Research Proposal

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My research studies the development of economies from two perspectives. One perspective analyzes data gathered as a byproduct of the operation of mobile phone networks in developing countries. A second analyzes the implications of innovations. As a postdoc I would hope to pursue both of these; here I briefly outline the first and provide more detail on the second.

Mobile Phones to Study Development

In my job market paper, "The Adoption of Network Goods: Evidence from the Spread of Mobile Phones in Rwanda," I build a structural model of adoption for an African country's mobile phone network. I use detailed transaction data for 88% of Rwandan mobile phone subscribers over 4.5 years to estimate a model of adoption and usage, and simulate the effect of policies to promote usage in rural areas, finding that both an obligation to provide coverage in rural areas and a government handset subsidy program increased welfare.

In related work, I analyze how individuals learn about profitable new technologies by tracing the adoption of a mobile phone discount, exploiting the fact that the network of users and all learning-by-doing experiences are visible in transaction records. I am also working on a credit scoring method for unbanked borrowers that uses behavioral signatures from mobile phone usage to predict loan repayment and entrepreneurial success.

Innovation and Hidden Quality

Even simple goods have many dimensions of quality. Given this high dimensionality, it is not feasible to communicate all dimensions of quality when exchanging goods over markets. As a result, only some dimensions are known to the consumer; some at the time of purchase (they may be directly observed, labeled, or regulated) and others after experiencing the good. The largest set of dimensions, which I call hidden quality, are effectively never known by the consumer.

This project analyses implications of quality being hidden: innovation can lower welfare, and a common policy response—labeling and regulation—can also reduce welfare, by inducing tradeoffs between newly regulated qualities and valued qualities that remain hidden.

For example, consider an orange. Its attributes include a nutrient profile, with nutrients we have discovered as well as ones we have yet to discover. These are many: the most commonly used nutrient database reported up to 146 different components per food item in 2011, up from 113 components in 2001 and 79 in 1996. But in reality, each nutrient in an orange is not just a number but a function of other factors, such as time since harvest and exposure to light, heat, and chemicals. The orange also may contain residue from any pesticides or fertilizers used during production, or waxes used to improve durability during transit. There may also be unforeseen effects of genetic engineering. Even for simple goods, it is likely that quality has an infinite number of dimensions.

It is not possible to fully represent this complexity when a good is exchanged. This is due to a combination of familiar reasons: verification is prohibitively costly for some dimensions, there are cognitive costs associated with assessing each dimension, and attributes may be shrouded (Gabaix and Laibson 2006). As a result, consumers make decisions on surprisingly little information. A consumer buying an orange may observe its smell, the condition of its skin, its weight, and a label. After purchase, the consumer may observe its taste and appearance within the peel. Even an extremely informed consumer knows more only very coarsely: she may have memorized a subset of the nutrient profile from a few representative oranges tested in a government lab, and may have internalized some rules of thumb about nutrient depletion or labels to avoid.

Hidden dimensions of quality can have large economic significance. Electronics on standby mode represent up to 10% of residential electricity consumption, but consumers have almost no information on it (Economist 2006). Although air conditioning systems represent 5.5% of vehicle fuel use in the U.S., they were not included in fuel economy ratings until 2008 (Rugh et al., 2004).

Given that consumers internalize these hidden dimensions, we might expect that consumers would learn them over time. This is certainly the case for some dimensions of quality; however, there is a large class of dimensions that are internalized but difficult to attribute. Attribution can be difficult because of a lag (micronutrient deficiency and radiation exposure have delayed effects) or because the consumer cannot disentangle multiple factors affecting an outcome (electronics draw substantial amounts of electricity in their idle state but consumers observe only aggregate power usage).

Although consumer decisions are based on a collapsed set of dimensions, the full set of quality is affected by producer decisions, so there is a friction in how producers respond to consumer preferences. In a static setting, the friction results in basic underprovision of hidden quality, with further effects constrained by production technology. With a given technology there are only so many ways to manipulate quality. However, in the presence of technological innovation, production functions are made more flexible, which can exacerbate the friction.

When innovation threatens hidden dimensions of quality, a common policy response is to regulate those threatened dimensions or require that they be labeled for consumers. However, if firms innovate to improve the newly regulated dimensions at the expense of other valued dimensions that remain hidden, such a policy can reduce welfare. In settings with many important hidden dimensions that can be traded off against each other, regulation should not sharply target a subset of dimensions but more softly represent consumer preferences across all valued dimensions.

I aim to find an empirical example to quantify the importance of hidden quality in a particular setting. I am looking into two settings: the labeling of automobile efficiency, and nutrients in foods.

Foods are quite complex, with many dimensions of quality that are hidden from consumers. Advances in agricultural and manufacturing have made production technology more flexible, and as a result foods are also differentiated in these hidden dimensions.

A significant change in agriculture has been the introduction of new crop varieties. Crops are bred to improve observables such as yields; but there is evidence that these improvements have been accompanied by losses in dimensions that consumers do not observe.

Mineral content in wheat in the U.S. and U.K. has declined significantly over the last century (Thomas, 2003, Fan et al., 2008, Davis et al., 2004), and the losses are linked to the use of modern, high yield varieties (Murphy et al., 2008, Garvin et al., 2006, McGrath et al.). The figure below shows the relationship between yield and mineral content for varieties of red winter wheat introduced between 1873 and 2000.[1]

Through a FOIA request, I have obtained a repeated FDA cross section on processed food packaging, which I intend to analyze to determine the effects of regulation on hidden quality.

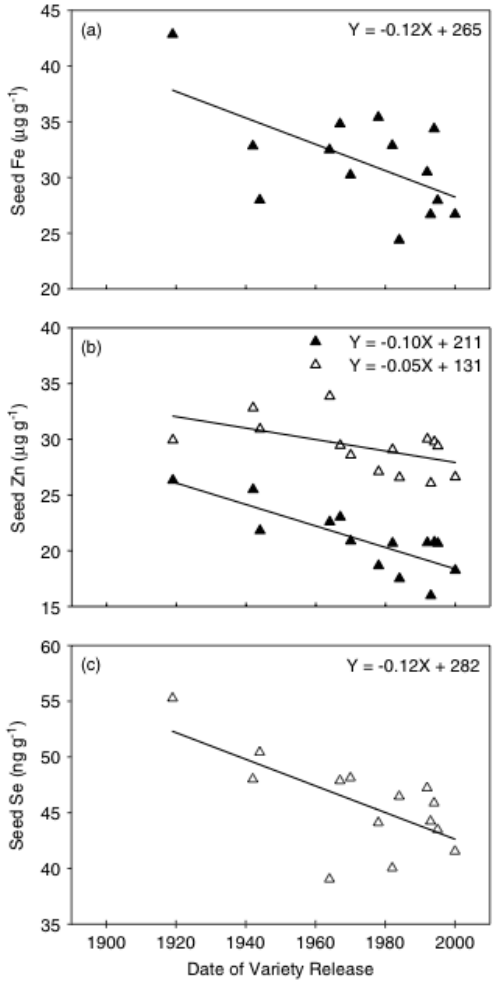

Figure 3. Significant regressions of wheat seed micronutrient contents on date of variety release. Filled and open triangles are data points for Hutchinson and Manhattan, KS, respectively. The best-fit simple linear regression line is shown.

[1] The welfare effects of these tradeoffs are not readily apparent: for example, it may be socially optimal to produce higher yielding varieties with reduced micronutrient content, and replace the missing micronutrients with supplements. However, most consumers are not aware of these changes.