Managing risk of equipment failure through performance-based contracts: an empirical analysis

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Risk management of equipment failure is a fundamental problem in capital intensive environments. While failures in this type of setting are often infrequent, the opportunity costs associated with equipment unavailability can be huge. In the aerospace industry, for example, aircraft owners (e.g. airlines) face the problem of how to properly manage the risk of infrequent equipment failure so as to protect aircraft availability and reliability, thus avoiding the high opportunity cost of having an aircraft on-the-ground. The type of service contract for the repair and maintenance of aircraft is thus a crucial decision that airlines make, as part of their risk management strategy.

In this research, we empirically analyze the impact of different types of contracts for service support on aircraft reliability. Our proprietary dataset comes from a major supplier of aircraft subsystems, who provides repair and maintenance services to its customers under two different types of contracts; Time and Material (T&M) and performance-based contracts (PBC). Under a T&M contract the customer pays for the materials and resources that are consumed each time a maintenance event (product removal/repair) occurs; under a PBC contract all costs for the maintenance event are covered by the supplier and the customer's payment for support services is based only on the actual flying hours the customer generates from their fleet of aircraft. Conceptually, PBC aligns incentives between the customer and the supplier so that both are rewarded as the product's use generates value to the customer. While the managerial and analytical arguments for PBC are pervasive, there is limited data and empirical research to support these conclusions.

The main hypothesis we test in this research is that risk management strategies based on PBC have a positive causal effect on product reliability. Our proprietary dataset, provided by the aircraft subsystems supplier, is based on maintenance transactions that occurred under both PBC and T&M contracts. We included five years of maintenance events for 5 different types (models) of aircraft subsystems (more than 700 products in total), belonging to more than 60 customers. From the data we are able to calculate a key measure of product reliability that is widely used in the Aerospace and Defense industry, i.e. the mean time between removals (MTBR) of subsystems from the aircraft.

Econometrically, the main challenge associated with isolating the true causal effect of different customer service contracts on product reliability is consideration of the inherent endogeneity associated with the choice of contract type by customers. Indeed, customers do not sign on for either a T&M or PBC contract at random, but rather this choice is based on a decision process that can depend on characteristics of both the products and the customers. We test and statistically confirm the presence of endogeneity due to customer selection of contract type. Accordingly, we utilize a structural estimation approach that explicitly deals with contract selection by customers. Our model allows us to explain the drivers of the contract type decision by a customer, which in turn allows us to capture the causal effect of PBC for service support on product reliability. Variables of importance in our analysis include characteristics of the products such as product type and product initial conditions, as well as characteristics of the customer that include customer fleet size and risk exposure.

Preliminary results provide statistical support for our primary hypothesis, suggesting improvements in product reliability under PBC of more than 10%. Robustness checks and alternative model specifications are currently under development. This study constitutes one of the first attempts to test the reliability improvement hypothesis for service support risk management strategies based on product performance, through rigorous econometric modeling that makes use of primary transactional data. The findings that will arise from this research are especially relevant considering the current lack of empirical evidence, and will be of importance not only to the aircraft repair and maintenance service industry, but also to all industries that provide after-sales support for managing risk of mission critical products.

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