

“Mobiles Make the Markets Now”:

How Mobile Phone Technology Makes Markets in Developing Countries More Efficient

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Abstract

The introduction of mobile telephony in developing countries has opened up an opportunity to empirically study the influence of information and communication technology on market behaviour. Mobile phones increase access to information and reduce search costs, which economic theory predicts will lead to lower equilibrium price dispersion across markets, producing a welfare improvement for market agents. This paper reviews recent microeconomic studies on the effects of mobile phone adoption in several agricultural sectors of developing countries, and relates their findings to relevant economic theory, as well as outlining possible impacts on macroeconomic processes. The introduction of mobile telephony is found to be causally related to decreased equilibrium price dispersion, improved adherence to the law of one price, reduction of waste, higher market integration, and welfare improvements for producers and consumers of agricultural goods. In conclusion, this paper shows that mobile phone technology can make markets more efficient. This means that information technology policy, and especially mobile phone network development, are relevant in a broader economic context. In particular, mobile phone technology could play a significant role in poverty reduction strategies.

Keywords: Telecommunications, mobile phones, search costs, price dispersion, markets, international development, developing countries.

"Mobiles Make the Markets Now"¹:

How Mobile Phone Technology Makes Markets in Developing Countries More Efficient

"A device that was a yuppie toy not so long ago has now become a potent force for economic development in the world's poorest countries", *The Economist* (2008) has reported about mobile phones, and in *The New York Times Magazine*, Corbett (2008) has raised the question whether "the cellphone [can] help end global poverty". Indeed, the mobile phone might be a game changer for developing countries. Yet little has been said about the economic mechanisms that underlie the technology's big potential. Economists have long accepted that information is crucial for the functioning of markets, since Stigler (1961) has laid down the fundamentals of this field. But despite the eminent role of information in economic theory, the body of empirical studies on the influence of ICTs on market behaviour is relatively small. In recent years, the impact of the Internet on markets in developed (Brown & Goolsbee, 2000) and developing countries (Goyal, 2010) has been subject to some research which found reductions in price dispersion. A range of more significant microeconomic studies, however, focuses on mobile phone technology in developing countries, where in some areas a phased roll-out has allowed for a near-experimental observation of its impact on market behaviour. Aker (2008) has claimed that mobile phones primarily impact markets by reducing the cost of search (p. 1). Her studies on grain markets in Niger (2008; 2010) and Jensen's (2007) research on the South Indian fisheries industry find that the introduction of mobile phones leads to a decrease in price dispersion, elimination of waste, and Marshallian welfare gains². It can thus be expected that mobile phone technology makes markets more efficient, benefiting producers, traders, and consumers of agricultural goods. In the following, this paper will outline the framework of economic theory in which mobile phones' impact on markets can be analysed. It will then proceed to review the existing body of microeconomic studies from developing countries, and link their findings to possible macroeconomic effects. Finally, it will conclude by giving a broader assessment of mobile phones' relevance for developing countries.

1 An anonymous Indian fish trader, cited in Abraham (2007).

2 A Marshallian surplus combines welfare gains for both producers and consumers of a given good.

Analytical Framework

Economic theory often relies on the notion that market participants have access to sufficient and symmetric price information to engage in optimal arbitrage: Knowing that elsewhere they can sell at a higher, or buy at a lower, price, they will trade in the market that allows them to achieve the most favourable deal (Jensen, 2007, pp. 879-880). This is captured in the law of one price, which states that the price of a good on two markets will not differ any more than the cost of transportation between them (p. 879).

In reality, however, the law of one price is often not adhered to; because information is costly or inaccessible, excess price dispersion arises (Stigler, 1961, pp. 213-214). To obtain price information, market participants have to engage in search (p. 213). Where the cost of search exceeds the expected gains, however, it is not undertaken (pp. 219-220). In this case, prices come to an equilibrium in which dispersion is higher than expected according to the law of one price (Jensen, 2007, p. 885).

Reducing the cost of information, then, lowers the threshold for expected gains at which search is conducted, and should lead to a decrease in price dispersion (Stigler, 1961, p. 217). As agents can engage in better arbitrage, adherence to the law of one price is improved, and the market gains efficiency. In particular, goods can be allocated more efficiently across markets. By dissolving market inefficiencies, improved access to information can be expected to yield welfare gains for both producers and consumers of goods (Jensen, 2007, p. 883).

Excess price dispersion is particularly common in developing countries (Jensen, 2007, p. 880), partly because of insufficient access to information and communication technology (ICT), which raises the cost of search. Many developing countries have very low rates in fixed-line telephony and Internet subscription (Fredriksson, 2010, pp. 128-131); high costs are often prohibitive (Fredriksson, 2009, p. 9), and in many cases infrastructure, particularly in rural areas, is insufficient or non-existent (Horezky, 2009). The introduction of an ICT that reduces the cost of search, then, should reduce price dispersion in these markets.

Mobile phones have been suggested to provide a more feasible means of search for much of the world's population. Over the last decade, the technology has seen rapid

growth in developing countries, especially in Africa, where it effectively "leapfrogged" landlines (Aker & Mbiti, 2010, p. 209). In particular, mobile telephony has facilitated access to ICT in rural areas (ibid.), and for lower income classes (pp. 209-211). It can thus be assumed that the cost of search has been reduced in these areas, which economic theory suggests should lead to a decrease in price dispersion.

Microeconomic Impact of Mobile Phones on Markets

Muto and Yamano (2009, pp. 1887-1888) suggest that the impact of lowered search costs on price dispersion should be particularly strong for highly perishable goods traded on local markets. Studying the fisheries sector of India's South Western state of Kerala, Jensen (2007) and Abraham (2007) indeed found that the adoption of mobile phones by agents of the market made it more efficient, by decreasing dispersion to near perfect adherence to the law of one price and eliminating waste, causing welfare gains for both producers and consumers of the commodity (Jensen, 2007, p. 883).

The fishing industry is located in several ports along the coast of Kerala; before the introduction of mobile phones, fishermen would usually sell their catch in their home port. As yield differs daily across the ports' fishing zones, this would lead to price dispersion across the towns' markets (p. 882); however, lacking access to price information on sea, fishermen would not be able to engage in arbitrage (p. 881). Resulting was a misallocation of goods, which left some towns underserved while producing waste in others (p. 882-883).

Mobile phones, however, make it possible for fishermen to search for market prices while on sea, enabling them to engage in arbitrage (p. 883). As Jensen has shown, this resulted in more efficient allocation of goods, diminishing waste altogether; price dispersion was decreased to a level adhering to the law of one price. This yields welfare gains for both producers of fish, as the amount sold increased, and consumers, as the price of the commodity decreased (Jensen, 2007, p. 883).

Aker (2008; 2010), studying grain markets in Niger, has shown that the mechanisms observed by Jensen also apply to non-perishable goods traded across long distances. Markets in the Western African nation are often vastly dispersed, making it

difficult to obtain price information (Aker, 2008, p. 6). Previous to the introduction of mobile phones, grain traders would rely on visiting weekly grain markets (p. 2), meaning high search costs resulting in considerable price dispersion.

Mobile phones, however, enable traders to collect price information remotely, thus vastly decreasing the cost of search and enabling them to engage in better arbitrage. This has led to a more efficient grain market: The introduction of mobile phones in Niger, Aker has shown, resulted in a 10 to 16 percent decrease in price dispersion (Aker, 2010, p. 57), yielding welfare gains for traders and consumers of grain (Aker, 2008, pp. 39-40).

That the effect observed by Aker is less strong than in Jensen's study can be attributed to the fact that grains are a storable, not as easily perishable good. However, it is still significant. In contrast, Muto and Yamano (2009), studying markets for corn and bananas in Uganda, found that the introduction of mobile phones only influenced the market for perishable goods (p. 1895). This study, however, observed only farmers' market participation, and not price dispersion directly. In conclusion, it seems thus reasonable to suggest that the adoption of mobile phones by market agents reduces price dispersion for both perishable and storable goods, albeit at a different scale.

Despite speculations that new technologies might need a start-up phase before proving effective, Jensen (2007) documents a quick adoption of mobile phones after introduction, soon levelling off on a high tableau (p. 891). This fast uptake goes along with a sudden decline in price dispersion, which Aker (2010) found to be strongest in the first three months (p. 51). Both studies found price dispersion to settle down in a new equilibrium (*ibid.*; Jensen, 2007, p. 899), leading to the conclusion that changes in equilibrium price dispersion effected by the introduction of mobile phones are persistent (Aker, 2010, pp. 51-52; Jensen, 2007, p. 919).

While reduced price dispersion as a result of decreased search costs has been found in all of the studies evaluated in this paper, some findings suggest that the size of the impact mobile phone technology can develop on market behaviour depends at least partly on network effects, interrelation with other infrastructure, and structural constraints within the economy. Finally, Aker (2010, pp. 55-57) has addressed alternative explanations for the impact of mobile phones on market behaviour other than reduced search costs, such as spillover effects and increased collusion.

For communication tools such as mobile phones, network effects³ can usually be expected, i.e. that they become more useful as the technology is adopted by more people. Indeed, Aker (2010, pp. 54-55) found that the reduction in price dispersion only became significant at a point when more market pairs got mobile phone network coverage. This suggests that there are significant network effects across markets.⁴

However, communication is only one of several interrelated infrastructural factors influencing market integration, as Abraham (2007, p. 16) has pointed out. The cost of transportation is particularly important (Jensen, 2007, p. 911), and is the primary cause of price dispersion (p. 881). Especially in cases when travelling is needed to obtain price information, as documented by Aker (2008, p. 2), expensive transportation is detrimental to the functioning of markets. In these cases, cheaper communication tools can make transportation obsolete, and thus reduce excess price dispersion.

Aker (2010) found that mobile phones were more useful in reducing price dispersion when cost of transportation was high (p. 54). In particular, the effect was stronger when markets were more remote (*ibid.*); and when they were connected by unpaved roads (*ibid.*). Similarly, Muto and Yamano (2009) report a positive correlation between banana farms' distance to the district centre and gains in market participation and income subsequent to the introduction of mobile phones (pp. 1893-1894). These findings suggests that the impact of mobile phone adoption on market behaviour is stronger where the cost of transportation is high, particularly in underdeveloped and remote areas.

Abraham (2007) has argued that structural obstacles prevent market agents from engaging in optimal arbitrage (p. 12). He describes that fishermen are bound to land their catch in certain ports by contracts with middlemen (*ibid.*). As a result, only few of them frequently sold their catch on the market offering the highest price (*ibid.*). However, at least in the population in concern, this seems to be insignificant, as Jensen (2007), studying the same industry, found that price dispersion was reduced to a level adhering to the law of one price (p. 879). Indeed, Goyal's (2010) research suggests that improved

3 Network effects have been defined as "a change in the benefit, or surplus, that an agent derives from a good when the number of other agents consuming the same kind of good changes." (Liebowitz & Margolis, 1998)

4 Intra-market network effects might also exist; however, as both Aker (2008; 2010) and Jensen (2007) studied the phased roll-out of mobile telephony across markets, their studies do not provide relevant indicators for this.

access to information might lead to intermediaries losing their monopsony power (p. 26), and thus the introduction of mobile telephony could contribute to decreasing structural constraints.

Although research suggests that the reduced cost of search is at the core of mobile phones' impact on price dispersion, alternative explanations such as spillover effects and collusion are possible. Aker (2010) has addressed these concerns, finding that spillover effects were unlikely to have taken place (p. 56-57). Jensen's (2007) data, as well, points in this direction (p. 895-897). Aker (2010) also presents indirect evidence against increased collusion (p. 57), which is supported by qualitative research undertaken by Jensen (2007, p. 909).

In conclusion, the introduction of mobile phone technology in developing countries has a significant microeconomic impact. It can decrease price dispersion, reduce waste, and yield a Marshallian welfare surplus. While interrelated factors such as the cost of transportation influence the strength of the effect, it seems to occur in different agricultural sectors, with both perishable and storable goods, and in local and national markets. These changes are primarily the result of a reduction in the cost of search (Aker, 2008, p. 1).

Macroeconomic Consequences of Mobile Phone Adoption

It is reasonable to expect that the microeconomic effects of mobile phone introduction translate into macroeconomic gains; however, there has been little research in this direction. While the existing body of studies suggests that ICTs have a positive impact on GDP growth (e.g. Hardy, 1980; Röller & Waverman, 2001), only Waverman, Meschi, and Fuss (2005) have investigated this for the specific case of mobile telephony in developing countries. More recently, Klöpper, Nolen and Marzoff (2010) have also found a significant impact on employment. However, none of these studies links the observed effects directly to reduced search costs.

As mobile telephony, through a decreased cost of search, makes markets more efficient, there should be a positive influence on overall GDP. Indeed, Waverman, Meschi, and Fuss (2005) found that the technology carried a significant growth dividend.

For low income countries, 10 more mobile phones for every 100 inhabitants would translate into a per capita GDP growth higher by 0.59 percent (p. 18). However, while the authors suggest that mobile phones' primary advantage is a reduction in search costs (p. 14), their study does not explicitly link GDP growth to improved market efficiency.

Increased coordination among firms might be a plausible alternative explanation for the GDP growth dividend Waverman, Meschi, and Fuss (2005) observed (Aker & Mbiti, 2010, pp. 218-219). Qualitative research by Samuel, Shah, and Hadingham (2005) found that for small-scale firms, mobile phone use was linked to significant time savings and improved communication with suppliers, translating into increased profits (pp. 50-51). Nevertheless, Aker (2008, p. 1) has profoundly argued that reduced search costs are the primary way in which mobile telephony impacts markets, and improved coordination among firms might well only be a secondary factor.

Improvements in the functioning of markets and the Marshallian welfare surplus described by Aker (2008; 2010) and Jensen (2007) might also lead to increased employment (Aker & Mbiti, 2010, p. 219). In a study on rural South African municipalities, Klonner, Nolen, and Marzloff (2010) found that employment increased by 15 percentage points when a locality received complete network coverage (p. 18). They interpret this as a consequence of the improved spatial integration of the wage labour market (pp. 4-5); yet it might also partly be an effect of more efficient crop markets.

While the findings of Waverman, Meschi, and Fuss (2005) and Klonner, Nolen, and Marzloff (2010) suggest that the adoption of mobile phones has positive macroeconomic impacts, research in this area is scarce. The current studies only speculate about the microeconomic causes of their observations, and do not provide specific evidence. At the moment, then, it seems too early to conclude whether decreases in search costs have a macroeconomic effect, and what is its scale.

Conclusion

This paper has shown that mobile phone technology, by reducing search costs, makes markets more efficient; and that this possibly has a positive impact on a country's macroeconomic development. Yet the question arises how much these gains matter in the

context of developing countries' overall economic and social situation.

Toyama (2010) recently fervently attacked ICT4D⁵, arguing that investments in expensive technologies, even if they are successful, take away money needed to serve more basic needs, such as education. But the use of mobile phones does not need to be subsidized - in fact, it is a prosperous business for network operators. And while in Africa, the average expenditure for mobile communication reaches 10 to 15 percent of the individual income (Gillwald, Milek, & Stork, 2010, p. 15), welfare gains make them a sustainable investment at least for some (Samuel, Shah, & Hadingham, 2005, pp. 50-51).

Toyama's (2010) main point is that "technology [...] is only a *magnifier of human intent and capacity*" [emphasis original], i.e. that it will not create opportunities out of nothing. This might indeed be the mobile phone's biggest strength: While there are some indicators that mobile phones enable new business models (Aker & Mbiti, 2010, p. 220), their primary leverage seems to be in enhancing existing markets.

Nevertheless, mobile telephony can develop disruptive impact. Muto and Yamano (2009, p. 1894), as well as Klonner, Nolen, and Marzolff (2010, p. 4), found that societies' least advanced members—the extremely poor and women—benefit the most from the introduction of mobile phones. This way, mobile phones might indeed contribute to decreasing economic disparities and to reducing poverty.

At the moment, there are not enough studies to conclude on the broader economic and social effects mobile phone technology has in developing countries. In particular, there is a research gap concerning the link between micro- and macroeconomic processes; however, future studies might investigate whether improvement in market efficiency translate into positive impacts on countries' economic and social situation.

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⁵ Information and Communication Technologies for Development.

⁶ Using the APA style.

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