour. Many of the underlying tasks require only basic mathematical skills (the arithmetic needed to give the balance when paid with notes) and no literacy skills. As a result, these low-physical-strain jobs are well-suited to a bright young child. Several entrepreneurs I met in both Kapchorwa and Oyam expressed they were pleased with a young child's performance in minding a shop along with a wife – an arrangement that creates minimal competition between these retail or services subsidiaries and the agricultural business. In Oyam, I noticed a substantial correlation between children and source of income; people who are involved in a non-farming activity that produces the majority of the family business's income have, on average, 4.5 children rather than 5.2.

Even though the income of farming entrepreneurs within the sample is isolated in a tight band, there is some slight variation in wealth. I capture this through assessments of the condition of the business people's homes.

Housing Unit	1 Point	2 Points	3 Points	4 Points
Electricity?	Yes	No		
Roof Material?	Good Condition	Fair Condition	Poor Condition	
Floor Material?	Good Condition	Fair Condition	Poor Condition	

[222] These would be more akin to "raffle" tickets in Britain, in that they are completely divorced from any state-sponsored gambling scheme.

Windows?	Good Condition	Fair Condition	Poor Condition	None
Main Door?	Good Condition	Poor Condition	No Door	

The score for the condition of the housing unit is the simple sum of the five scores assessed in this table, *supra*. Note that lower scores indicate a home in better condition.

Without seeking to prove or assess the causal relationship between the two, I was curious to find whether wealthier family businesses (as indicated by condition of the family home) produced more children. I expected this would be the case for three distinct, but related, reasons. First, I expected that additional children were an advantage in incremental contribution of labour and that, all else equal, farmers prefer C + 1 to C. Second, I expected that an additional child is essentially a fixed cost, rather than a cost proportional to net revenue,[223] and hence more easily borne by a business operating at scale. Finally, I expected that wealthier businesspeople might diversify not only in their lines of business but also in their plans for their children; having a variety of children (older and younger, smarter and slower, boys and girls, etc.) was seen as desirable by most farmers I interviewed. In short, I expected econ-like behaviour, but observations suggest human or non-optimal behaviour.

In the data, there is a small, significant correlation between quality of family housing and the size of the family. Families that have better housing tend to have more children, and

[223] This is not entirely true, as additional sons can mean a more fragmented partition of the property upon the death of the patriarch, leading to squabbles and jeopardising whether the farm will have a size that meets the "critical mass" production requirements (approximately 1.3 acres per farm) of a working supersubsistence agricultural business.

this is truer in Oyam than in Kapchorwa (it is worth noting that the quality of housing stock is more variable in Oyam than in Kapchorwa).[224] To confirm that housing stock was a good proxy for wealth, I also compared children to a luxury item – ownership of an FM radio – and results were similar.[225]

Finally, I examined qualitative survey questions against family size. Businesspeople with smaller families worry marginally more about drought and flood,[226] worry marginally more about falling ill or becoming injured,[227] worry marginally more about a decrease in crop prices,[228] and, interestingly, far more often send more money than they receive in remittances[229] (despite having incomes that are lower on average and in random subsamples than farmers with more children). The remittance deficit[230] is likely because the entrepreneurs studied with few children also tended to have young children (i.e. no children old enough to have gotten jobs in the city or moved away to send remittances to their parents). These results were consistent between regions.

Given this information, entrepreneurial decision-making in these two regions tends to focus on very early planning, producing children often and early where possible, particularly in cases where labour-intensive crops are part of the broader investment strategy. Because the cost of diversification is low, and penalties for crop failure are dire, poor farmers with fewer children diversify and attempt to get a higher marginal product

[224] Due to the scoring method in Table IX, specifically that lower scores mean better housing stock, negative correlations are "positive," with constituent significant correlations of -0.092 in Kapchorwa and -0.080 in Oyam.
[225] Results were actually stronger in Oyam, where there are 4.7 children per household that owns a modern radio versus only 4.1 children per household without an FM radio.
[226] Corr. 0.026.
[227] Corr. 0.024.
[228] Corr. 0.030.
[229] Corr. 0.085.
[230] Domestic remittance deficits and surpluses have not been studied in depth in Anglophone east Africa. The studies that exist in other locations suggest this may be a relevant factor in domestic liquidity estimates and in analysing domestic transfer transaction scale. *See*, *e.g.*, Kimhi [2010].

of labour earlier in each child's life through selling mobile phone chips or other activities that do not require the physical strength of a (usually male) teenager.

In general, there are two family planning patterns, one for high labour demand that is sustained and one for high labour demand that is periodic. Increased worker specialisation may be possible with more children and more financial resources; households with more financial resources seem to prefer to produce more children. As the school attendance rate is only negligibly higher among wealthier households, one can assume these additional children are agricultural labourers.

Turning to the linguistics and culture of the two regions, both have a dominant cosmology of uncertainty – the saying in Oyam, *aniym col*, means "the future is uncertain" and is one of the most oft-heard idioms in the village.[231] The goal of any enterprise is to adapt to future uncertainty, keeping net revenue as smooth and reliable as possible while controlling costs. It is not that entrepreneurs in the region are acting entirely contrary to their pecuniary interests; they consider their interests and often after-the-fact are able to identify how many "too many" children they produced – the fascinating thing is that, from an expected value perspective, farmers misidentify the number to produce *ex ante*.

The culture of the region can, of course, contain fears about the future and still be compatible with an econ approach. While increasing the number of children in the household generates fixed costs, these costs are predictable and the net present value of a child's contribution to the household is positive net of these costs, even if one makes conservative estimates as to the marginal product of labour of a child at each year of life[232]

[231] The literal translation is "what is ahead is dark," but dark is not meant in a pessimistic way, rather in that what lies ahead is unseen (or un-seeable).

[232] These levels of productivity are no doubt influenced by parental and other training, but the majority of a young child's inability to be as productive as an agricultural worker stems from the limitations of his or her physical size and strength, not his or her on-the-job training.

and uses an annual effective discount rate[233] that reflects the small agricultural firm's high cost of capital.[234] Also, the child's labour output is not affected by inflation (a major risk in Uganda, where inflation was over 30% in October of 2011, while this research was underway[235]), since the child is paid in commodities generated by the farm (food and housing provided on-site or obtained through quasi-barter) rather than being paid a marginal wage in fluctuating local currency. These predictable workforce costs are easily borne when compared to unpredictable costs of low-frequency, high-magnitude events like drought or flood or livestock disease.

The exogenous factors that may affect family planning strategies and make their skew consistently suboptimal are chiefly cultural[236] and relate to the overestimation of infant mortality rates and the overestimation of labour requirements.

The poor estimation of infant mortality rates is likely related to three factors. First, a historically very high[237] infant mortality rate in Uganda generally and in Northern Uganda specifically that is part of the cultural consciousness. Second, a tendency for HIV-positive and other disease-afflicted mothers to frequently bear stillborn or sickly children until very recently (today, zidovudine is generally administered to mothers to reduce disease transmission, including HIV transmission, risk). Third, a tendency for women to dramatise and overestimate the risk[238] surrounding pregnancy, both specifically and generally, due

[233] I estimate the effective prevailing interest rate to be close to 0.18APR and higher for smaller farms; unsecured commercial credit (notes) trade intraregionally at close to double this rate.
[234] Cost of capital here to mean cost of money borrowing, not the acquisition of capital goods.
[235] The ADB and IMF both noted inflation rates between 30.2% and 30.9% in Ugandan shilling priced goods, using slightly different methodologies. The 2012 ADB report describes the inflation dynamics in Uganda in greater detail than is possible here.
[236] By cultural, I do not mean having to do with a given tribe or demographic grouping, but rather that certain normative judgments (as well as quantitative errors) are integrated into the cultural discourse and habits that develop therefrom. *See generally* F. Ferraro & et al. *Economics Language and Assumptions: How Theories Can Become Self-Fulfilling*. Academy of Management Review. 2005.
[237] In excess of 25% in 1960, 2013-14 Bill and Melinda Gates Foundation Annual Report.
[238] By risk, I mean specifically risk of child mortality.

to – among other things – a cultural narrative that glorifies and commemorates risky births as special, heroic, and magical.

The poor estimation of labour requirements is likely related to three separate, further factors. First, agricultural entrepreneurs fear losing children during their most productive years, particularly to marriage, and want to have "replacement children" available aged 14 to 18 whenever a child aged 16 to 20 elects to depart the business. Second, nearly every farmer I talked to on farm site visits overestimated the number of hours he or she spent completing a given task, often by 50 to 200%; because there is poor empirical information (lack of time logging, time-and-motion studies, productivity-per-time-unit audits, etc.) compared to a developed-world business, managers overestimate both the amount of work to be done in man-hours and, hence, as a function of this, the number of workers needed to complete that volume of work. Third, agricultural entrepreneurs are concerned about low-probability (hence low-frequency), high-variance events like a spectacular harvest[239] they lack the manpower to exploit or a natural disaster they need a large family to successfully weather; planning for these "tail" events that lie at five or six sigma leads to an oversupply of labour under normal conditions within two or three sigma of the mean condition.

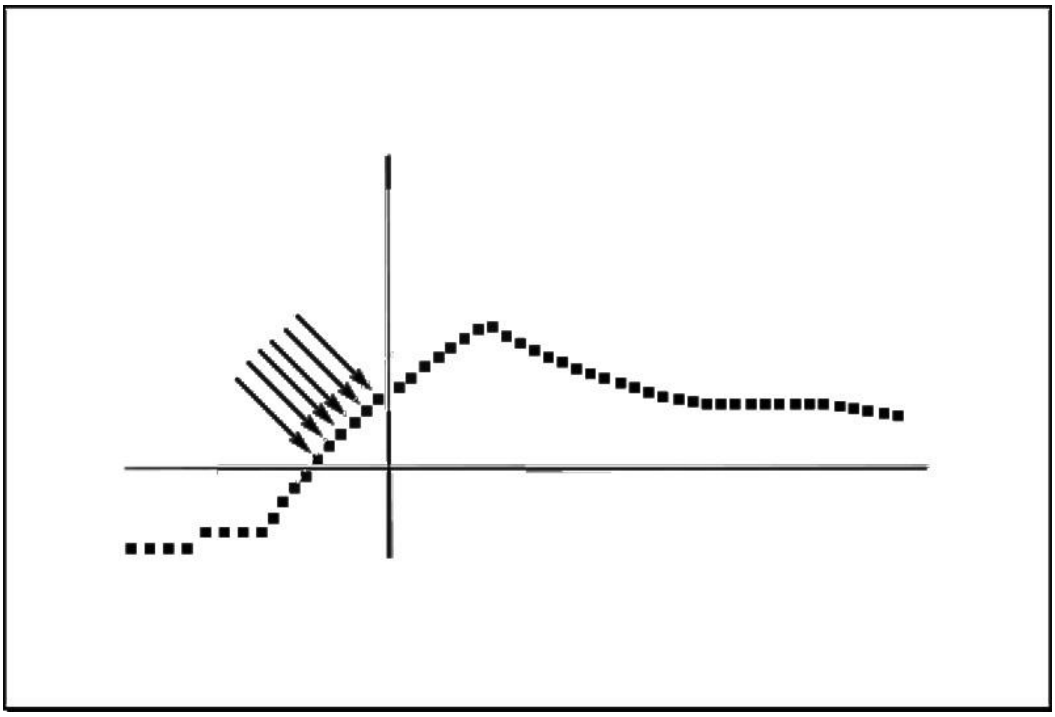
The estimation errors and framing effects are not only exacerbated by cultural factors, but exacerbated by the iterative nature of child production and the fleeting utility of a child once produced. The bi-axial figure, *infra*, is an illustration of the utility[240] of a child as a farm labourer (Y) plotted on the child's age in years (X). Each point plotted represents one year of age, ending at the male life expectancy in Northern Uganda.

[239] *See cf*. M. Landsberger. *Windfall Income and Consumption: Comment*. American Economic Review, vol. 56, pp. 534-39. 1966.
[240] Arbitrary unit.

The horizontal line rendered at age twelve illustrates the point at which the child is likely to be economically "net positive" while the vertical line rendered at age eighteen illustrates the point at which the child is likely to be married or to leave the business.[241] In essence, the typical child will only offer a positive value proposition to the employer for half a dozen years before leaving (most entrepreneurs interviewed anticipated children leaving the business between sixteen and twenty years of age).

[241] The subtleties that separate various types of break-even points in accounting and mathematical economics are not particularly relevant here.

Figure III.



The plots highlighted with arrows, *supra*, illustrate the "black" years[242] during which a child contributes positively to the family business.

Once a child reaches the age of three or four, there is a temptation to produce more children to fill the labour gap left[243] by the child when he or she leaves at eighteen (thereby having a child fourteen or fifteen years of age when the eighteen-year-old leaves the business to be married, move to the city, or start his or her own farm).[244] There is, however, a decreasing marginal utility of additional children beyond this, as there is a limited amount of work available to be done on a two-hectare farm (even the farmer who

[242] In other words, internal year profitability.

[243] For contemporary observations on biases and decision errors generated by self-predictions, *see generally* D.J. Koehler & C.S.K. Poon, Self-Predictions Overweight Strength of Current Intentions. *Journal of Experimental Social Psychology*. Forthcoming.

[244] From a labour economics standpoint, this can be visualised as a near-zero churn rate. For more information on the current understanding of the dynamics of churn *see* recent research by Lazear and others. This work recognises that low churn or reductions in churn have substantial macro cost consequences to the host economy (dataset used by Lazear focuses on the recent recession).

drastically and habitually overestimates the amount of work to be done does not believe the amount of work to be done is infinite).

There are interim iterative probabilities that separate the entrepreneur-manager from the productive teenaged worker, however. We can think of this as the following probabilities, each of which is constituent to the decision to have sex to create a worker:

- Probability the sexual act will result in a pregnancy;
- Probability the pregnancy will reach term;
- Probability mother and child will survive the pregnancy;
- Probability child will survive early childhood;
- Probability child is not or won't become too crippled or diseased to work;
- Probability child will not marry before being a profitable worker.

There are undoubtedly further contributory probabilities that one could integrate into this calculation. Note that the probability the child will suffer some ill fate prior to its economic productivity is overestimated, likely as an aggregation of marginal overestimates of some or all of these contributor probabilities. Informally, one can visualise this as a case where states do not map directly onto outcomes, but into some mixing space of lotteries that lead to outcomes (by analogy, a fertility model with an Anscombe-Aumann flavour).

Even an entrepreneur with perfect (supernaturally so, as some questions like the productivity of an unborn child as a worker are unknowable) information informing the above probabilities and binary classifications may struggle to produce the optimal number of child workers, however. This is because the data are poor and because the data, historically, is direr as a collection than the current condition (due to the relatively recent introduction of Western European or American medical care, etc.). Also, the notoriety of child death and disease, amplified by cultural factors in both regions studied, likely leads to the overestimation of childhood problems (this can be thought of as a collective

framing issue – losses of children in the community are noticed, publicised, and thought to be more common than any local empirical evidence would indicate).

But returning to the entrepreneur with supernaturally good information, such an entrepreneur would likely engage in some kind of analysis of similarly-weighted empirical frequencies. Provided with cases similar to his own, suppose couples from the same region with similar ages and health histories, he might be able to estimate the odds of questions like fertility and infant mortality within an order of magnitude. Given the empirical frequency data from others, defined classically $s(x_i, x_j)$, the entrepreneur would build a similarity function s wherein for the vectors of characteristics, *e.g.* $x_i = (x_i^1, \dots, x_i^m)$ and $x_j = (x_j^1, \dots, x_j^m)$, $s(x_i, x_j) > 0$. The degree of similarity, expressed as a positive value, *supra*, would then influence the weight given (primitive kernel estimation). The problem lies in that axiomatisation of this formula in that qualitative probabilities (like "how many of my neighbours' babies seem to die?" or "how often do I suppose neighbours have sex to achieve pregnancy?") are difficult to weight, even if arbitrary values are assigned; this leads to the question of whether the scarce evidence (and even the supernaturally complete evidence available to the hypothetical entrepreneur here is scarce) can possibly inform optimisation of child production.

Assuming it cannot (i.e., the prediction must be made from a dataset that contains probabilities of dubious predictive value), the econ decision would be to minimise marginal cost and attempt to minimise overproduction, if any, of workers, as idle workers are waste. Yet Ugandan entrepreneurs do precisely the opposite: they err on the side of producing too many workers.

This human – rather than econ – decision framework incorporates the following reasoning: Children are difficult and time-consuming to produce and require a lead time of years before they are viable contributions to the venture's workforce, it is best to err

on the side of more children rather than fewer, particularly as their interim cost during the first years is relatively low and constantly decreasing (as the risk of maternal childbirth mortality, the largest cost centre of child production, declines each year in Northern Uganda by a nontrivial interval). It is not surprising, then, that firms may elect to produce slightly more workers than would be optimal, as the – sometimes erroneous – human beliefs (spare workers are good, child mortality is common, sex is fun, etc.) dominate the econ calculations of the perfect worker production timing, mix, and number.

The role of children in Northern Uganda as workers is driven by the lack of ready substitutes.[245] This rises from the confluence of the post-conflict, fragmented nature of the society, the ubiquity of subsistence farming (thereby removing many able-bodied farmers from the labour pool), and the low net productivity of farming businesses. The amount it would cost to hire a farmer from a neighbouring farm to ignore his own crops while nurturing another's is undoubtedly prohibitive. As a result, children are the primary – and, in many cases, only – labour available to the Ugandan agricultural businessperson.

The cost-benefit considerations of having children are relevant.[246] The costs of children, particularly if they are not given formal education, though not trivial, are not overwhelming. The potential costs are the risk of the mother's death, the risk of an ill child who will not add productivity to the business, or the "opportunity cost" of a fetus who will occupy a pregnancy cycle with a failed pregnancy. The concept of family planning as a labour input is important broadly, as it has far-reaching economic

[245] Put differently, the role of children in each Ugandan agricultural business is a product of the weak – or, often, non-existent – labour market for farm workers, meaning each farm's workforce is autonomous and effectively partitioned from all surrounding workforces.
[246] Though this may seem an overly utilitarian or insensitive line of analysis, it is a well-worn path in the social sciences and has been recently examined in many contexts, with different ethnic and geographic contexts.

implications in aggregate, but also specifically, in that it each failed cycle of potential child-bearing is a future worker not “hired” and essentially unavailable.

The econ’s optimal family plan would be one that employs two to three people of adult productivity for the 1.5 to 2 hectares of arable land on most farms studied, given the low level of agricultural mechanisation on Ugandan small-holder commercial farms. The family plan adopted by most farmers studied overshoots this (with the farmer-manager and three children aged 12 or more at some times) during peak productivity periods, while falling well short of this during earlier and later periods of the entrepreneur’s life (in the former case, due to children being in infancy or yet unborn; in the latter case, due to children having left the business due to marriage, relocation to the city, or starting their own farms).

The execution against plan must be analysed with respect to the underlying estimations by management about labour supply and general human resources planning. Because management tends to overestimate the amount of labour needed – for a variety of reasons, including, notably, historically-higher infant mortality in the region – and because the penalties to profitability for overproducing children are perceived as less than those for underproducing children, a higher-than-optimal peak number of children tends to be created on a per-hectare and per-business basis. This skew is the result of not only the poor estimation of labour required, but also the poor estimation of probabilities that lie within the iterative calculation each time a child is to be produced. While there may be occasional attempts at econ-like, firm-level utility maximisation in the choices made by these rural entrepreneurs, it is likely any optimal state reached (e.g. the farmer-manager plus two children in the prime of their productive teenaged years) is fleeting and, by the very nature of both Northern Ugandan society and human biology, impossible to maintain in steady state where the only source of additional or

replacement labour is the virility of the enterprise's patriarch and the fecundity of his[247] mate(s). Finally, even if it were possible for agricultural entrepreneurs to optimise their reproductive strategies to meet farm labour needs, it is very likely these estimates are flawed, as they are based upon assumptions about a series of variables from maternal fertility to infant mortality that are often incorrect by 40 to 100%.[248] Still, we do see attempts to adjust family planning to labour needs, including a significantly lower number of children in families that have other substantial investments (and streams of income) aside from working the land.[249]

Perhaps Neher said it best, or most simply, in that "If parents believe they can make themselves better off by having large families, they will do so." Though in the Northern Ugandan context, it appears those who depend mostly upon agriculture for their livelihoods believe this – and significantly overshoot the mark.

The shining piece of evidence for human – versus econ – behaviour as to human capital on the farm is perhaps a simple thing I noticed in my first weeks in Uganda: that all farmers would rather have their children tending their crops than create a local child labour market where people needing an extra ten-year-old or an extra strong teenager could rent one from a nearby farm. Though such a market would undoubtedly ease labour shortages and likely even lead to higher per-worker productivity across the community, the local customs, family ties, and traditional practices in Oyam and

[247] In this sample, overwhelmingly "his."

[248] Drawn from field notes on interviews with a variety of people concerning infant mortality rates and maternal birth-related mortality rates. None of the over ninety people interviewed estimated the infant mortality rate to be lower than the Ugandan infant mortality rate listed in the World Bank's most recent data. Sixty-five overestimated the Ugandan infant mortality rate by 50% or more. This overestimation is not unique to Uganda; studies have shown that disproportionate exposure to particularly memorable or traumatic events (like witnessing one's children or child-aged relatives dying) will cause overestimation of that event's frequency within the broader population context. For more on this phenomenon, *see*, *e.g.*, the lineage of decision research beginning with [Lichtenstein 1978].

[249] This is similar to the labour profile of firms that acquire non-labour-intensive subsidiaries versus peers with labour-intensive business lines.

Kapchorwa stand in the way of this. Each farm is, economically, an island and the price at which a farmer would "rent" his son to a neighbour is prohibitively, and in my interviews, fancifully, high. In short, farmers' attempts to preserve their *independence* and *pride* prevent a more sophisticated labour market from developing – neither being things econs would value over efficiency.

Reconciling Competing, Exclusive Systems of Decision-making

For decades, researchers have noticed – and attempted to explain – contradictory decision-making by a discrete group or individual actor (individual). Here, I'm struck by the conflict between predictable, anticipated decisions of econs in the first two instances (logistical planning and capital equipment purchases) but very much non-econ choices made in the final instance (human resources and personnel management).

In the interdisciplinary literature, the effort to reconcile seemingly-mutually-exclusive methodologies for making decisions resulted in the constructs of System 1 vs. System 2 thinking (decision sciences), Dual Process Theory (psychology), and other systems in disciplines from organisational behaviour to management theory to evolutionary biology to decision analysis in sector-specific contexts (e.g. understanding why doctors choose a certain treatment or prescribe a certain drug).[250]

Here, the first two sections describe decisions that are made in an analytical context. That is, the farmer has not only an interest in considering the decision at stake, but has time to plan the decision, study the best available information, and so forth. While one might suggest the third section is one where farmers are driven by passion and simply impregnate their wives too often and accidentally, neither the data nor the interviews seems to support this hypothesis. The frequency of children born is too predictable

[250] See, e.g., J. Evans. *In two minds: dual-process accounts of reasoning*. Trends in Cognitive Sciences 7 (10). pp. 454–459. 2003.

(while not optimal, it is predictable), and interviews with farmers, local aid workers, and others in the villages suggest the vast majority of women are using pharmaceutical birth control to produce children and that few unexpected children are born (and certainly not 3 to 4 "unexpected" children per household. Instead, I distinguish the third decision (human capital) from the first two (logistics and capital goods) on a separate basis: that farmers are thoughtful and deliberative about when to have additional children, but that these decisions are based on erroneous information, taken as true.

Explanatory Theories

Research by Jonathan Evans[251] and others suggests prior knowledge acquired in a System 1 analytical or empirical context may infect or distort reasoning in a System 2 construct. For instance, even if farmers are attempting to act rationally and be econ-like in their child-production decision-making, nearly all interviewed have acute, painful recollections of high infant mortality rates when they were young (this applies to infant mortality rates but it should be noted that many, in interviews, noted emotionally-fraught impressions and recollections of child mortality rates due to war, on-farm injury, malaria, and other factors). The deep and persistent presence of foreign aid workers reciting these statistics, billboards bearing these statistics, UN-controlled radio stations blaring these statistics no doubt had an effect: some farmers can recall these (now incorrect) statistics by heart.

One that is particularly troubling (and was recited by many subjects) is the idea that "one in ten" Ugandan children will perish either from infant mortality, disease, farm (workplace) accident, infection, etc. I endeavoured to find the source of this well-known

[251] *See*, *e.g.*, J. Evans et al. *On the conflict between logic and belief in syllogistic reasoning*. Memory and Cognition 11 (3). pp. 285–306. 1983; *see also* E. Stupple et al. *When logic and belief collide: Individual differences in reasoning times support a selective processing model*. Journal of Cognitive Psychology 23 (8): 931–941. 2011.

number and was unsuccessful. Yet it was known in both Oyam and Kapchorwa, despite never (so far as I can determine) having been true (for instance, the World Bank's infant mortality statistics for Uganda reveal roughly 0.1% of children born in Uganda die as infants). Despite local impressions that "hundreds of thousands" of young boys and girls were being kidnapped or killed by the LRA during the LRA wars (2001-2012),[252] credible observations of the LRA's strength suggest its entire army – even at its height – was composed of less than 5,000 men and that many or most of the deaths during the period were not caused directly by military conflict (the leading causes of death among young people during that period were malaria and AIDS, not violent conflict) and that total casualties during that period were in the tens – rather than hundreds – of thousands. Similarly, some people believe future kidnappings by the LRA (despite there not having been a kidnapping of a child by the LRA in Oyam since 2007). Many people, dependent upon state-run media but distrusting of the party that controls it, insist the threat to children remains real and that children will be the first to be killed in the next war.

Often, in interviews, farmers talked about "extra children" or (when referring to older children) "extra workers" or "extra people on the farm" suggesting they recognise the rate at which children are being produced is superoptimal. These comments were often followed by a discussion of infant mortality, child mortality, the dangers of being a child in Uganda, disease, and so forth. Of 2,983 people who responded to my question, "Have you experienced the death of a boy or girl less than eight years old who was your child?" the response was positive for only 21 people (<1%). Of those, the most common cause of death was overwhelmingly disease, with only two respondents (9.5%) replying with other causes of death (malnutrition and HIV). Though my entrepreneurial sample is

[252] These impressions are likely not wholly unrelated to the fantastic and exaggerated reporting of Ugandan radio "journalists" who routinely inflate this number. This is particularly true on government-sponsored or NRM (the ruling party) -sponsored radio, where exaggerating the intensity of the LRA problem and the fighting distracts from recent fumbles and scandals.

atypically wealthy, literate, and seemingly well-informed, they were almost unanimously unwilling to accept that their risk of losing a child was vastly lower than had been true in earlier generations and was vastly lower than was true for their impoverished neighbours. This was similar to when I raised the issue of foreign aid and aid agencies, to which the reply was always that the respondent's ethnic group was the most harmed by recent events, the most impoverished, the most needy, and so forth (regardless of the actual profile of events or distribution of wealth).

This creates a belief bias effect where the pertinent conclusion (infant mortality and child mortality are alarmingly prevalent in Northern Uganda) is more plausible to the farmer-listener (based on prior true states or erroneous statistical estimates) than it would be if the same listener studied the current state (or to a listener never exposed to prior information about Ugandan mortality rates). This belief is so strong that farmers, confronted with robust (audited) statistics from the World Health Organisation and other credible entities as to the frequency of infant and child death in Uganda in interviews, would challenge the statistics, argue that the rate in the north was dramatically higher (an assertion for which I was able to find no evidence) or that the rate in their ethnic group was dramatically higher (again, no evidence).

I theorise Ugandan entrepreneurs, while acting predictably and like econs in the first two instances (integrating all available information, choosing decisions that maximise profits, favouring near-optimal choices over those that may appease social norms while curtailing productivity or profitability), are acting differently in the third instance because they are correcting for factors that do not exist today but may have existed in the past (such as high infant mortality rates). In correcting for perceived higher rates of children being unavailable to work (due to death, illness, kidnapping, etc.), these farmers overproduce children in anticipation some may be unavailable to work. Even in the face

of solid empirical evidence that nearly every child born will be available to work on the farm, entrepreneurs are affirmatively (and passionately) opposed to digesting this new information and integrating it into their decision-making process. This information indigestion, combined with a perceived need for more children to "backfill" the labour pool for when other children die (or "age out" of the labour force through marriage or relocation) drives a perceived need for many more children than are actually needed. One of the last questions I asked before leaving Uganda was, "Do you wish, thinking about your family's future, that you had more or fewer children?" The answers provided were presented in random order via the smartphone app:

- I wish I had more children.
- I wish I had fewer children.
- I have stopped producing more children because I feel I have too many.
- I am still producing more children because I feel I have too few.
- I feel I have about the right number of children.
- I have no children.
- I don't understand the question or don't feel comfortable answering.

I then asked a question focusing the same issue in a purely commercial framing: "Thinking only about your farming business and the role your children play as workers, do you wish that you had more or fewer children?" I provided the same answers, again in random order.

Among farmers older than 28, 62% of respondents replied with either "I wish I had fewer children" or "I have stopped producing children because I feel I have too many." Among those over 32, the portion providing either of these two answers leaps to 76%.

When provided the question in the second, industrial context, these answers are even more prevalent, with a stunning 84% of farmers over 32 responding that they wished

they'd had fewer children or have stopped producing children because they feel they have too many (note the sample is overwhelmingly male, so most of the sample is likely to be fertile in the 32-50 age range).

Conclusion

In weighing transport and logistics methods for moving their crops to market, farmers in Northern Uganda (as anticipated) choose methods that are suited to their payload needs. In cases where farmers are far from town, they choose crops that are more profitable per transported unit in order to make up for the transport costs. This is behaviour one would expect an econ farmer to exhibit; the errors in estimation here are typical, in a narrow range, relatively normally-distributed, and surprisingly minor given the poor information availability in the region.

When farmers in the same region make choices regarding capital equipment on the farm, the farmers again behave essentially like econs, attempting to balance capital investments with the costs of purchase, costs of idle equipment, and risk of inoperable equipment. Examining the utility and range of uses for each of the two pieces of equipment studied, slight overadoption of capital seems apparent, but this may be accounted for in the inoperability of ox ploughs at some times when they are needed and unpredictability (unfeasibility) of bicycle-borrowing or bicycle-sharing. To the extent these are concerns, the excess capacity may be nearly- or fully-explained.

In each case, an econ could conceivably make the same choices as the vast majority (90%+) of farmers, particularly given the information disadvantage (relative to developed-world farmers) these entrepreneurs operate at on daily. The choices made by these farmers are surprisingly consistent, fall into a narrow range, and are predictable from season to season in both logistics and capital equipment.

In the third case, however, the overproduction of children is substantial and noticeable relative to their useful duration as workers on the farm (labour being the primary reason for having children for most subjects interviewed). While the cadence of child production in each family is relatively predictable and the two-to-three-year spacing between children is desirable from a workforce perspective, maintaining this supply of children against perceived threats (infant mortality, disease, abduction, etc. – all routinely estimated at dramatically higher frequencies than those evident) and the very real threat of "graduation" from farm labour (through marriage, migration to another farm in adulthood, etc.) drives the overproduction of children in the Ugandan rural family and in the individual farm's labour force.

A mix of factors contributes to the Northern Ugandan agricultural entrepreneur's overproduction of children per household, but that the driving factors are not unplanned pregnancies or hedonistic tendencies. Rather, the choice to have children is a conscious one, family planning is common, and the choice to produce too many children is one subject to significant (albeit flawed) analysis. Just as logistics and capital equipment purchases are planned, so is the production of each child – however, in the latter case, the planning integrates observations that are dearly-held and popular, despite being empirically untrue. The persistence of these perceptions flies in the face of the experience of those who wished they'd had fewer children or have stopped producing children because they feel they have too many. There may be implications for educational institutions and aid initiatives to focus on education around misperceptions and mis-estimations that may be contributing to the overproduction of children in

Northern Uganda, production most agree continues at a socially, environmentally, and commercially unsustainable[253] rate.

I conclude that it is poor estimation on the basis of insufficient (or entirely erroneous) information that contributes to the human rather than econ behaviour recorded in the area of child production. What separates this domain from questions of logistics and capital equipment purchases is not its sexual nature, but rather the complexity of planning a workforce years in advance, even when the scope of work, the size of the firm, and the capital requirements are well-known in advance. A tight labour market where penalties for failure are high and alternatives to one's children are scarce amplifies the perception of underproduction of children as a risk. The narrow period of the child's life during which he or she offers maximum productivity drives management's desire for replacement workers (when other workers disappear due to marriage or relocation or urban migration) and misperceptions about child mortality rates and other statistics drive significant overproduction of children relative to firms' actual needs. Unlike in the context of logistics (where a new arrangement or supplier can be selected each season) or capital equipment (where capital goods can be liquidated or otherwise offloaded if the surplus is financially unbearable), the effects of an extra child (or children) are substantial, persistent, irreversible, and cannot be easily mitigated. It is this inefficient, consistent pattern – and cycle – that is not apparent ex ante but creates parental regret once its effects are observed ex post.[254] The most important finding here is that this regret is not only predictable and repeatable, but, perhaps, preventable.[255]

[253] *See* comments by Prof. Teddy Brett of the LSE within Madeleine Bunting. *Is Birth Control One of Uganda's Biggest Challenges?* The Guardian. 11 July 2008.
[254] One could conceptualise this as the human capital equivalent of flawed mental accounting. *See generally*. R.H. Thaler. *Mental Accounting Matters*. Journal of Behavioural Decision-Making. 1999.
[255] Communicating increasingly-complex concepts to poor populations in poor countries is an area of increasing academic interest. *See*, *e.g.*, M. Bertrand et al. *Behavioral Economics and*

Marketing in Aid of Decision Making Among the Poor. American Marketing Association Journal, vol. 25, pp. 8-23. 2006. However, communicating messages that are intended to have socially-beneficial effects can often backfire or be misinterpreted, so any behaviour-change-targeted communications around Ugandan reproductive habits would need to be crafted with the utmost care. *See*, *e.g.*, *cf*. R. B. Cialdini. *Crafting Normative Messages to Protect the Environment featured in* R. B. Cialdini. Influence, Science, and Practice. Allyn & Bacon. 2001. *see also cf.* L. Ross & R. E. Nisbett. The Person and the Situation: Perspectives of Social Psychology at p. 11. McGraw Hill. 1991.

APPENDICES:

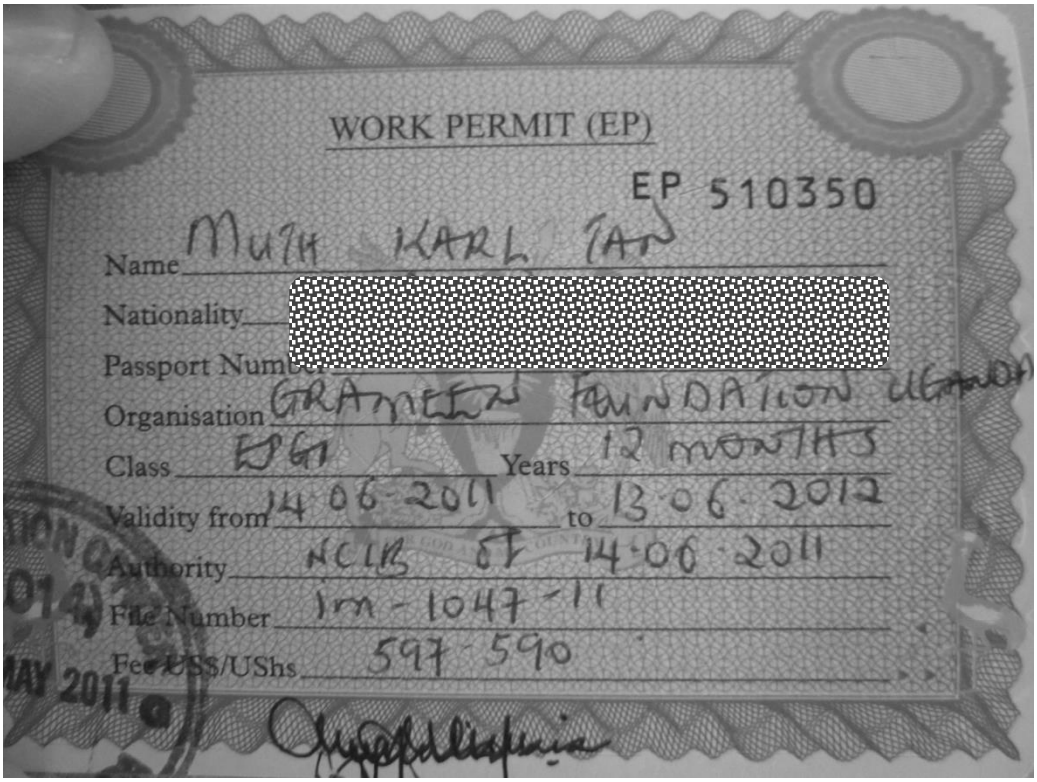
Appendix A. Working Immigrant Status in Uganda.

I entered Uganda on a tourist visa during initial fieldwork and was issued a work permit (employment permit) for my remaining time living and working in Uganda, where I conducted my experimental work, field work, and my work as an economist for Grameen.

The permit seen below was extended once on 1 June 2012 until 1 June 2013.

To the best of my knowledge, I did not do any work in Uganda between 14 June 2011 and 1 June 2013 that violated Ugandan immigration laws or exceeded the bounds of the work allowable under my employment permit.

I have paid taxes to the Uganda Revenue Authority, as I agreed to do in various immigration documents, and currently owe no further taxes.


WORK PERMIT (EP)

EP 510350

Name MUTH KARL IAN

Nationality [redacted]

Passport Number [redacted]

Organisation GRAMEEN FOUNDATION UGANDA

Class EG1 Years 12 MONTHS

Validity from 14-06-2011 to 13-06-2012

Authority NCIB OF 14-06-2011

File Number Im-1047-11

Fee US$/UShs 597-590

MAY 2011

Appendix B. Agreement With Grameen.

In order to have access to many of the subjects, resources, and areas needed for my research, I asked permission to use some of the data I worked with as an economist for Grameen in my Ph.D. work. To ensure full disclosure of that contract's terms and to illustrate that these terms of employment did not interfere with, or create a real or perceived conflict of interest with, my work as an academic researcher, the terms of that contract are included here in full.

VOLUNTEER AGREEMENT

This Volunteer Agreement ("Agreement") is made as of the 4th of January, 2011 between Grameen Foundation USA, a non-profit organization ("GFUSA") with its principal place of business at 1101 15th Street NW, 3rd Floor, Washington, DC 20005, and Karl T. Muth with an address of 61 W. 15th Street, No. 208, Chicago, IL 60605 ("Volunteer")

In consideration for GFUSA's agreement to permit Volunteer to participate in certain GFUSA activities and projects (as described in Exhibit A annexed hereto), Volunteer agrees to perform certain services upon the terms set forth herein. GFUSA accepts the rendering of such services on the terms and conditions set forth herein.

Section 1. TERM

This Agreement will become effective January 4, 2011 and will continue in effect until July 31, 2011 or such time as Volunteer notifies GFUSA in writing that Volunteer intends to discontinue his/her volunteer services ("Term"). At such time, s/he will provide at least one week's notice to GFUSA. GFUSA may terminate this Agreement at any time with written notice.

Section 2. RELATIONSHIP OF THE PARTIES

Both GFUSA and Volunteer agree that the relationship created by this Agreement is that of volunteer/non-profit organization and not that of employee/employer and that it does not create any agency, partnership, joint venture, franchise or other similar or special relationship between the parties. Volunteer is responsible for providing at his/her own expense evacuation, disability, unemployment, workers' compensation, and other insurance, training, permits and licenses for himself/herself. Volunteer shall not have the right or authority to assume or create any obligations or to make any representations, warranties or commitments on behalf of GFUSA, whether express or implied, or to bind GFUSA in any respect whatsoever.

Section 3. SERVICES TO BE PERFORMED BY VOLUNTEER

Unless otherwise agreed to in advance from time to time between the parties, Volunteer agrees during the Term to devote approximately three hours per week Monday through Friday in the performance of the services detailed in Exhibit A (the "Services"). Volunteer's point of contact at GFUSA during the term will be Camilla Nestor, Vice President, Microfinance, cnestor@grameenfoundation.org, Tel: +1.202.628.3560 x140.

Section 4. COMPENSATION & EXPENSE REIMBURSEMENT

4.1 Compensation. Volunteer and GFUSA agree that no monetary compensation will be paid for the Services. Volunteer agrees that s/he is not entitled to any of the rights or benefits afforded to GFUSA employees, including disability, unemployment, workers' compensation, medical or other insurance, vacation or sick leave or any other employee benefit. In lieu of monetary compensation, and in exchange for the Services performed by Volunteer, GFUSA grants Volunteer a license as set forth in Section 6.2.

4.2 Expense Reimbursement. Unless specifically agreed to in advance in writing, GFUSA is not responsible for any travel expenses paid or incurred by Volunteer in performing the Services. GFUSA will reimburse Volunteer for all duly-documented and reasonable business expenses, including software licenses or hardware, paid or incurred in performing the Services.

4.3 Support. GFUSA may permit Volunteer to use certain office space and office equipment and supplies as GFUSA may, in its discretion, designate.

4.4 International Travel. Volunteer is solely responsible for ensuring s/he obtains a proper visa, or other authorization, required to travel in the countries and locales in which any services will be performed.

Section 5. CONFIDENTIALITY

5.1 Definition. ***Confidential Information*** means any information relating to or disclosed during the Term which is or should be reasonably understood by Volunteer to be confidential or proprietary to GFUSA or any of its partners or consultants, including, but not limited to, the material terms of this Agreement, technical processes and formulas, source codes and other software, product designs, sales, cost and other unpublished financial information, product and business plans, projections, and marketing data for both GFUSA and its partners. Confidential Information does not include information (a) independently developed by Volunteer prior to access to GFUSA's Confidential Information; (b) generally known to the public through no act or omission of Volunteer; (c) obtained by Volunteer from any third party not owing any confidentiality obligation to GFUSA; *provided* that (i) no such exception shall apply except to the extent clearly demonstrated by Volunteer; and (ii) only the specific information that meets the exclusion shall be excluded and not any other information that happens to appear in proximity to such excluded portion (for example, a portion of a document may be excluded without affecting the confidential nature of those portions that do not themselves qualify for exclusion); or (d) market data or field data created or harvested by the Volunteer as part of the Services using Volunteer's survey tools, Volunteer's econometric tools, software created or substantially created by Volunteer, or Volunteer-created methodologies. Volunteer shall not publish any data gathered while rendering the Services without the notation, "Data gathered on behalf of Grameen Foundation" or a similar notation. Volunteer shall send two (2) bound proof copies of the Ph.D. thesis to Camilla Nestor or Grameen Foundation for review and comment at least forty-five (45) days prior to the viva (defense).

5.2 Obligations. Volunteer acknowledges that Confidential Information may be disclosed during the course of this Agreement. Volunteer agrees that s/he will (a) not disclose the Confidential Information to anyone except to perform Volunteer's obligations hereunder; (b) take steps that are substantially equivalent to the steps it takes to protect his or her own proprietary information (and in any event no less than reasonable steps), during the Term, and for a period of five (5) years following expiration or termination of this Agreement, to prevent the duplication or disclosure or access to the Confidential Information, by any third party; and (c) use the Confidential Information only for the purpose of performing the Services. Volunteer may disclose Confidential Information required to be disclosed by law; *provided* that s/he shall (i) notify GFUSA promptly upon learning about any court order or other legal requirement that purports to compel disclosure of any Confidential Information; and (ii) cooperate with GFUSA (at GFUSA's expense) in the exercise of GFUSA's right to protect the confidentiality of the Confidential Information before any tribunal or governmental agency. Disclosure of Confidential Information pursuant to a court order or other legal requirement that purports to compel disclosure of any Confidential Information shall not constitute publication or otherwise alter the character of that information as Confidential Information as between the parties hereunder. The parties agree that any breach or threatened breach of this Agreement by Volunteer would cause not only financial harm, but irreparable harm to GFUSA; and that money damages will not provide an adequate remedy. In the event of a breach or threatened breach of this Agreement by Volunteer, GFUSA shall, in addition to any other rights and remedies it may have, be entitled (without the necessity of posting any bond or surety) to an injunction restraining Volunteer from disclosing or using, in whole or in part, any Confidential Information.

Section 6. INTELLECTUAL PROPERTY

6.1 Volunteer hereby represents and warrants that all Services will be provided while Volunteer is working independently of any employer of Volunteer and independently from any third party (any such employer or third party being referred to herein as a "Third Party"), and that no Services will:

a. use any Third Party resources, including without limitation any computers or software programs owned by or licensed to such Third Party;

b. be performed during any period when Volunteer is working for any Third Party;
c. result in any Work Product (as defined below) that is related to the product offering of any Third Party to whom Volunteer has a contract (for fee or on a volunteer basis) or employment relationship, and
d. not violate any employment or contract obligation Volunteer has to any Third Party.

6.2 Work Product: "Work Product" means all software, reports, documentation and other work product created in whole or in part or delivered by Volunteer in preparation for or performing or otherwise the course of the Services. Volunteer hereby assigns to GFUSA all right, title and interest in and to all such Work Product and all intellectual property rights therein as of the date such Work Product is created. Volunteer agrees that GFUSA shall be entitled to exploit all such Work Product without any requirement to compensate Volunteer, except as provided in Section 4.1. Volunteer represents and warrants that s/he has sufficient rights to use and deliver all Work Product and to assign such all rights to such Work Product to GFUSA. Without limiting the foregoing, Volunteer represents and warrants that all software and documentation delivered hereunder by Volunteer will be Volunteer's original works of authorship. Without the express written consent of GFUSA, Volunteer shall not incorporate into any Work Product any third party material or third party intellectual property. Notwithstanding the foregoing, GFUSA grants Volunteer a limited license to use the Work Product for any academic, non-commercial purpose, including dissertations and other academic work.

Section 7. COMPLIANCE WITH LAW

7.1 Volunteer agrees that in rendering Services under this Agreement, Volunteer will neither undertake nor cause or permit to be undertaken any activity which, to Volunteer's knowledge or through reasonable inquiry, is unlawful under the laws of the United States of America, or any state within the United States in which Services will be performed, and/or any other country in which Services will be performed.

7.2 Volunteer represents and warrants that he or she has not provided and will not knowingly provide, material support or resources to any individual or entity that it knows, or has reason to know, is or acts as an agent for an individual or entity that advocates, plans, sponsors, engages in, or has engaged in terrorist activity. Such individuals and entities may be, but are not necessarily, listed by the United Nations Security Council Resolutions 1267 and 1390; the list promulgated by the European Union pursuant to EU Regulation 2580; the Annex to Executive Order 13244, or may be designed by the United States, under any of the following authorities: Section 219 of the Immigration and Nationality Act (as amended 8 U.S.C. 1189), the International Emergency Economic Powers Act (50 U.S.C. 1701 et seq.), the National Emergencies Act (50 U.S.C. 1601 et seq.) or Section 213 (a)(3)(B) of the Immigration and Nationality Act, as amended by the USA PATRIOT Act of 2001 (8 U.S.C. 1182).

7.3 Volunteer represents that it shall comply with the provisions of the Foreign Corrupt Practices Act as in effect on the date hereof (and as amended and supplemented from time to time) in the United States of America and that no activities undertaken by Volunteer will involve corrupt payments to local or foreign officials for the purpose of obtaining or keeping any business.

Section 8. Liability.

8.1 Volunteer will perform the Services hereunder entirely at his or her own risk and agrees to hold GFUSA harmless for any injury, loss, damages or expenses of any nature sustained by Volunteer in rendering Services under this Agreement.

8.2 Volunteer hereby agrees to indemnify and hold harmless GFUSA, its trustees, employees, directors, contractors and agents from and against any damages, liability or expenses (including without limitation, attorneys fees) arising from (1) any breach by Volunteer of any provision of this Agreement; or (2) any negligent act or omission or any intentional tort committed by Volunteer.

Section 9. CHOICE OF LAW

This Agreement will be governed by the laws of the District of Columbia without reference to its conflicts of law provisions.

Section 10. ENTIRE AGREEMENT

This Agreement supersedes any and all prior oral and/or written discussions, agreements and/or promises, if any, between the parties and constitutes the entire and final agreement between the parties on the subject matter herein. This Agreement cannot be amended except in writing.

Section 11. PRESS RELEASES

Volunteer shall obtain GFUSA's consent prior to issuing any press release related to this Agreement. Volunteer hereby permits GFUSA to publish profiles on Volunteer's contributions to GFUSA and microfinance in GFUSA materials, reports and publications and will provide biographical information to GFUSA for such purposes.

Section 12. CODE OF CONDUCT

Volunteer has read and agrees to adhere to the Grameen Foundation USA Code of Conduct attached herein.

THE PARTIES HERETO HAVE EXECUTED THIS AGREEMENT as of the day and year first above set forth.

VOLUNTEER	**GRAMEEN FOUNDATION USA**
	_____
Karl T. Muth	Shannon Maynard
	Director, Bankers without borders™

EXHIBIT A

Statement of Work

Project Summary: As part of a Grameen Foundation (GF) initiative to evaluate the potential for microinsurance products tailored for the very poor to help clients manage risk, Grameen Foundation is initiating supply-demand research in Uganda. GF will utilize its Community Knowledge Worker (CKW) network to conduct demand-side research. The volunteers will lead supply and demand research which will form the basis for a GF decision about how to best engage in the microinsurance/risk management space.

Objective: ***Understand Demand***
Understand perception of risk in a specific agricultural community in Uganda (may narrow down to specific region within Uganda based on local team's advice)
Gauge reaction to some potential products to better understand perception of insurance

Action Plan

Refine the survey tool
Explore other survey tools used by Microfinance Opportunities and others
Use survey to better understand how farmers perceive and prioritize risk generally
Include a couple of product prototypes to gauge reaction
Translate tool into relevant local languages
Include poverty scorecard so data can be analyzed according to different poverty levels of farmers
Create research plan
Create sampling plan and operational plan, including desired sample size and how to achieve it
Develop training materials around survey delivery for GF's CKW team
Work with GF's CKW team on implementing the survey through CKWs
Field test the survey through CKWs and refine if necessary
Create data analysis plan, detailing how data will be captured and analyzed

a. ***Objective: Understand Supply***

Map current providers of insurance within agricultural communities in Uganda (to include all types of insurance that relate to the risks farmers face)
Explore potential uses of farmer data with insurance companies and evaluate whether this could expand availability of insurance

Action Plan

Prepare written summary identifying all current providers of insurance within the surveyed communities – ie, every type of insurance the farmer may feasibly have access to. Gather basic data on features of this insurance.
Current outreach (numbers of people currently reached)
Product terms and conditions
Company's estimates of demand
Discuss with select short list of companies how they could feasibly use data generated by CKWs about farmers crop yields, weather conditions, etc. to improve their products and/or increase supply of insurance products.

b. ***Objective: Evaluate Supply-Demand Gaps [in discussion with GF]***

Evaluate whether the potential for increased supply that could come through improved farmer data would result in greater uptake of insurance products by better meeting farmer demand.

Action Plan

Match information learned about farmer's risk perceptions with information learned about potential to increase supply – would the increased availability of data to insurance companies result in increased uptake of insurance products by rural farmers? Why/why not?

Timeline:

January 15	*Final draft of survey tool shared with GF*
February 28	*Final version of the Survey Tool is in place, translated and ready to be deployed in Uganda.*
March	*Survey is rolled out in a limited population for testing and initial data returns*
March-April	*Survey (with any edits or corrections needed) is rolled out to full population*
February	*Volunteers provide GF with a written summary identifying all current providers of insurance within the surveyed communities and key features outlined above*
April-May	*Depending on results at this point, volunteers might travel to Uganda to meet with CKWs; review administration of the Survey Tool first-hand; and meet with select list of local insurance providers to discuss supply-side findings and potential areas of intersection with initial demand results.*
By July 31	*Volunteers finalize summary paper and clean dataset detailing findings and present to GF*

The dates in the table above might be changed upon the agreement between the project manager and the volunteer.

Grameen Foundation USA Staff

Agreement for Compliance with

Policies and Procedures for

Code of Conduct and Conflict of Interest

A. <u>Code of Conduct</u>

In order to ensure the successful mission and protect the reputation of GF, it is imperative that GF employees and volunteers ("GF Staff")[256] engage in behavior that is ethically sound and legally compliant. Our reputation for integrity and excellence requires careful observance of the spirit and letter of all applicable laws and regulations and the avoidance of even the appearance of improper behavior or impropriety, as well as a scrupulous regard for the highest standards of conduct and personal integrity. The continued success of GF is dependent upon our donors and partners' trust and we are dedicated to preserving that trust. GF Staff owe a duty to GF and its donors and partners to conduct all activities in a manner that will merit continued trust and confidence.

[256] Officers, Directors and Advisory Council Members are bound by the Grameen Foundation USA Conflict of Interest Policy adopted by the Board of Directors on March 22, 2007. Contractors are bound by the contract signed with GF.

GF, pursuant to its documents of incorporation, and within the confines of its bylaws, has a mission to enable the poor, especially the poorest, to create a world without poverty. How GF performs its mission is as important as the mission itself. GF must at all times perform its operations in a manner that increases and evinces integrity, accountability, responsibility and transparency.

In connection with all operations, GF Staff are required to comply with all internal policies, procedures and directives as well as with all applicable laws and regulations. All GF Staff members are required to conduct business in accordance with the letter, spirit, and intent of all relevant laws and regulations and to refrain from any illegal, dishonest, or unethical conduct.

GF Staff, in delivering services and in all other GF activities, agree to meet the following Code of Conduct.

No GF Staff shall:

Accept, or seek on behalf of any person, any financial advantage or gain of other than nominal value offered as a result of the GF Staff's affiliation with GF (Private Benefit).
Knowingly take any action or make any statement intended to influence the conduct of GF in such a way as to confer any financial benefit on any person, corporation or entity in which the individual has a significant interest or affiliation (Private Inurement).
Publicly use its GF affiliation in connection with the promotion of partisan politics, religious matters, or positions on any issues not in conformity with GF's vision and beliefs.
Disclose or use any confidential GF information that is available solely as a result of the affiliation with GF, to or with any person not authorized by GF to receive such information, or to use any GF information to the disadvantage of GF.
Authorize the use of the Grameen name or logo, GF funds, GF Trademarks, services or property of GF for personal gain, or for the benefit or advantage of any person except in conformance with GF policy.
Operate in any manner contrary to the best interests of GF.
Operate or act in a manner that creates a conflict with the interests of GF (see **Conflict of Interest Policy)**.

In general, the use of good judgment, based on high ethical principles, will guide GF Staff with respect to lines of acceptable conduct. If a situation arises wherein it is difficult to determine the proper course of action, GF Staff must seek advice and counsel from their supervisors and, if appropriate, from the General Counsel.

Reporting unethical conduct, illegal behavior, fraud, abuse or waste is a mandatory obligation of all GF Staff members. If you have knowledge of conduct that could potentially harm GF you are obligated to report such conduct to the General Counsel or your point of contact at GF. By not reporting such conduct, GF Staff would be acting contrary to the best interests of GF, which is a violation of the Code of Conduct.

To do this, we must also maintain at all times an environment where GF Staff feel free to call attention to legal or policy violations and to investigate impartially the related concerns. GF will not retaliate against any individual for reporting suspected violations of laws, regulations or GF policies in good faith. In addition, we will not tolerate retaliation against GF Staff for such reporting. GF Staff are expected to cooperate in internal investigations of misconduct.

We have a history of succeeding through honest business activities. We do not seek the furtherance of our mission through illegal or unethical business practices but rather seek to achieve successes fairly and honestly. GF Staff should endeavor to deal fairly with all individuals and entities. GF Staff should not take unfair advantage of anyone through manipulation, concealment, abuse of privileged information, misrepresentation of material facts, or any unfair dealing practice.

GF is an equal opportunity employer, which does not discriminate against applicants, employees or volunteers based on race, color, religion, sex, national origin, citizenship, age, handicap or disability, veteran status, or any other characteristic protected by law. Our policy applies to all personnel transactions, terms, and conditions of employment. GF will make reasonable accommodations where and when required because of an individual's disability or religion.

All GF Staff should strive to preserve and protect GF's assets and ensure their efficient use. All GF assets may only be used for legitimate GF business purposes. Please remember that the materials, products, photographs, designs, plans, ideas and data of this organization (including those created by GF Staff using GF

time, resources, or opportunity) are the property of GF, and may not be given to anyone except through normal channels and with appropriate authorization by GF. Assets also include, without limitation, proprietary information and intellectual property rights, computer systems and the data on these systems, including, without limitation, passwords allowing access to the data on the systems.

Compliance with proper business ethics and conduct is the responsibility of every GF Staff member. Sometimes the line between personal and GF benefits is difficult to draw, and sometimes both personal and GF benefits may be derived from certain activities. In such situations, GF Staff must take measures to ensure that any use of GF property or services that is not solely for the benefit of GF's mission is approved beforehand by a supervisor or the General Counsel.

Contact the General Counsel for more information or questions about the Code of Conduct.

Disregarding or failing to comply with this Code of Conduct could lead to legal action, and/or termination of the volunteer relationship with GF

B. GF Staff Conflict of Interest Policy

GF Staff must ensure that they at all times conduct GF business in such a manner as to avoid a potential or actual conflict of interest. In general, a conflict of interest arises when a person's personal, professional, or financial interests compete or conflict with his or her responsibilities to Grameen Foundation (a potential or actual "Conflict of Interest"). Such a Conflict of Interest can exist whether or not money is involved, and whether the conflict is actual or only perceived.

"Conflict of Interest" is defined as:

A situation where a person's competing interests and loyalties between his or her personal, business or other interests and the interests of GF make it difficult to fulfill his or her duties to GF impartially; or
Any financial or other interest which conflicts with the obligations of the individual to GF because it:
could impair the individual's objectivity, or
could create an unfair advantage for any person or organization

There may be times when the GF Staff member's personal interests conflict with, or appear to conflict with, the best interests of GF. A conflict could be a financial interest (such as owning a financial interest in a company that does business with GF) or a situation in which a relative[1] owns or works for a competitor, supplier, or partner of GF. A potential conflict also arises when a GF Staff member or relative receives any remuneration, gift of more than de minimis value (i.e., in excess of $25), or special consideration as a result of any transaction or business dealings involving GF. Even if there is no evidence of improper conduct, a conflict of interest can create an appearance of impropriety that can undermine confidence in the ability of that person to conduct his or her duties with proper ethics.

If any GF Staff member is, or will be serving as, a director or officer of an organization that is a partner, supplier or competitor of GF, a potential conflict may exist. When a GF Staff member acts as a director of a partner, he or she has an affirmative obligation to act in a fiduciary or similar capacity regarding actions of the partner. These obligations may conflict with GF's best interest and require both disclosure and prior approval by the Executive Leadership Team.

Employees may not hold outside jobs or engage in activities that are in competition with GF, or that interfere with their duties with GF, without the express written consent of the President.

All GF Staff members are obligated to promptly disclose any actual or potential conflict of interest arising between his or her personal, business or financial interests and the interests of GF. For example, a non-exhaustive list of the types of situations that require disclosure and prior approval, include:

any interest (or any interest held by an immediate family member) in any Recipient of GF funds or in any organization or entity furnishing property or services to GF or otherwise entering into a transaction with GF
any transaction involving GF that would benefit the person or his or her immediate family, or any organization in which he or she (or his or her immediate family) has an interest
any opportunity within the scope of GF's activities that a person (or his or her immediate family) wishes to exploit for personal benefit
the receipt (including receipt by the person's immediate family) of any gifts or compensation as a result of any transaction involving GF

Such disclosure must be made to any member of the Executive Leadership Team and must be made immediately upon becoming aware of the potential conflict. Until GF approves actions to mitigate or otherwise resolve the conflict, the GF Staff member must abstain from participating in any discussions, deliberations, decisions or voting related to the conflict of interest.

This policy imposes an ongoing obligation on all GF Staff to be aware of and consider this Policy at all times. Complying with the requirements of this Policy should become a habit and the practice of all GF Staff. This Policy establishes only the framework within which GF wishes the business to operate. The purpose of these guidelines is to provide general direction so that GF Staff can seek further clarification on issues related to the subject of acceptable standards of operation. Contact the General Counsel for more information or questions about the Conflict of Interest Policy.

Disregarding or failing to comply with this Conflict of Interest Policy could lead to legal action and/or termination of the volunteer relationship with GF.

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As a Volunteer of Grameen Foundation USA I hereby agree to be bound to the terms and conditions of the Grameen Foundation Code of Conduct and Conflict of Interest Policies and Procedures as set forth above**.**

GRAMEEN FOUNDATION USA

1101 15th STREET NW, 3rd FLOOR

WASHINGTON, D.C. 20005

TRAVEL WAIVER AND RELEASE OF LIABILITY

I, Karl T. Muth, am a volunteer for Grameen Foundation USA, and have agreed to travel to the country of Uganda to continue work on behalf of Grameen Foundation in the field of economics, including helping with the administration/analysis of market survey work, conducting product analysis, and continuing market analysis related to insurance.

Grameen Foundation, USA is a non-profit organization, all references to Grameen Foundation USA include its Board of Directors, employees, volunteers, sponsors, agents and assigns.

I hereby certify that I freely choose to travel to and conduct some field research and freely accept all the risks associated with the Program.

I agree to inform myself about the potential dangers of the areas I am traveling to and precautions that should be taken, including reviewing the State Department Consular Travel Information at http://www.travel.state.gov and the Centers for Disease Control Travelers Information at http://www.cdc.gov/travel/ for health and immunization information.
I agree to register with the appropriate Consular Section of my country's embassy or consulate upon arrival in or prior to traveling to Uganda.

I hereby assume all risk of injury, death or illness resulting from my participation in this travel, and that I fully understand the dangers and hazards of such activity, and agree that:

I have or will secure health insurance to provide adequate coverage for any injuries or illnesses that I may sustain or experience while participating in this travel.
By my signature below I certify that I have confirmed that my health care coverage will adequately cover me while outside of the United States, and hereby release Grameen Foundation, USA and their officers, employees, representatives and agents from any responsibility or liability for expenses incurred by me for injuries or illnesses (including death) that I may incur because of those injuries or illnesses.

I understand that the activities I may undertake may be potentially dangerous and that I may be injured and/or lose or damage personal property or suffer financial loss. Therefore I assume all risks related to the activities including but not limited to:

Loss or injury as a result of a crime or criminal act by third parties, terrorism, war, civil unrest, riot, detention by a foreign government, arrest or other act of any government or authority.

Theft or loss of personal.
Loss or death or injury as a result of any natural disaster or event or extreme weather conditions or events.
Alteration including delay, extension or cancellation of the travel due to natural disaster, civil unrest, war, terrorist attack, medical quarantine or any other disturbances or causes.

I further acknowledge that the above list is not inclusive of all possible risks associated with the travel, and that the above list in no way limits the extent or reach of this release and covenant not to sue. I understand that participating in this travel is an acceptance of risk of injury.

I do hereby agree to waive any claims for personal injury or property damage against Grameen Foundation USA, and against any and all employees of Grameen Foundation USA and by my signature below do release and forever discharge Grameen Foundation USA, and their officials, officers, agents, employees and representatives (including volunteers), and their heirs, executors, administrators, successors and assigns, from each and every right and claim that I may hereafter have on account of damages or personal injury resulting from any incident, occurrence or activity arising from my participation in this travel and work.

I hereby declare that the terms of this release are contractual and not a mere recital. This release shall bind me as the signor, my heirs, next of kin, executors, administrators, successors, or assigns and shall inure to the benefit of the parties released, their heirs, next of kin, executors, administrators, successors or assigns. The release granted herein shall commence and be in full force and effect after the date set forth below.

I agree that should any provision or aspect of this release be found to be unenforceable, all remaining provisions of the release will remain in full force and effect.

I represent that my agreement to the provisions herein is wholly voluntary, and further understand that prior to signing this release I have the right to consult with the adviser, counselor, or attorney of my choice.

I agree that, should there be any dispute concerning my participation in this travel that would require the adjudication of a court of law, venue will lie only in the state and federal courts of the District of Columbia.

This release represents my complete understanding regarding the release of the Grameen Foundation USA from responsibility and liability for my participation in this travel, supersedes any previous or contemporaneous understandings I may have had with the Grameen Foundation USA on this subject, whether written or oral, and cannot be changed or amended in any way without my written concurrence.

I represent that I am at least eighteen years of age.

THE UNDERSIGNED HAS READ THE FOREGOING RELEASE AND FULLY UNDERSTANDS AND AGREES WITH ITS TERMS AND CONDITIONS. FURTHER, THE UNDERSIGNED AGREES UNDER PENALTY OF PERJURY THAT THE SIGNATURE IS A TRUE AND CORRECT SIGNATURE.

Signature

Karl T. Muth

Volunteer's Name

Appendix C. Disclosure of Research and Research Intent.

All participants in this research, including the experimental portions of this research, were informed of the nature of this research, its potential global audience, and the non-privacy of their answers to questions concerning their household size, income, and other characteristics. The two individuals whose farms are highlighted in Chapter 2 were made aware that specific characteristics of their homes, families, and businesses might be made public through the publication of this research.

Though not funded by the ESRC, this research was conducted with the ESRC research ethics guidelines in mind (Framework for Research Ethics, or FRE, introduced in 2006). Specifically, all subjects were told of the nature and scope of the research prior to being asked to participate in any survey, disclosure, or experiment. All subjects were told of the gambling component of the experimental portion of the research prior to choosing to participate and told they were not required to participate and that moral, ethical, religious, or other objections to gambling were example reasons to not participate.

Grameen Foundation, the Bill and Melinda Gates Foundation, and other partners worked to make further disclosures throughout this research, making it clear to all parties involved what the scope, nature, intent, and outcome of this research might involve. Field notes as cited here were anonymised to the extent practical and all data used herein is used in an aggregated form except where it was absolutely necessary to discuss a particular business or person as an example or relevant special case.

Appendix D. Bicycle.

A man west of Kapchorwa uses a sturdy Raleigh II Elite bicycle to transport lumber and a canvas-lined burlap bag containing his seeds for the next season.

A Lango child utilises an inferior bicycle cobbled together from Raleigh II, Raleigh Speed, and Chinese knockoff Shimano drivetrain parts.

Appendix E. Oxen.

Oxen of the longhorn type favoured by the Sebei (but not by the Langi or southern Ugandans) for ploughing are herded near a road that leads to South Sudan.

Appendix F. New Vision Newspaper Article Re Ox-ploughs.

The following article appeared in the New Vision newspaper in Uganda on 31 August 2010 and describes Chinese-made steel single-share, two-ox ploughs, which only became available recently. Prior to this, only wooden single-ox ploughs with transverse anchored tines (an Ethiopian design) were available.

The ox-plough makes work easy

By Joshua Kato

PREPARING land for planting is one of the most important activities in the farming process. For whatever crop a farmer intends to plant, land has to be prepared. Ploughing or Okukabala in Luganda is normally done a few days into the rainy season.

In most cases, Ugandan farmers use the traditional hand hoe to plough the shamba. Research shows that on average, this hoe takes more than a month to plough an acre.

By this time, the area that the farmer ploughed first might be overgrown with grass.

The ideal tool for ploughing that every commercial farmer should have is a tractor-walking or heavy duty; however, because it is expensive, it is out of reach of most farmers in Uganda.

A tractor plough digs deeper in the soils, hence reaching the fertile, virgin soils. Comparatively, a hand hoe digs less than six inches at the most.

The nearest affordable farm tool is the Ox-plough. It is called the Ox-plough because it is composed of a pair of oxen and a plough.

To plough an acre, a plough needs just four days, and that is if it is used moderately. The Ox-plough is one of the oldest forms of agriculture mechanisation.

The plough is attached to the oxen that then pull it. The farmer then pushes the plough's hoe deep down the soil. The plough digs into the soils as it moves along.

Ploughs are not commonly used in the central and western regions; however, they are used by commercial farmers in the north and east. In the last four years, groups like FAO, Farm Africa and the Government have given out thousands of ox-ploughs to returning IDPs in northern Uganda.

For a set, a farmer needs two oxen, which are well built bulls most of the time.
The best cows are moderate in size and short horned, like those indigenous in Teso and Karamoja regions. They should be well fed to help in maintaining their energy levels.
Prices of these bulls vary however they range from sh250,000 to sh400,000. The plough itself costs sh250,000[257] in most agro-inputs outlets across the country. To have a complete set, a farmer needs at least sh1m.
The ploughs can be got from most agricultural machinery out lets [*sic*] across the country.

[257] The prefix sh is used within Uganda to mean Ugandan shillings, rather than the standard international currency abbreviation UGX.