



Effect of armed conflicts on humanitarian operations: Total factor productivity and efficiency of rural hospitals

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ABSTRACT

We study an important but widely neglected topic in humanitarian operations: armed conflicts. Specifically, this paper empirically analyzes the effect of armed conflicts on the operational performance of first-layer response organizations. Using as a case study the Colombian conflict we investigate the effect of conflict on public rural hospitals' (i) total factor productivity, (ii) efficiency and (iii) efficiency variability. The panel data set (2007–2011) used in this study includes information at the hospital level for 163 hospitals and qualitative data collected from interviews with medical staff from the Colombian Ministry of Health and hospitals in different conflict zones. Our results indicate that armed conflict has a positive effect on total factor productivity, while it has a negative impact on hospital efficiency, and interestingly that efficiency and total factor productivity both increase in post conflict. Finally, the results show that efficiency variability is higher in peace and post-conflict hospitals and lower in medium and severe-conflict hospitals. These results have operations management implications and opportunities for future research related to sourcing decisions, supply chain and workforce flexibility, behavioral impacts on the workforce, and humanitarian response to conflicts.

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1. Introduction

In this paper we study an important but widely neglected topic in humanitarian operations: armed conflicts. As stated by Uppsala Universitet, 24 developing countries experienced active armed conflicts in 2013. Each of these armed conflicts (henceforth referred to as conflicts) caused at least 25 deaths and affected millions of people worldwide (Uppsala-Universitet, 2014). Common characteristics of the 24 developing countries suffering conflicts in 2013 were a gross national income per capita below US\$11,905 as determined by the World Bank as well as their economic dependence on mining, hydrocarbons, or agricultural activities. Such economic activities took place in rural areas and the conflicts these countries faced were also mostly rural. This is why hospitals that serve rural areas, henceforth referred to as either rural hospitals or

simply hospitals, are one of the first layers of humanitarian response to conflicts. As a result of conflicts, rural hospitals face a series of challenges that may include abrupt demand changes, capital or labor destruction, unrest, violence and fear experienced by medical personnel, transportation problems and disruptions in the supply of medical items.

We analyze empirically the effect of armed conflicts on the operational performance of rural hospitals, and use total factor productivity and efficiency as measures of hospital performance. We investigate three research questions: (i) What is the effect of conflicts on hospital total factor productivity? (ii) What is the effect of conflicts on hospital efficiency? and (iii) What is the effect of conflicts on hospital efficiency variability? First, we examine total factor productivity (TFP), which incorporates unobservable aspects such as managerial ability and input quality that are not explained by the mix of capital and labor. According to Solow (1957), TFP includes slowdowns, speedups and improvements in training of the labor force. While limited literature has found both positive and negative effect of conflicts on TFP, we ultimately propose that conflicts have a positive effect on TFP. Second, we look at efficiency, which is modeled as the ratio between outputs (inpatients) and

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inputs used for healthcare provision at the hospital level. We conjecture that conflicts have a negative effect on efficiency. Finally, we propose that efficiency variability is lower in hospitals that are located in conflict regions compared to hospitals located in peaceful regions.

To examine our research questions, we use a panel data set with information on 163 rural public hospitals in Colombia during the period 2007–2011. The data set contains information at the hospital level and is combined with cross-sectional data on conflict at the municipality level. We also include socio-economic control variables at the municipality level obtained from different government organizations in Colombia. In addition, we complete the data with field visits to rural hospitals and six semi-structured interviews with staff from the Ministry of Health and rural hospitals in different conflict zones in Colombia. It is important to remark that gathering this unique data set was difficult. Even though hospital information is public, there were many challenges and barriers for collecting both quantitative and qualitative data, which are explained in Section 5.

Based on the data, we obtain TFP as the residual of a Cobb–Douglas production function using a fixed effect model for years 2007–2011 and estimate the relative efficiency of hospitals using data envelopment analysis. We find that conflict has a positive effect on TFP while it has a negative effect on efficiency. The results also show that efficiency variability is higher in peace and post-conflict hospitals and lower in medium and severe-conflict hospitals. In addition, we find that both TFP and efficiency increase in post conflict. These results lead to operations management implications and opportunities for future research related to sourcing decisions, supply chain and workforce flexibility, behavioral impacts on the workforce, and humanitarian response to conflicts.

2. Brief typology of disasters

This section presents a brief typology of disasters with the aim of positioning our research in the humanitarian operations management literature. To begin with, the disaster cycle is composed of preparedness, response, rehabilitation and mitigation (Tomasini and Van Wassenhove, 2009). Preparedness focuses on reducing the expected impact of a disaster. Response addresses the urgent needs of the affected population. Rehabilitation aims at attaining or increasing the quality of life of the affected community relative to what it was before the disaster. Mitigation considers how to avoid and reduce the risk of future disasters. Our research studies the response stage.

Disasters range from natural to man-made (Van Wassenhove, 2006). According to the International Federation of Red Cross and Red Crescent Societies (IFRC, 2014), natural disasters can be biological (outbreaks of epidemic diseases, animal plagues and infestation), climatological (heat/cold waves, wildfire), meteorological (hurricanes, typhoons), hydrological (flood, wet mass movement), or geophysical (earthquakes, tsunami). The location and intensity of natural disasters is uncertain and its response is urgent but its timeline is relatively short compared to the entire disaster cycle. The operations management literature has focused on the study of preparedness and response to natural disasters (Starr and Van Wassenhove, 2014; Altay and Green, 2006). Some examples of recent research on natural disasters include the Ekici et al. (2013) study of food distribution planning and influenza pandemic and the Pedraza-Martinez et al. (2011) research on field vehicle fleet management for disaster response.

Man-made disasters include armed conflicts, industrial accidents and transport accidents (IFRC, 2014). The term conflict can be defined as “a contested incompatibility that concerns government

and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths in one calendar year” (Themnér and Wallensteen, 2013). Conflict’s duration may extend for years and their intensity may change over time between different regions in the same affected country. In the operations management community man-made disasters have been studied much less than natural disasters. Pedraza-Martinez and Van Wassenhove (2013) are the first to empirically investigate the impact of conflicts on operations management. They study vehicle replacement at the International Committee of the Red Cross and build a conflict index to test whether conflict impacts replacement decisions. They did not find a significant relationship between conflict and vehicles’ salvage value and highlight the need for more research on the impact of conflicts on operations management. Eftekhari et al. (2016) elaborate on the impact of conflicts on last mile fleet management in humanitarian operations. We contribute to the nascent research on man-made disasters in operations management by investigating the impact of armed conflicts on service-oriented organizations such as rural hospitals.

In this paper we study the impact of conflict across four stages (peace, medium conflict, severe conflict, and post conflict). The use of these four stages comes from the fact that conflict dynamics are mainly characterized by processes of escalation and de-escalation of the conflict intensity (Dudouet, 2013). Conflict escalation is described by the increase in the intensity and frequency of violent actions (Mitchell, 2011). Typically a de-escalation process described as going from armed to unarmed resistance follows the escalation stage. The subsequent demilitarization or post-conflict stage can be achieved through mechanisms such as decapitation of the structure (capture/killing leader), success/failure (any party succeeds/fails in the objective), repression (use of force), negotiation or reorientation to other ways of resistance (Cronin, 2009). Although data limitations do not allow us to directly investigate the transition of each hospital from one stage to the other, we study hospital performance under each conflict stage and compare it to hospital performance in other conflict stages. Armed conflicts can range from short-rapidly changing ones that last one year or less (as in Rwanda in 2009) to steady-state slow-changing ones (as in Colombia, Myanmar, Thailand) that continue active for decades (Kreutz, 2010). While in the first transitions between stages such as peace, medium conflict and severe conflict occur rapidly, in the second transitions between stages occur slowly. In both cases rural hospitals are key response organizations that face complex situations. In case of long-term conflicts response and rehabilitation stages may occur during conflicts (Crost et al., 2014). Therefore, aid providers face challenges to keep safe both their staff and civilians (UN-Assembly, 2015). We study steady-state slow-changing conflict.

Complex disasters include shocks like natural disasters in conflict-prone areas that increase humanitarian logistics challenges (Starr and Van Wassenhove, 2014). For instance, last mile distribution of aid in conflict areas in the aftermath of disasters may be disrupted due to security reasons. Moreover, conflicts may create demand mobility in the form of internally displaced people, which increases demand uncertainty. Complex disasters also include escalating disasters such as the tsunami and nuclear disaster in Fukushima, Japan in 2010, and the cholera outbreak in Haiti following the 2010 earthquake. We include complex disasters in this brief typology for completeness. Although the area of complex disasters remains mostly unexplored, it is not the focus of our research.

Finally, disasters can also be classified according to their magnitude and required level of response. Small to medium disasters can be handled by means of local or national response that

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