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Research Article

The Impact of Mobile Telephony on Developing Country Micro-Enterprise: A Nigerian Case Study

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Abstract

Informational challenges—absence, uncertainty, asymmetry—shape the working of markets and commerce in many developing countries. For developing country micro-enterprises, which form the bulk of all enterprises worldwide, these challenges shape the characteristics of their supply chains. They reduce the chances that business and trade will emerge. They keep supply chains localized and intermediated. They make trade within those supply chains slow, costly, and risky.

Mobile telephony may provide an opportunity to address the informational challenges and, hence, to alter the characteristics of trade within micro-enterprise supply chains. However, mobile telephony has only recently penetrated. This paper, therefore, presents one of the first case studies of the impact of mobile telephony on the numerically-dominant form of enterprise, based around a case study of the cloth-weaving sector in Nigeria.

It finds that there are ways in which costs and risks are being reduced and time is saved, often by substitution of journeys. But it also finds a continuing need for journeys and physical meetings due to issues of trust, design intensity, physical inspection and exchange, and interaction complexity. As a result, there are few signs of the de-localization or disintermediation predicted by some commentators. An economizing effect of mobile phones on supply chain processes may therefore co-exist with the entrenchment of supply chain structures and a growing "competitive divide" between those with and without access to telephony.

Introduction

There has been a rapid growth in the spread of mobile telephony worldwide, including a particular growth in recent years in developing countries. To take one comparative example, the average growth rate in mobile subscribers in Africa from 2002–2007 was 49% per annum while the figure for Europe was 17% (ITU, 2008). African mobile subscribers comprised 89% of all phone subscriptions while the figure for Europe was 73%. Yet, despite the fact that developing country citizens make up 80% of the world's population and the majority of the world's mobile phone users, research on mobile telephony in developing countries has been relatively limited to date (Donner, 2008).

Our understanding of mobile telephony is thus uneven and heavily skewed toward those countries and users that are now in a global minor-

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ity. As Castells et al. (2007, 4) illustrate: "we know a good deal about Norway because of the quality of Norwegian research in this field, while we know little about Nigeria because of the scant reliable evidence on this important country."

Castells and others warn that we should not take a "year zero"-type approach to understanding mobile telephony, but we can build on pre-existing telecommunications research. In this case, within the literature with a specific focus on telecommunications and developing countries, one can identify two particular clusters of work. One set has taken an "upstream" perspective, focusing on diffusion of telecommunications and attendant policies or strategies (e.g., Mureithi, 2003; Courtright, 2004; Rouvinen, 2006).

A second set has taken a "downstream" perspective, focusing on the impact of telecommunications. This literature has typically been economic and macro-level. Following from the original ideas of Jipp (1963), such work has posited a positive relationship between diffusion of telecommunications and national economic development (Bedi, 1999; Forestier et al., 2002; Waverman et al., 2005).

More micro-level analysis of telecommunications impacts in developing countries has been less extensive. Some of it has been criticized for either extrapolating from studies in industrialized countries and/or for relying on economic calculations of the benefits that would accrue in theory, based on questionable assumptions (Saunders et al., 1994; Bedi, 1999). What developing country fieldwork there is has tended to rely on survey data that provides insights into users and purposes of telephony, but not actual impacts (Saunders et al., 1994; Tucker, 2007). In addition, field studies of telephony in developing countries have tended to focus mainly on social rather than business uses because they find the former dominates the latter (e.g., Bayes, 2001; Bertolini, 2002; Souter et al., 2005). Thus we may find detailed anthropological studies of telephony's role in social and political development (e.g., Rafael, 2003; Ureta, 2004), but little work appears to have been done on telephony and micro-enterprise in developing countries (Donner, 2008). This despite the fact that, numerically, such enterprises (defined as those that employ up to 10 people (Devins et al., 2002) form by far the bulk of all enterprises worldwide, that they provide the most significant part of income generation and employment in many developing countries, and that they are "a key ingredient in poverty reduction" (Palmer, 2004, 31; see also Albu & Scott, 2001; ILO, 2001). Hence, there have been calls for more research on this area (e.g., Gamos, 2003; Jensen, 2007).

In part, the lack of research is predictable given the relatively limited access that such enterprises—the bulk of which are operated in the informal sector by those from poor communities—have historically had to telephony (Scott et al., 2004). Since the turn of the 21st century, though, this has been changing, largely thanks to the diffusion of mobile telephony. This once-elite, but now mass-market, technology is intersecting with the organizations that make up the major form of income and employment-generation in the "majority world" of developing countries.

It is therefore an appropriate moment to investigate the gap in knowledge that has existed to date. This paper argues a need for greater understanding of the impact that mobile telephony is having on micro-enterprise in developing countries. It answers this need through an in-depth case study of the role of mobile telephony in the supply chains of one micro-enterprise sector: the cloth-weaving sector in Nigeria.

The case study is preceded by a review of the way that information shapes micro-enterprise supply chain processes and structures, and a review of ideas and evidence to date about the potential impact of mobile telephony.[1] Following an outline of research methods, the focal case study sector is described and then analysed in terms of participants, processes, and structures. A similar pattern is then employed to describe the way in which mobile telephony is accessed by supply chain stakeholders, and to analyze its impact on supply chain processes and structures. The final section then draws a set of conclusions.

1. We see it as appropriate and necessary that mobile phone research should review literature not just on mobile telephony but on fixed-line telephony, and on telecommunications more broadly, as we do in this and following sections. However, a question remains, as posed later, about the relation between fixed and mobile telephony. Are mobiles just smaller, cheaper versions of fixed phones, or does their mobility add something new?

Literature Review and Research Focus

Information, Trade, and Developing Country Micro-Enterprise

We are seeking to understand the role of mobile phones in developing countries in micro-enterprise supply chains: the inter-linkages of relations that run from the original supplier of raw materials through to the final customer. Identifying mobile phones as tools for the communication of information, we need to start from an information-based perspective. Therefore, our literature starting point will be works on information, trade, and enterprise; in particular, the literature that moves beyond abstract mainstream/neoclassical economic views of trade to the arguably more "real-world" views of new institutional economics (Crow, 2004). From this perspective, micro-enterprise supply chain relations can be understood as a series of trading activities that rely heavily on information in the three main steps of trading (Norton, 1992; Casson, 1997):

- information acquired prior to trading (on the existence of the other party, on their reputation and trustworthiness, on typical prices);
- information communicated during trading (on items offered and money/other items sought, on quality of items offered, as part of negotiation);
- information acquired after trading (on whether or not the terms of the agreed trade contract have been fulfilled).

Availability, quality, cost and other characteristics of information, and the ability to communicate that information, are thus critical foundations for all trade and all enterprise, including micro-enterprise (Porter & Millar, 1985; Stiglitz, 1988).

In practice, almost all real world commerce suffers from information failures of various kinds. These problems are often particularly acute for micro-enterprise in developing countries (Albu & Scott, 2001; Müller-Falcke, 2001). Those seeking to trade, whether buying or selling, may suffer from an absence of information. For example, they may not be aware of whom they could trade with. They may suffer from information uncertainties. For example, they may be uncertain about an appropriate price for an item they are seeking to trade. They may suffer from information asymmetries, meaning that those they trade with have information that they lack or that they are uncertain about. For example, they may trade with someone who does know an appropriate price for an item when they do not. Finally, micro-enterprise supply chains in developing countries also suffer problems because communication has traditionally had to take place face-to-face, there being no other reliable means for the communication of information.

Informational characteristics in turn shape both the process and structure of commerce (Williamson, 1975; Stiglitz, 1988). Thus the informational challenges just described have led to a characteristic pattern in developing country micro-enterprise supply chains (Fafchamps, 1996; Overå, 2006). In terms of the trading process, we can identify three typical characteristics:

- Trading tends to be slow. Both trading itself and gathering of background data require physical interaction, which may in turn require journeys. Journeys are often slow because of relatively poor-quality and/or lack of transport infrastructure.
- Trading tends to be costly. There are high financial and time costs of gathering information necessary in order to trade. Journeys, in particular, are costly both in terms of direct costs but also indirect costs: for most micro-entrepreneurs, a day spent journeying is a day for which income generation must be foregone.
- Trading tends to be risky. Micro-entrepreneurs are subject to (or may subject other supply chain actors to) trading risks because of information asymmetries. These include opportunism such as overcharging for goods or agreeing to a contract knowing it cannot properly be fulfilled, and adverse selection such as unwittingly selecting a trade partner or trade items of poor quality. For trading in a number of developing country contexts, one should recognize the risks of commerce-related travel. These would include the physical risks of both traffic accidents and crime.

One impact of these information-driven process challenges is that the development of commerce, of business, and of markets in many developing coun-

tries is constrained (Loasby, 2000; Albu & Scott, 2001). Where commerce and supply chains do develop then, in part because of these informational issues, they tend to have particular structural characteristics. One of these is that trading tends to be localized (Duncombe & Heeks, 2002; Jensen, 2007). Trading or data-gathering with anyone at a distance requires a potentially slow, costly, and risky journey. Since delay, cost, and risk tend to be proportional to distance, there are incentives to localisation of supply chains.

A second structural characteristic is the presence of intermediaries (Casson, 1997; Bedi, 1999; Chowdhury, 2002). Intermediaries are supply chain actors who are neither producers nor final consumers, but who interpose themselves between a producer and a consumer. They buy from one and sell to the other, or they may otherwise handle the trade between the two. Intermediaries have come to exist in supply chains where they address some of the negative information-related characteristics of trading. They hold both quantitative and qualitative information on buyers, sellers, products and prices. They can thus reduce the informational costs and increase the communication speed of all three stages of trading for buyers and sellers. Their broader spread of contacts allows trade to become less localized. They can make trade less risky, or at least make it perceived to be less risky, because of their informational resources and reputation.

However, intermediaries can also have a negative impact on micro-entrepreneurs. They are typically in a more powerful position than other supply chain actors, particularly due to information asymmetries; they know things that micro-producers and customers do not. As a result they are often seen to force prices paid to producers down, well below market values, resulting in reducing income for the micro-entrepreneurs (Bayes, 2001; Rahman, 2007). They may also, for example, be able to force loans on micro-entrepreneurs that have to be repaid at high interest rates.

The Potential Impact of Mobile Telephony

What, then, might be the impact on micro-enterprise supply chains of mobile telephony? To initially respond, of necessity, we draw on broader, often theoretical, literature on information and communication technologies in development.

From this we could conceive the impacts of mobile telephony at different levels (see Figure 1). At the most micro level, mobiles could have a quantitative impact by increasing the speed of communication (i.e., information flow) and by reducing the cost of communication (Norton, 1992). They could have a qualitative impact by increasing the quality of information that is communicated for decision making (Bedi, 1999).

In turn, this would then be predicted to impact the three trading process characteristics (Saunders et al., 1994; Müller-Falcke, 2001). Trading could become quicker as the information necessary for trading can be gathered more quickly and as direct trading-related communication occurs more quickly. Trading could become less costly, especially if journeys can be avoided. And trading could become less risky as information uncertainties and asymmetries are removed, and as travel is avoided.

The structure of supply chains could also be altered (Bedi, 1999; Eggleston et al., 2002). Trading could become less localized as telephonic communication is relatively independent of geography. Equally, intermediaries could be removed as the informational advantages that they offer are undermined or substituted by the mobile phone. Buyers could pay less by dealing directly with producers, and the information asymmetries that benefit intermediaries could be eroded. Micro-entrepreneurs could then be empowered. Finally, at the most macro level, all this should help to increase business investment, allow new businesses and markets to emerge, and contribute overall to economic development.

These are the potentials, but what is the reality of mobile telephony in developing country micro-enterprise? As noted above, the base of literature on this topic has so far been very limited—hence the rationale for the study reported here. Entrepreneurs using mobiles do report a perception that trading increases in speed and reduces in cost, though there is limited detail on how this occurs (Donner, 2004) save Jensen's (2007) detailed study of fish trading. There is some general sense that mobile phones may enable a greater locational spread of micro-enterprise activity (Overå, 2006; Jensen, 2007).

On the issue of intermediation, there are some indications that mobile phones are associated with disintermediation (Bayes, 2001; Overå, 2006), but also with ongoing intermediation (Duncombe &

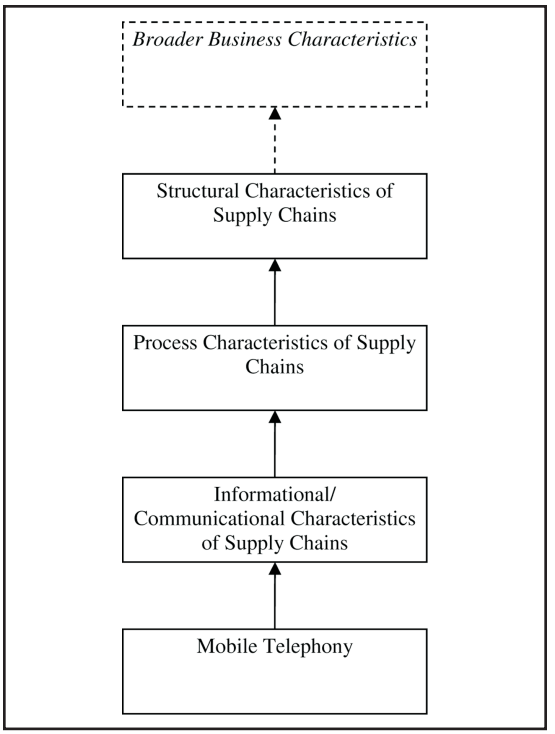


Figure 1. Conceptualizing the Impact of Mobile Telephony on Commerce.

Heeks, 2001; Molony, 2006). Likewise, there is some evidence that mobile phones substitute for travel (Duncombe & Heeks, 2001), but other research suggests a mixed picture in which some journeys are substituted but others are not (Souter et al., 2005; Overå, 2006). Trust may be a factor helping to explain some of these outcomes (Molony, 2006). Overall, then, we have limited field evidence about the impact of mobiles on micro-enterprise, and what evidence we do have points, in some cases, in slightly different directions.

Finally, and stepping back to an even broader perspective, there is an issue to investigate around the generic role of mobile phones in developing countries. There has been some tendency to assume that role is global—much the same in industrialized as in developing countries—but other analyses question one-size-fits-all perspectives (Hamilton, 2003; Castells et al., 2007). They argue that usage models are different in developing countries. For many in industrialized countries, mobile phones are a supplement to fixed-line telephony, and are valued specifically for their mobility. By contrast, there is evidence for some developing country users that a mobile phone is their first link to the network. It may thus be valued for its connectivity and convenience, more than for its mobility, and its impact may therefore be very much like that of a fixed line. Similarly the "Northern" model of an individually-owned phone purchased by its one user may not apply in the global South, where there has been a long history of shared ownership and access models in relation to information and communication technologies (James, 2005).



Figure 2. Aso Oke *Clothing (Africa Styles, 2008).*

Research Methods

In seeking a better understanding of the impact of mobile telephony on micro-enterprise in developing countries, the research reported here focused on the *aso oke* (meaning "top cloth") industry. This produces clothing for ceremonial occasions by hand-weaving and is primarily associated with the Yorùbá people of southwestern Nigeria (see Figure 2).

We wanted to choose a production-oriented sector to study since such enterprises are crucial to wealth creation and poverty alleviation. Production-oriented enterprises form up to 40% of all micro-enterprises in developing countries, and they constitute a core source of value addition (Albu & Scott, 2001). *Aso oke* specifically has been a key economic activity in rural and peri-urban areas of southwest Nigeria, partly because its high quality and customized design make it relatively resistant to the scale



Figure 3. Male Weaver Using Horizontal Loom.

economics and imports that have damaged other small-scale textile activities (Liedholm, 1982; Clarke, 1999).

Aso oke was also chosen for three other reasons. It has a well-developed supply chain, from thread suppliers through weavers and sub-weavers to final buyers. Intermediaries have traditionally played an important role in the supply chain. And it is a sector that had seen some level of penetration of mobile telephony in the year or two prior to planned fieldwork.

A case study methodology was thus adopted, in contrast to the more generic survey-based approach that has typified studies of telephony in developing countries. This involved conducting in-depth, face-to-face, semi-structured interviews with representatives of the different groups of participants in the case industry. A total of 16 interviews were documented from seven intermediaries, six weavers, and three buyers. These interviews covered not only their own experiences but also their reports of prevalent patterns of mobile phone use in the *aso oke* supply chain. Observations and personal reflections were also documented in the form of field notes, with photographs collected to supplement explanations of some product features and production techniques.

Interviews and the researcher's observations and reflections were written up as descriptive text, and were analyzed with the aid of the qualitative analysis software package NVivo. Analysis was an iterative process involving the segmentation of data into clusters and the creation of matrices. Causal maps (Eden & Ackermann, 1998), also referred to as causal networks (Miles & Huberman, 1994) were used to integrate data into an explanatory framework of the phenomena being studied. In this manner, the circumstances that give rise to information failures in the industry, and the effect of such failures on the process and structure of trade were identified. The analysis also allowed for the contextualization of the use of mobile phones in addressing information failures, and the causal maps helped in ascertaining the opportunities and limitations associated with mobile phone use.

Analyzing the Case Industry Supply Chain

Aso oke involves the weaving of cloth on handlooms (see Figure 3). The cloth can be used in the production of fashion accessories such as shoes or bags, and in the production of home furnishings such as throws and cushion covers. However, as illustrated above, its main market is in being sewn together to create clothes for ceremonial occasions.

The *aso oke* industry is buyer-driven: transactions begin when a buyer approaches either a weaver or, much more often, an intermediary to place an order. Orders for the fabric are usually bespoke and placing an order involves negotiating the buyer's design requirements: such things as the pattern and colors of the fabric, its consistency, and finishing. This negotiation will involve the weaver being called to meet the intermediary and/or buyer.

Once the design has been agreed upon, a sample of the ordered fabric is produced and presented to the buyer for approval. Approval leads to the negotiation of the terms of the transaction, including order quantity, delivery dates, and price. A deposit is then paid by the buyer that serves to both seal the trade agreement and provide some initial capital for producing the order. Payment of the deposit, therefore, marks the beginning of the production stage. Raw materials are purchased either by the intermediary or, infrequently, by the weaver and the fabric is woven to the buyer's specifications.

An *aso oke* order tends to be completed in batches. These batches are delivered to the buyer as they are completed and, depending on the size of the order, deposits for future batches are collected at the time of each delivery. The balance payment for the order is collected when the final batch of fabric has been delivered to the buyer.

From this basic process description we can then draw out the three main stakeholder roles related to the industry:

- Buyers: the buyer is the individual who commissions an order. They may be the final individual consumer or, in the case of a group wishing to wear similar clothes for a ceremony, a representative of those final consumers. They almost always deal with an intermediary rather than dealing with a weaver directly.
- Producers: like buyers and intermediaries, weavers were both men and women. Some weavers work on their own, but others are grouped with a hierarchy of master weaver and sub-weavers. It is the master weaver who interacts with the intermediaries or buyers, and who organizes fulfillment of orders via the sub-weavers. Sub-weavers have typically been trained, or are being trained, by the master weaver.
- Intermediaries: intermediaries act to promote trade by providing access for buyers to producers and vice versa, by generating alternatives when initial requests prove unworkable, and by developing and negotiating trade agreements. They are normally responsible for paying for the raw materials. They also act to monitor the contract as it is fulfilled, particularly the progress being made by the weaver, the quality of cloth delivered, and its fit to the originally agreed design.

In addition, there are suppliers who provide the raw material for *aso oke* thread. Occasionally, the weavers may buy directly from them. More often, though, the intermediary would purchase thread, sometimes allowing the weaver to pick it up on their behalf.

As discussed in more detail below, these stakeholders are geographically somewhat dispersed, and so travel is central to the *aso oke* supply chain. Weavers travel to intermediaries to see if they have orders; intermediaries or their representatives travel to weavers to deliver orders or to summon weavers for a meeting to discuss orders. Weavers and intermediaries travel to each other and to buyers to check design requirements and design approvals. Intermediaries and weavers travel to check availability of, and purchase, thread from suppliers. Intermediaries travel between weavers and buyers to check or report on progress, and to communicate and resolve any emergent issues or changes during fulfillment of an order. Journey distances were not great, normally within the boundaries of a single state and perhaps a maximum 200km return distance. However, they could still be long in terms of time because of high traffic density in urban areas, infrequent taxi/minibus departure times, and poor state of the road surface.

As a result, trade within the *aso oke* sector has developed the characteristics that are typical of developing country micro-enterprise supply chains. It is slow, requiring an order months ahead of the planned ceremony and needing many days for any interactions regarding changes or problems to resolve which, as one interviewee reported, was frustrating: "There is little discipline in the industry and a general impatience; people seem to want the fast way out." It is costly, with the buyer ultimately having to pay the cost of journeys and intermediation, and with income for weavers being squeezed down.

And it is risky. Actors were able to relate stories of accidents or other misfortunes related to travel. But other, more intrinsic risks were also present. The nature of information asymmetries, particularly the buyers' lack of information, and the knowledge that there was a low probability of repeat purchases from buyers meant opportunistic behavior arose. Interviewees cited examples that included overcharging for an order, using poor quality thread (raw materials) in weaving the cloth, and making the cloth of shorter length and/or width than is standard. However, there were also examples given of buyers or intermediaries under-paying for orders, relying on their greater power than weavers, and on the lack of likely contract enforcement through law.

The intermittent nature of orders makes for a "feast or famine" type of model, which fell particularly hard on weavers because of their lack of capital reserves. As a result, as one interviewed intermediary saw it, "weavers never say no" and accepted orders even when they lacked the time and/or skills to satisfactorily complete them. There were thus examples mentioned of weavers missing their delivery deadlines—highly problematic when the clothes were for a specific occasion. At the most extreme, interviewees reported supply chain participants absconding without delivering on their part of the contract, weavers failing to deliver ordered textiles, and intermediaries or buyers failing to complete payment of orders placed.

The actual prevalence of such behavior was unclear but, in any case, it was the perceptions of such behavior rather than their actuality that had two effects. First, it increased the importance of trust and reputation, and the need for constant interaction along the supply chain to both reassure and monitor the parties involved. Second, the circulation of such stories reduced the overall reputational capital of the *aso oke* sector. Combined with the slow and costly nature of trade, this perceived risk was seen to lead buyers to turn to alternative sources, such as purchase of "off-the-shelf" ceremonial attire through more formal retail outlets.

The Structure of Trade

i. Intermediation

The *aso oke* supply chain is characterized by the importance of intermediaries. In part, intermediaries have arisen because they have access to capital that other players lack. They can obtain credit from thread suppliers or can themselves pay the supplier, allowing a full order to get underway before the buyer has paid. They thus can act as financial buffers given the time delays during an individual order between first purchase of raw materials and final payment for the finished product. They also help by holding inventory until it can be sold, say, when excess fabric has been mistakenly ordered by a buyer or mistakenly produced by a weaver. They thus help the market to function where it might otherwise not due to shortages of working capital.

However, intermediaries have also emerged because of the informational aspects of the *aso oke* supply chain. *Aso oke* is a heterogeneous occasional good defined by idiosyncratic tastes. The majority of buyers/consumers therefore suffer from information absence or uncertainty. They do not know enough about the product or how it is traded to make what they feel are sound judgments on where to find weavers, how to differentiate weavers and their products, what types of design are feasible to produce, and on the terms of transaction, including price. As such, they will readily approach intermediaries who do hold this information. They will continue to rely on intermediaries during the transaction process because they cannot observe, without high cost, the actions of producers and, crucially, because even if they did observe those actions they would not necessarily have the knowledge to be able to interpret them. Intermediaries charge higher prices than weavers but buyers saw this as worthwhile given the resultant lower transaction costs and greater certainties in trading including the greater certainty of a good-quality product.

Likewise, the majority of producers/weavers also suffer from information absence or uncertainty. They do not know enough about the location and design preferences of potential consumers. Because of the association of the product with specific occasions, there is also a lack of formal marketing/sales channels, such as shops, that might be approached. Thus producers, too, will readily approach intermediaries and also rely on them during completion of a transaction because the intermediaries can monitor the actions of the buyer; something that would otherwise be costly for the weaver.

Information failures have therefore shaped the structure of commerce in this industry to favor the emergence of intermediaries. That emergence is reinforced by the opportunistic behaviors and perceived risk of adverse selection that also arise partly due to those information failures. This means trust, reputation and monitoring are all important, and all of these are factors conducive to the existence of intermediaries who can act as the trust/reputation proxies for both weavers and buyers, and who can undertake knowledgeable monitoring of both weaver and buyer behavior.

As a final point, structuring within this supply chain has some self-reinforcing effect. Information failures and lack of trust between producers (weavers) and buyers lead to the existence of intermediaries. Existence of intermediaries reduces the opportunities for flattening of asymmetries and creation of trust between producers and buyers.

ii. Location

In one sense, *aso oke* supply chains are localized; very few stretch across into a different Nigerian state because of the costs imposed by journeys. Within those states, though, the various actors are dispersed.

Production of *aso oke* is largely centered on small informal groups that are family/kinship-oriented and communal in nature. This results from the passing down of weaving skills to younger generations through family or community ties; a practice that has resulted in particular geographic areas in southwest Nigeria being associated with weaving.

Buyers are, as might be expected, distributed in

relation to centers of population. They tend to interact with intermediaries or weavers who are relatively closer rather than relatively farther, but interaction would typically still require a journey. Some orders come from distant parts of Nigeria or even from overseas, making a journey by the buyer prohibitively costly. In such cases, they use kinship or friendship networks to identify a representative nearby who acts on their behalf.

The geography of intermediary and weaver locations appeared to relate to the level of trust and integration in the intermediary-weaver relationship. In some cases, weavers were found to work exclusively or predominantly for one intermediary. Those weavers were regarded by the intermediary as parts of an integrated, but extended "organization" that they controlled. Trust tended to be high and the requirement for physical journeys kept to a minimum. In such cases, the distance between intermediary and weaver could be 40–100km.

Where there was a looser or newer relationship between intermediary and weavers, distance could still vary, but the preference was for it to be small. The extreme example was one intermediary who also designed clothes. She selected nearby weavers whom she could sit with during the production process. Only in this way did she feel she could verify the correct design, width and quality of cloth was being woven. Something similar also occurred in the "sitting with Nellie" process of learning by subweavers from master-weavers, where trust was being built through the learning process.

Despite variations, then, we can say generally that the weaker and less integrated the relationship between intermediaries and weavers that was observed, the greater was the use of physical verification as a monitoring mechanism, and the shorter the preferred geographic distance between the intermediary and his/her weavers. A summary is provided in Figure 4.

Findings on Mobile Telephony and the Supply Chain

Access to Mobile Telephones

The licensing and launch of GSM (Global System for Mobile) mobile operators in Nigeria in 2001 represented a significant liberalization compared to the previous domination of telecommunications provision by the government-owned monopoly, NITEL (Smith-Hillman & Braithwaite, 2004). The years since 2001 have seen very strong growth in subscriber numbers and reach, particularly for mobile phones, along with falls in prices and improvements in service quality.

In the area under study, no interviewees had fixed-line telephones, and access to functioning fixed-line public payphones was negligible. Instead, all accessible telephony was mobile—either using GSM (location-independent) or using wireless local loop (WLL: where the mobile phone is restricted to the area around one particular exchange). There were three access models found, listed in descending order of reported prevalence.

i. Private Ownership of Mobile Phones

All interviewed buyers and intermediaries owned their own mobile phone, and this was regarded as a norm for the *aso oke* sector. Ownership of a mobile phone by the weavers was, by comparison, less common; field data suggested about one-quarter of weavers had a phone. This occurred via one of two observed and reported models.

In some cases, an intermediary was operating their own vertically-integrated supply chain, working always with one particular group of weavers who produced exclusively for that intermediary. These intermediaries would provide a mobile handset complete with Subscriber Identity Module (SIM) card for the master weaver of the group. The phone was still owned by the intermediary, but the master weaver was responsible for purchasing airtime.

Alternatively, the intermediary would sell a mobile phone to the weaver and then recoup the cost by deducting an agreed amount from each completed order. The intermediary was thus likely to keep sending orders to that weaver until the debt was repaid. However, the intermediary determined the price of the mobile phone and the deduction, and the debt was seen to increase their leverage over the weaver.

ii. Access to Commercial Third-Party Mobile Phones

Since GSM licensing, a number of "phone shops" have sprung up around Nigeria. These may be physical premises or so-called "umbrella people" who sit outside under an umbrella, selling use of their mobile phone. They were particularly used by weavers. Outgoing calls were charged at the advertised tariff rate of the operator to whom the phone shop

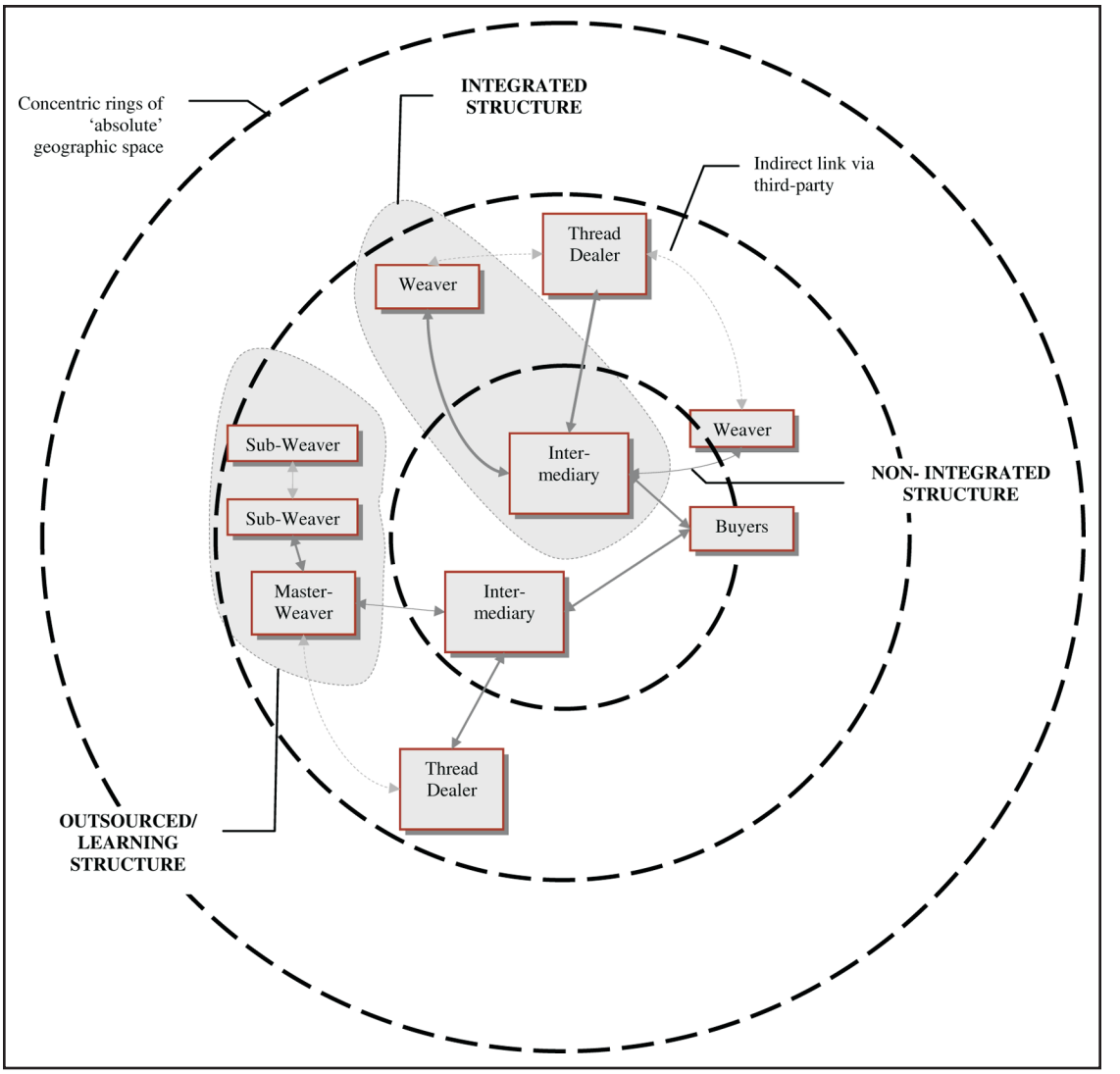


Figure 4. Pre-Mobile Geographic Distribution of Sectoral Stakeholders.

owner subscribed. For incoming calls, the weaver would have to pay a small one-time "registration fee." They could then give the phone shop number to intermediaries or buyers. When a call arrived, the message would be noted down by the phone shop owner. Either their employee would then go to tell the weaver, or the weaver would periodically go to check for messages. Alternatively, the caller might ask for the weaver to be summoned to receive a call, in which case they would call back after a few minutes while a message was sent to the weaver to come to the shop to receive the call.

ii. Access to Non-Commercial Third-Party Mobile Phones

A few weavers gained access to a mobile phone through family or friends. This was not often used for outgoing calls (such weavers would more often use a phone shop for this). Instead, the number was given out for incoming calls. As with the phone shop, either a message would be taken or the weaver would be summoned to receive a call-back after a certain time interval. No financial charge was made.

Supply Chain Process Impacts of Mobile Telephony

Two main process-related benefits were reported for mobile phones: their impact on the time and on the financial costs of transacting. Phone calls were particularly used for the following elements of the trading process: checking initial identity and possibility of ordering (buyer → intermediary/weaver); seeking orders (weaver → intermediary); initial confirmation of order (intermediary/buyer → weaver); searching for and confirming presence of raw materials (intermediary/weaver → supplier); confirming credit arrangements and pick up of raw materials by a representative (intermediary ↔ supplier); checking if changes to order or delivery were possible (all main actors); communication of minor amendments or minor issues related to order or production details (all main actors); checking and confirming presence of completed parts or whole of orders (all main actors); setting up and confirming presence for physical meetings (all main actors).

The mobile phone calls saved time and money by substituting for journeys. Time saved per call was typically several hours and, overall, this had meant that the turnaround time between first order and final fulfillment was reduced. Money saved was typically understood by comparing call costs with transport costs: for example, interviewees talked about a call rate of N50 (c.US$0.4) per minute being cheaper than a taxi cost for an average journey of, say, N1,000 (c.US$8), given that calls were normally completed in less than five minutes. There was some consideration of the opportunity costs of travel that could be recouped through use of the phone. For example, weavers could invest the time they would spend travelling in producing cloth; intermediaries could invest the time seeking orders or engaging in other business. There seemed to be little consideration of the capital cost of the mobile phone, which was regarded as a sunk cost.

Mobile phones seemed particularly to be valued because they were seen to substitute for unproductive travel. Examples were journeys by weavers to an intermediary only to find that there were no orders available, or by an intermediary/weaver in search of a particular color of thread that proved out of stock, or other journeys where the intended visitee was absent from home.

Partly as a result, mobile phones were seen to have reduced some of the risks inherent in commerce. They had reduced the number of journeys required; journeys that were seen as sources of physical risk. They had reduced a number of information uncertainties: about the existence and acceptance of new orders; about availability of raw materials; about the behavior of other actors, especially progress in fulfilling an order. And, where a journey was still needed, the mobile phone would greatly reduce uncertainty about the potential value and outcome of that journey. Thus, as one interviewee put it, "GSM gives me rest of mind."

However, as just hinted, it would be a mistake to see journeys and face-to-face interactions as having disappeared from the trading process. They were still required because physical inspection was still required. The need for inspection arose from a factor specific to design-intensive sectors like *aso oke*—the need to physically see particular items: the buyer's ideas (if any) for design; the types of cloth a weaver had previously produced and their design ideas; the weaver's design sample; the actual color of a thread; the fit-to-design of cloth as delivered during an order.

But the need for inspection also arose from a much more generic factor—trust or, rather, the lack thereof—between key supply chain participants. The potential for opportunistic behaviors was described above; an especial difficulty for *aso oke* given the staggered nature of the transaction. Mobile phone calls were used to monitor behavior of other participants, but their value depended on various criteria, described by one intermediary:

> 'Who you are' in the industry and related to this, whether or not there already exists trust between you and the person you are dealing with, and lastly 'what you can produce' as an indication of the quality of your output. If these things are present then having a telephone results in faster order production. It makes the process of getting orders faster and also makes life easier in terms of movement.

But where these criteria were not met, phone calls would likely still leave information uncertainties. Monitoring of contract compliance, principally of weavers' progress in producing the cloth, therefore often continued to be conducted through a journey and physical inspection. This was despite (or perhaps because of!) the fact that all calls, save sometimes that of a buyer seeking a recommended intermedi-

ary in order to set up a pre-order meeting, were made between parties who already knew each other through physically meeting and transacting (often many times) prior to the phone call.

Finally, journeys were required to allow for physical movement of raw materials and goods and/or exchange of money, and sometimes because of the complexity of the interaction required, say, in order to discuss and agree to the exact specification of a design and order. The relative "poverty" of communication by phone, plus both parties' constant awareness of the cost of the call, militated against complex communication by phone.

In terms of risk, then, there has been a reduction, but not an elimination. There has also been some transfer. Where previously, for example, intermediaries had to travel to weavers to see if they could accept an order, now they summon the weaver by phone to come and meet them to discuss the order. Initial journey risk has thus shifted from intermediaries to weavers.

Supply Chain Structure Impacts of Mobile Telephony

i. Intermediation

Far from leading to disintermediation in the *aso oke* supply chain, the advent of mobile telephony seems, if anything, to have entrenched the role of intermediaries.

We can break this down. First, mobile phones have done nothing to address buyer-side information absences or uncertainties. They do not help buyers in becoming aware of weavers' identities, so they do not substitute for the intermediaries' role as a contact node. They do not help buyers understand key aspects of the transaction such as price, quality and design, so they do not substitute for the intermediaries' role as a source of information and knowledge. They do not help buyers inspect key items such as design samples, finished cloth, and extent of order completion, so they do not substitute for the intermediaries' role in undertaking or arranging journeys and physical inspections. Overall, mobile telephony has not helped buyers know of, trust, manage or transact with weavers.

For the buyers, then, the uncertainties and the risks, including potential for opportunistic behavior and adverse selection, remain much as they were vis-à-vis producers. However, personal 24/7 ownership of mobile phones by both buyers and intermediaries *has* made it easier for buyers to transact with intermediaries. Given that this is a buyer-driven supply chain, and that mobile telephony has made it no easier for buyers to deal with weavers, but easier for them to deal with intermediaries, little disintermediation can be expected from this direction.

Second, mobile phones have done little or nothing to rebalance the asymmetric relationship between weavers and intermediaries. As with buyers, phones have not made it easier for weavers to identify buyers, so weavers remain normally reliant on intermediaries for their orders. Indeed, those with phones reported they now had more contact with more intermediaries than previously. Telephony has not changed the non-informational asymmetries, such as the ability of the intermediary to provide working capital and to arrange credit lines. And, for a few weavers, provision to them of a mobile phone by an intermediary had helped to embed their unequal relationship with that intermediary.

Third, mobile phones had facilitated the emergence of a new type of intermediary: the "coordinator-weaver" (outlined alongside other supply chain structures in Figure 5). In one case where a weaver had been able to invest in a mobile phone, other weavers had begun to align themselves with the phone-owning weaver. The latter would then coordinate the collection, distribution and management of orders from different intermediaries. Although akin in some ways to the role of "master-weaver", this was a new role within the supply chain that had not previously been seen. It pushed existing intermediaries toward a demand-side role of identifying buyers and managing the buyer-intermediary relationship. The new coordinator-weaver intermediary then took a supply-side role of managing cloth production and the weaver-intermediary relationship.

Through use of their mobile phone, the coordinator-weaver was able to build up a larger network of weavers than was possible for any master-weaver. They could therefore accept more and/or larger orders than had previously been possible, thus taking on a role for allocating work that had previously been undertaken by the single, now buyer-side intermediary.

Lastly, presence of a phone has made it easier for intermediaries to use their financial power with thread suppliers. The earlier system of arranging credit with suppliers was seen as risky. It relied on written notes that were readily forged; as a result,

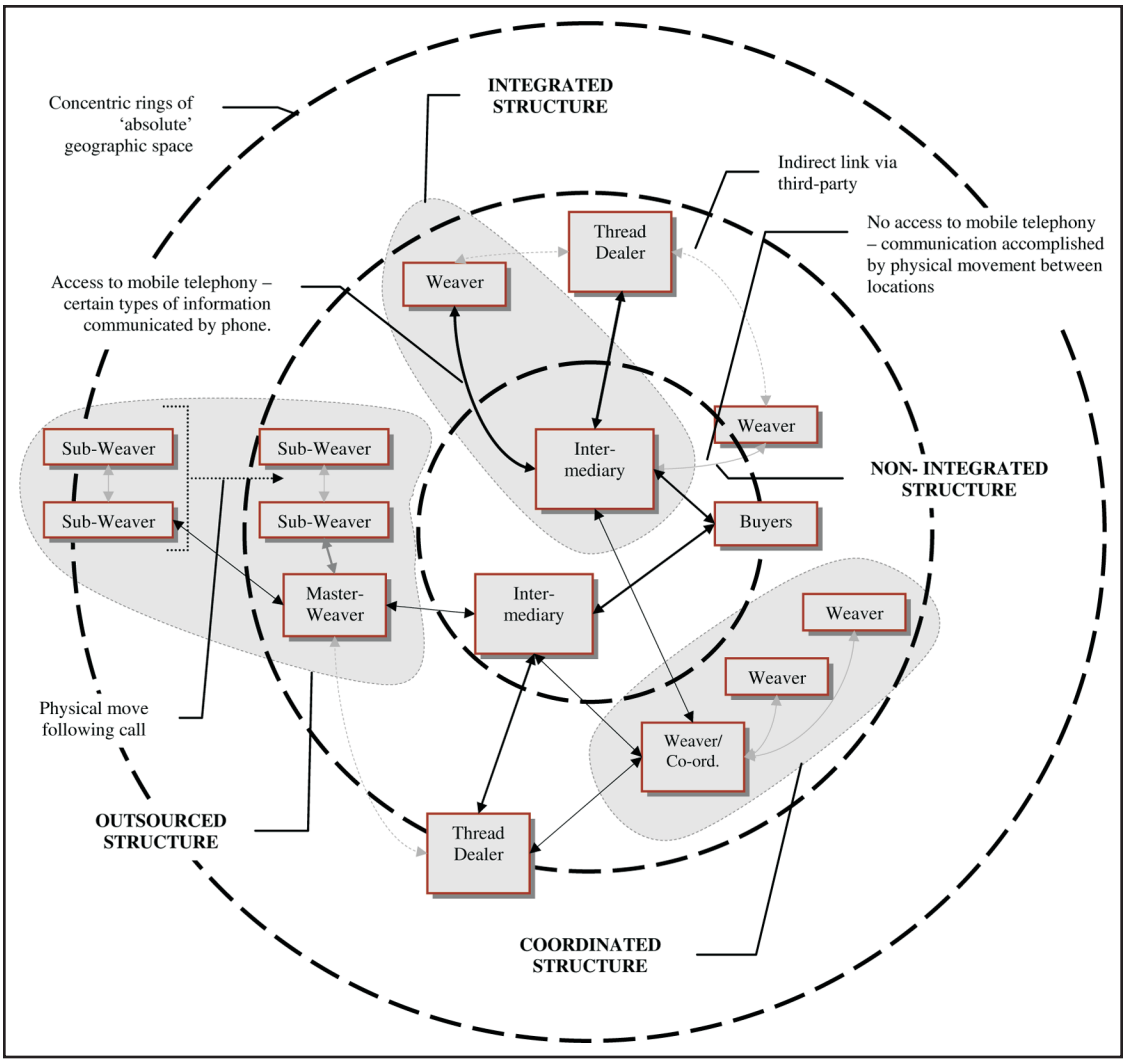


Figure 5. Examples of Geographic and Structural Changes Following Introduction of Mobile Telephony.

most suppliers would only operate on a cash-and-carry basis, slowing the thread-purchase transaction. Mobile telephony had changed this. Suppliers with a pre-existing relationship with an intermediary would now allow thread to be taken away (e.g., by a weaver) on the strength of a phone-based promise from the intermediary to pay at some short-term future date convenient to both intermediary and supplier.

By contrast, no weavers were reported as having established credit facilities with suppliers. Coupled with their more limited access to mobile telephony compared to the 24/7 access available to intermediaries, this had, if anything, strengthened the position of intermediaries.

ii. Location

There was limited evidence that mobile telephones were significantly changing the geography of supply chains in the *aso oke* sector. There were one or two reports that telephony had enabled a broader geographical spread in the search for raw materials, though this was constrained by a perceived need to physically inspect the actual color and quality of thread, and by the need for physical procurement.

Likewise, in one case, a master-weaver was able

to access a broader geographical spread of sub-weavers when a large order came in. Some who worked for him were Ghanaian and, following their apprenticeship, they had returned to Ghana. Where previously they would not have been part of the master-weaver's "mental map" of sub-weavers to draw on, his access to mobile telephony had changed that. What it meant, though, was not outsourcing to a distant location (Ghana). Instead, it meant that he would call up the sub-weavers in Ghana, and they would then travel to his workshop in Nigeria to help complete the order.

These examples, potential geographical extension of relation with thread dealers and with sub-weavers, plus the emergence of weaver-coordinators just described, are summarized in Figure 5. However, these were just individual cases and, save these examples, the evidence was that—because they were mainly reinforcing existing relationships and existing structures—mobile phones were also reinforcing existing geographies within this micro-enterprise sector.

iii. Competitive Advantage

One further structural consideration—not yet much reported in discussion of micro-enterprise and mobile telephony—is the competitive advantage that mobile phone access brings to those who have it over those who do not.[2] This is likely to be a feature of micro-enterprise in developing countries in the short-term as a significant (albeit declining) proportion of the population lacks access to telephony (Overå, 2006). Given the widespread ownership of mobile phones among buyers and intermediaries, they have become the preferred means of contact wherever feasible within the limits imposed by factors such as trust, the need for physical verification of information or physical exchange, and the need for complex interactions around issues of design.

Weavers who lack phone access will therefore lose out on orders. This, indeed, had been the experience of some weavers. They were able to recount incidents where they had travelled to an intermediary's premises in search of business only to learn that an order had just been given out to another weaver who had a mobile phone and who had been called as soon as the order arrived. This, of course, had acted as a strong incentive for weavers to arrange mobile phone access, and can be interpreted as a growing barrier to entry into the *aso oke* trade.

It can also be interpreted as a sign of growing inequality between weavers: a "competitive divide" deriving from the "digital divide." At one end, those without mobile phones were losing orders and income. At the other, one of those who had managed to obtain his own mobile phone was developing into an intermediary through his role as a coordinator-weaver.

Conclusions

In terms of both numbers and reach, mobile telephony is the dominant form of telephony, and micro-enterprise is the dominant form of enterprise in the "majority world" of developing countries. Despite the global importance of both phenomena, few studies have so far investigated their intersection, partly because mobile phones have only recently penetrated micro-enterprise supply chains in developing countries. The research reported here focuses on this fast-growing trend, offering insights into something that has already, or will soon, impact the livelihoods of tens and then hundreds of millions of micro-entrepreneurs.

i. Mobiles and Information

In conceptual terms, this study confirms the need to understand mobile phones as devices for communication of information. That may seem an absurdly naïve statement of the obvious, but its implications are not always recognized—that one must therefore build analysis of a major part of mobile telephony's impact on an informational foundation, first understanding the role of information in the phenomenon under investigation, and only then moving on to study mobile telephony.

That was the approach used in this article. It began by understanding how information and information failures have shaped the process of micro-enterprise commerce, and then by understanding

2. Ironically, the only other study found to mention this focuses on the opposite. Jensen (2007), in his study of the fishing industry in Kerala, talks of a "digital provide" because fishermen without mobile phones benefit from some of the spillover effects of improved market functioning created by those who do own mobile phones. However, he is looking at the glass half-full effect since he also reports that phones were a foundation for greater inequality. The richer fishermen who purchased phones found their profitability increasing roughly twice as much as that of the poorer fishermen who did not own phones.

how they have shaped the structure of micro-enterprise commerce. The selected sector—the *aso oke* cloth-making sector in Nigeria—exhibited the information, process, and structural traits identified from the literature. It can therefore be seen as emblematic of the difficulties faced by traders within developing country micro-enterprise supply chains (and, of course, was selected partly for this reason).

Our focus on supply chains has left us saying little directly about the micro-level impact of mobiles on information. By substituting for some journeys, plus in-person meetings, we can see that phone calls have reduced the time and financial cost of information-gathering, often by several hours and several U.S. dollars respectively per call (not to mention the opportunity cost gains). Improvements in the quality of information within any individual communication were not evident, if we are considering information quality in terms of accuracy and relevance. Where mobile telephony did have a qualitative impact was on completeness of information. Travellers could now know whether or not a journey was needed before embarking on it. More sources of information—about orders, about thread, about capacity to weave—could be investigated. To (only) this extent, then, the informational impact of mobile telephony was helping make not just faster and cheaper, but also better, decisions.

ii. Mobiles and Supply Chain Processes

The research reported here partly supports the few studies that have been done before on mobile telephony and micro-enterprise. Based on interviewee and other evidence, it finds that mobile phones ameliorate, but do not eliminate, the three process challenges in micro-enterprise supply chains: speed, cost, and risk. In terms of objective evidence and also in the perceptions of stakeholders, mobiles were seen to reduce the delays, reduce the financial costs, and reduce the personal risks of involvement in commerce in this sector.

That reduction, though, was by no means to zero, largely because journeys and in-person meetings remained an integral part of trade even post-mobile. Some of that can be explained because this was a manufacturing sector with physical materials to be exchanged in trade. Much, though, was explained by the nature of information and decisions involved.

Some supply chain decisions are structured—simple, standardized, and objective. In this case, they might revolve around questions such as "Do you have an order for me?" or "Is your design sample ready?" or "Are you at home tomorrow afternoon?" These are readily amenable to phone-based information-gathering.

Other supply chain decisions are unstructured—complex, non-routine, and/or with degrees of subjectivity and uncertainty. In this case, they might revolve around questions such as "Can you produce a design that looks like this?" or "What would be the implications of introducing a gold thread into the cloth?" or "How far have you got in weaving the next part of the order?" These are not always readily amenable to phone-based information gathering, especially given the design-intensity and variable levels of trust found in the sector. One could, then, see support for Molony's (2006) finding that mobiles are not yet impacting some of the core decisions and interactions of micro-enterprise trade.

iii. Mobiles and Supply Chain Structures

So, there is some, but bounded, support for earlier studies on the economizing and travel-substitution effects of mobile telephony on supply chain processes. But there is as yet no support for those studies that saw a disintermediating effect. Rather, it was intermediaries who were driving the adoption of new technology in this supply chain. And it was intermediaries who found their roles consolidated, with a new form of intermediary even emerging.

In financial terms, it is claimed that buyers should be able to use telephony to reduce their costs by purchasing direct from the producer. This could be true of *aso oke:* weavers charge less than intermediaries. The problem is that any mobile-enabled reduction in purchase price through disintermediation is, or is perceived to be, more than offset by an increase in transaction costs, an increase in uncertainty, and an increase in risk. Thus, unlike Jensen's (2007) study, we did not find strong evidence for price effects of mobile usage.

A further key claim for mobile telephony is that, by reducing the time and cost of obtaining information, it will impact the information asymmetries that have encouraged the emergence of intermediaries. Our finding was that mobile phones reduced the time and cost of obtaining *some* information but, in the main, not the type of information on which the value and existence of intermediaries is based such

as identities and reputations of buyers and producers. Nor have mobile phones impacted the other asymmetries on which intermediation in this sector is based—unequal access to knowledge about design, supply mechanisms, costs, trading processes, mechanisms of redress; and unequal access to capital. Thus, by and large, asymmetries of information, knowledge, and capital—overall, asymmetries of power—between intermediaries and other stakeholders were at least maintained and in some cases strengthened.

There were few signs, then, of mobile telephony levelling the playing field; and more signs that it had been a technology of inequality. In comparing the "haves" and "have nots," we find a gradient of access. Those who were most-resourced prior to the arrival of mobiles now have 24/7 access to a personally-owned mobile phone. Those who were least-resourced still have no access to mobile. Those in-between have some access. As with access, so with impacts. The most-resourced have gained through mobiles in terms of more orders, larger orders, faster turnaround, and better quality of final product, leading to more customer satisfaction. The least-resourced are losing orders. Those in-between have seen some benefits, though they might also be characterized as "running in order to stand still."

In terms of other structural change, the picture is of a glass perhaps four-fifths empty and one-fifth full. There were (only a) few signs of mobile telephony building new relationships and new supply chain geographies; and more signs that it had acted to strengthen existing relationships and existing geographies. One or two examples of novelty—of calling on new, more distant thread suppliers or on far-off sub-weavers who otherwise would have been dropped from outsourcing networks—must be balanced against many more examples of a reinforced status quo.

In some ways, then, we find ourselves moving on from our conceptual starting point—the new institutional economics view of information and trade—to support the heterodox institutional economics view, which sees change (such as new technology) helping to reproduce pre-existing socio-economo-political relations (Rahman, 2007).

iv. Mobiles and Development

At the broadest level, we noted earlier that information failures in developing countries constrain the emergence of markets, and constrain business activity and investment. Our fieldwork provided no direct evidence on this. However, we have seen that mobile phones reduced some information failures and their related costs and risks. Accordingly, they did help to make trade and markets in this sector operate somewhat more efficiently and effectively. To that extent, we may hypothesize that mobile penetration has encouraged business activity and investment in this sector.

We can now turn to the last issue raised in the literature review—our conceptualization of mobiles in developing as opposed to industrialized countries. The picture here is mixed. The majority of mobiles encountered in this study were owned by one individual, as is the norm assumed for industrialized countries. But those mobiles were shared with others to allow more dispersed access, and the access model used by most weavers was one of public or shared access to mobile telephony. We also found novel ownership models such as the loan or "hire purchase"-type agreements between some intermediaries and their weavers.

By and large, the mobile phones in this study were valued for their connectivity—they represented the first accessible, reliable means of telecommunications for most of the stakeholders. They were not supplementary or complementary to existing fixed lines. Hence, partially, conclusions drawn here may also apply to fixed-line telephony and its delivery of connectivity. Nonetheless, at least for some, the mobility of the mobile phone was valued. Those who owned, or had been given, a GSM mobile appreciated the ability to be in contact during those journeys they were still required to make. And even those with WLL mobiles felt in contact as they moved about their local area. Thus, partially, conclusions drawn here are unique to the mobile form of telephony.

v. Limitations and Future Research

Finally, we should note this as "work in progress." First, because it describes just one case study sector. Whether it is representative of production micro-enterprise more generally is an open question. Most likely, it does epitomize the type of production that lies at the intersection of the cultural and the functional; production where local taste, culture and custom still matter and, hence, where design matters (Molony, 2006 provides another example). As devel-

oping countries are driven to liberalize their import regimes, such relatively protected and design-intensive sectors—clothing, furniture and furnishings, handicrafts, even food processing—will likely become more important as sources of employment and income. How far we can generalize, though, is unclear because in some ways our method argues the need for micro-level study that uncovers the specific process, structure, context and impact in specific sectors.

Second, we have monitored the impact of mobile telephony in the early stages of its penetration into this supply chain. So far, we find, it has an economizing effect on supply chain processes, but no significant restructuring effect on the organization of supply chains. Developing countries, though, have been sites of much innovation in business uses of mobile telephony. Thus, future study may show new patterns emerging in supply chain processes and structures. For example, intermediaries have so far used the technology to maintain and even consolidate their position. Further diffusion and familiarity with mobile phones may, however, change this. ■

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