Private Enterprise Development in Low-Income Countries

Mitigating Market Frictions by Monitoring Employees in SMEs: A Field Experiment in Kenya's Public Transport Sector

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We provide firms a new technology that delivers real-time information to the owner of the vehicle about the driver's productivity and safety. We find that owners use this information to change their management of drivers and re-optimize their contracts. Drivers respond to these changes by increasing their labour supply by twelve percent and taking better care of the vehicle. Overall, these changes lead to an increase in firm profitability and stimulate firm growth, thereby suggesting that improved monitoring technologies can help overcome important frictions faced by firms in developing countries.

Motivation

Small and Medium Enterprises (SMEs) play a major role in many economies, especially in developing countries. According to the World Bank, formal SMEs alone contribute up to 45% of total employment and up to 33% of GDP in emerging economies (World Bank Brief, 2015). In Kenya, where this project takes place, 80% of jobs created in 2014 were in the informal sector, which is dominated by SMEs (2014 Economic Survey). Empirical research on small firm growth has identified three key challenges facing SME's: credit constraints, labour market frictions, and managerial deficits. The latter, which refers to the difficulties that small firms face in managing firm operations, monitoring their employees, and setting achievable targets, has started to receive more attention in the literature. We contribute to this line of research by investigating how firms' choice of contract and management of their employees respond to agency problems and imperfect monitoring. Contracting under asymmetric information is problematic for firms. This difficulty is exacerbated in developing countries where limited liability and weak legal institutions limit the set of contracts that firms can feasibly enforce. Monitoring technologies that provide information to the principal can theoretically overcome these constraints. The purpose of the project is to determine the extent to which the provision of monitoring technologies to SMEs affects the terms of the contract between employers and employees, and managerial practices. We then investigate how changes in the contracting structure impact 1) employee behaviour, 2) firm productivity and growth; and 3) the negative externalities generated by the business.

Context

Kenya's informal transportation system is dominated by thousands of small-scale entrepreneurs that own a few minibuses ("matatus") that run on designated routes. This informal network of buses constitutes the only dependable transit system in Nairobi, and the city comes to a near standstill on days where drivers' strike. The industry remains almost entirely locally owned: private entrepreneurs purchase 14 or 33 seat minibuses, which they register with an existing SACCO. The presence of severe competition within a route explains the dangerous and reckless driving that prevails throughout the industry. According to the World Health Organization's Global Status Report on Road Safety, approximately 3,000-13,000 people die annually from traffic incidents where at least 30% of cases involve matatus (WHO (2015)). Conditions have not improved measurably in recent years.

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Experimental Design

We recruited 250 firms ("matatus") to participate in our study. Matatu owners were randomly allocated to a treatment and a control group. Owners in the treatment group were provided with free access to the data produced by a monitoring device that was installed in their vehicles at baseline. Owners in the control group were also fitted with the device, but received the information six months after installation. The monitoring system was designed from scratch by the research team and their partners at EchoMobile. The system is considerably cheaper, more flexible and more powerful than traditional tracking devices. The device captures key information including the 95th percentile and average forward/backward/lateral/vertical acceleration, as well as the 95th percentile and average forward/backward jerk. The device was also calibrated to generate alerts for every instance of vehicle speeding, over-acceleration, sharp braking and sharp turning. The data captured by the device was transmitted to owners via a mobile application that was specifically designed to present information simply. The app provided information in three ways. The first tab was a map of Nairobi and presented real-time and historical location of the vehicle. The second tab displayed all the safety alerts that were captured by the device. The final tab conveyed a summary of the driver's productivity and safety. The productivity section of this page listed the total mileage covered, and the duration the ignition was turned on that day. The safety section of this page provided the owner with an overview of the number of safety violations that occurred that day, as well as the driver's daily safety rating relative to all the other drivers on the road that day.

Four months after the information treatment was launched we introduced a second treatment arm, referred to as the "safety" treatment. We selected half of the treatment drivers and half of the control drivers and offered them cash incentives to drive safely. This arm was designed to simulate the role of a functioning regulatory system and monetize the trade-off between revenue and safety that drivers face. The cash incentive drivers were again randomly split into two groups: a one- month treatment group and a two-month treatment group (which we did not inform drivers of). This was done so we could study whether any changes in driving behaviour that might be induced by the incentives would persist after they were removed.

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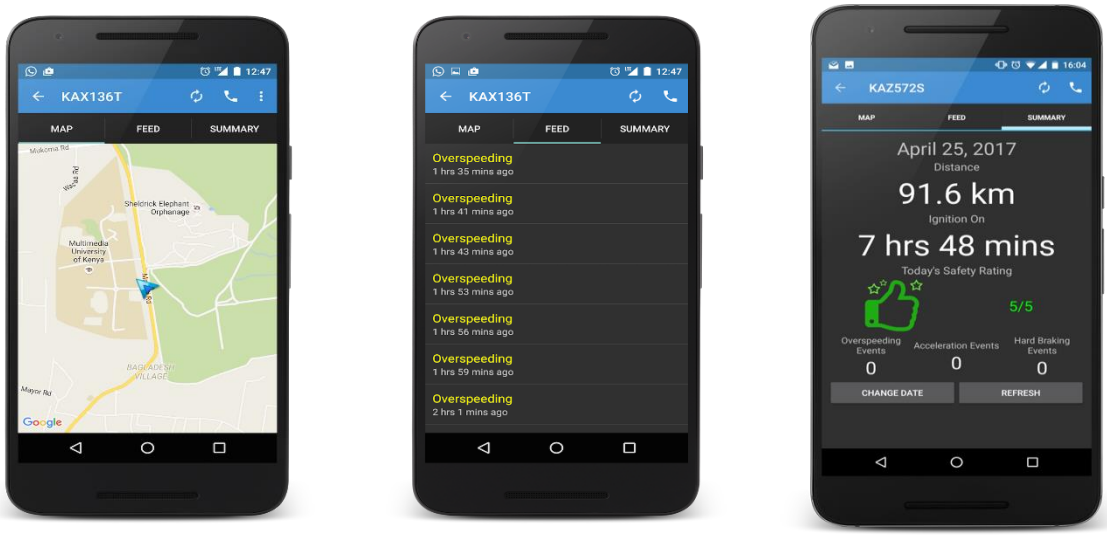

Main Findings

Information Treatment

Finding 1 (Owner response): We first investigate whether access to the tracking information changes the terms of the contract. While the intervention could also have changed the type of contract they offered their drivers, extensive interviews with owners suggested this was unlikely to occur. Social norms are engrained in this industry, and a change of this magnitude would be unexpected in a 6-month time frame. However, owners can use the information from the device to change the terms of the contract i.e. the target price they set for drivers to deliver at the end of the day (equivalent to a rental price). We investigate this hypothesis by breaking out the treatment effects by month. There are no significant changes in the first month, likely because owners were still learning how to use the app and experiment with ways to improve their business operations. In subsequent months however, we see the target steadily declining. By month 6, the target amount is 135 KES below the control group, representing a 4.5% decrease. While the result is not statistically significant (likely because we are underpowered), the downward trend is clear. This steady reduction suggests that the information allows managers to re-optimize the terms of their employees' contracts.

Finding 2 (Driver response): Drivers choose how much effort to supply, how recklessly they will drive, and the amount of revenue they disclose to the owner (which is either the target amount, or some amount below). We proxy driver effort by the number of hours the tracking device was on. We find that the number of hours increases by 0.9 hours per day in month 2 and rises steadily until the end of the study. By month 6, effort levels increase by 1.4 hours per day in the treatment group. This represents a 12% increase in drivers' labour supply. With more hours on the road, we also see the number of kilometres increase by approximately 12 kilometres per day.

Without the monitoring technology, drivers can choose how recklessly to drive with few repercussions. With the technology, however, owners can choose the amount of risk they want drivers to take because they can observe their driving behaviour. We hypothesize that owners will prefer less risk than what the drivers would optimally choose. With less risk, damages to the vehicle should be reduced. We see damages decreasing substantially throughout the entire 6-month period. In month 2 daily repair costs for treatment owners are reduced by 100 KES, and continue falling until month 6 where they are 250 KES less than what control owners are incurring on average. This represents a 50% decrease in daily repair costs, which is significant, as these repairs constitute a major business expense for owners.

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Finally, we investigate drivers' reporting behaviour. Owners can use the device to estimate actual revenue more accurately, and they are more likely to detect when the driver is underreporting. Drivers should respond to this additional oversight by lying less. Our results confirm this behaviour: the amount drivers under-report falls by approximately 70-100 KES per day.

Finding 3 (Firm productivity/growth): Treatment owners see their daily profits rise by approximately 12% in month 4 and 5 (440 KES). Taking the average gains over the study period and extrapolating to the full year (assuming the matatu operates 25 days a month), we can expect a 120,000 KES (1200 USD) increase in annual firm profits. The device cost 125 USD, which means that it would take less than 3 months for the investment to become cost-effective for the owner.
Are treatment firms also more likely to grow their business than control firms? We measure firm growth by the number of vehicles that owners have in their fleet at end line. A simple regression of this outcome on treatment with the standard controls reveals that treatment owners have 0.145 more vehicles in their fleet on average than control owners. This represents an 11-percentage point increase in fleet size. We hypothesize that the monitoring device introduced a number of changes that encouraged treatment owners' to grow their businesses more actively. First, profits increased. Second, our results suggest that owners started trusting their drivers more, and they are more like to report that their drivers have become more honest. Finally, treatment owners' assessment of whether their drivers' skills have improved increases as well.

Finding 4 (Externalities): The device conveyed information to owners about productivity and safety. To the extent that owners contract explicitly over safety we might expect owners to set higher safety standards for their drivers. However, if owners care only about revenue, and increased effort comes at the expenses of safety, we might expect instances of unsafe driving to increase. This would lead to socially suboptimal behaviour by the drivers. The device collected five pieces of information that correlate with safe driving: maximum speeds, speeding over 80km, acceleration, sharp braking and sharp turning. We do not see any significant changes along any of these measures. Overall the evidence points towards safety standards staying the same, despite the emphasis we placed on safety across all tabs in the app. While this confirms that owners can incentivize optimal levels of effort without further compromising passenger safety, we cannot expect owners to internalize the negative externalities produced by unsafe driving.

Cash Treatment

Finally, we tested the impact of an intervention that incentivizes drivers to take safety into account. Drivers were offered 600 shillings at the beginning of the day, and incurred a penalty for each safety violation they incurred. The experiment was designed to mimic an intervention that a regulatory body could feasibly implement. We find that the cash treatment has no discernible effect on average speed, over-acceleration, and sharp turning. However, we detect large decreases in the instances of speeding and sharp braking. These results suggest that drivers can be incentivized to take safety into account. However, the incentives must come from a third party, as owners are unlikely to induce similar changes in driving behaviour.
We also examine driving behaviour among the group of drivers whose cash incentives were removed after the first month. The goal of this exercise is to examine whether the behavioural changes induced by the cash treatment persist after the incentives are removed. We see that the number of speeding events rebounds almost completely to pre-treatment levels, while the number of sharp braking events remains lower but insignificant. Overall, it appears that the behavioural effects of the cash treatment arm wear off after the removal of the incentives. This suggests that inducing better driving habits for a short time period may not be sufficient to see longer run improvement in safety outcomes.

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Policy Implications

These results are important for a number of key stakeholders including small firms operating in the transportation industry, and policy makers working to improve road safety conditions in urban hubs. We know firms struggle to grow in developing countries for a number of reasons, and this paper identifies another important barrier that is relatively understudied empirically: moral hazard in labour contracting. One solution that can potentially ease this friction is improved monitoring. Monitoring is typically difficult in small firms, however, because they cannot hire dedicated staff to oversee employee performance, and it takes time away from regular business operations. In our paper, we demonstrate that introducing cost-effective monitoring technologies can be a worthwhile investment for companies looking to increase their profits and grow their asset base.

We do not find that safety standards improve when information from the device is conveyed to owners. However, when the drivers are incentivized to drive more safely we see instances of speeding and sharp braking fall. This suggests that simply introducing monitoring technologies, without further regulation, might not achieve the desired effects for governments trying to improve road safety. Local transport authorities in Nairobi and South Africa have already started to discuss ways of introducing remote tracking solutions throughout the transportation industry to help monitor and record the behaviour of the drivers on the road. Our research suggests that while this will improve firm operations, more targeted interventions requiring regulatory oversight will be necessary if these devices are to induce safer driving.

Moving Forward… Cities across Africa are experiencing rapid population growth. In a companion project we focus on a problem where the challenges associated with this rapid urbanization are particularly salient, namely ensuring the efficiency and safety of public transportation systems in sub-Saharan Africa. Accidents in this industry are frequent and deadly. Bus drivers face incentives to drive recklessly in order to increase their take-home pay, which endangers passengers on board, as well as other vehicles on the road. These dangerous driving conditions disproportionately affect the poor, who rely heavily on public transportation to get to work. The goal of this project is to determine whether providing information to private stakeholders (passengers) improves the safety of public transportation systems in the context of weak regulatory environments. To this end, we equip matatus operating along one of Kenya's major transit corridors with a monitoring device, and track their safety performance. We then provide this information to passengers. By observing each passengers' subsequent travel choice, we will understand the extent to which they value safety. Moreover, we intend to use the tracking data produced by the device to observe whether bus companies improve their safety performance once this attribute is observed by all their customers.