Regulation, Market and Technology: Evidence from the U.S. Trucking Industry
Dissertation Abstract
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My dissertation focuses on the trucking industry in the United States. I explore the causal effects of environmental policies on trucking decisions, the technological challenges of reducing fuel consumption and factors affecting trucking fleets’ composition. As the fuel economy standards for medium- and heavy-duty trucks are finalized in August 2016, my dissertation addresses a timely and important issue – how to effectively reduce greenhouse gases emissions from trucking operation. Three essential policy tools are examined – taxes, fuel economy standards, and engine emission standards.

In the first essay, I exploit a rich vehicle-level micro dataset of the U.S. heavy-duty trucking fleets to examine how truckers respond to changes in per-mile fuel cost. Per-mile fuel cost depends on the fuel economy of the vehicle and on the price of diesel, which is taxed at a different rate than other motor fuels. The U.S. Environmental Protection Agency (EPA) categorizes medium- and heavy-duty trucks into two groups - combination trucks and vocational vehicles. They are regulated separately due to their distinctive driving patterns and trip distances. Combination trucks are tractor-trailers weighing more than 26,000 pounds, typically with a body type of either an enclosed box or a platform. They are mostly used for long-haul shipping. Vocational vehicles are straight trucks (with a loading area as part of the vehicle) with gross vehicle weight greater than 10,000 pounds. They travel locally for various professional purposes and include step vans, dump trucks, concrete mixers, etc. My empirical results show that the average medium-run elasticities of vehicle-miles-traveled are -0.23 for combination trucks and -0.27 for vocational vehicles; the average elasticities of payload distance are -0.43 for combination trucks and -0.36 for vocational vehicles. Within each of the two groups, the estimated elasticities vary significantly among different truck weight classes and business sectors. The heterogeneity in truckers' responsiveness calls for differentiated policies, in particular, fuel taxes. I derive the optimal fuel taxes in a general equilibrium model that includes the externalities of truck operation (such as air pollution, road damage, accidents, and noise pollution), measures shipping demand in terms of payload distance and allows truckers to choose their routes based on shipping demand. In the second-best setting, most of the optimally differentiated diesel taxes are about twice or three times of the actual rate. Compared to the optimal uniform tax, implementing differentiated taxes based on vehicle weight classes reduces the existing distortion and generates an overall welfare gain of about 54 billion US dollars per annum. The total tax paid by the trucking industry is reduced by 33 billion dollars.

In the second essay, I look at the evidence about fuel economy and other truck attributes from the U.S. Inventory and Use Survey (VIUS). I estimate the trade-off effects between fuel economy and truck attributes, providing implications for a dynamic baseline of improvements in fuel economy. My estimation results show that the annual rates of fuel economy improvement from 1973 to 2002 are about 0.93% for combination trucks and 0.83% for vocational vehicles. In other words, in the absence of regulations, we can
expect reductions in fuel consumption by 8.01% for combination trucks and 7.15% for vocational vehicles in ten years, just under half of the targets. The difference in technological progress among fleets with various sizes suggests that incentivizing trucking fleets to update their vehicles more frequently can be an effective channel to improve overall on-road in-use trucks’ fuel economy.

In the third essay, I examine the factors affecting changes in trucking fleets’ composition in California using the disaggregated registration data from the California Department of Motor Vehicles. In particular, I am interested in identifying the effect of engine emission standards on trucks’ vintage distribution. The 2002 Consent Decrees required some engine manufacturers – Caterpillar, Cummins, Detroit Diesel, Volvo, Mack Trucks/Renault and Navistar to comply with the 2004 model year standards by October 2002. The policy is expected to raise the price of new trucks and thus has the potential to induce truck owners to hold on to their old and inefficient trucks. This is exactly the opposite effect than that intended by the regulators, and thus it is important to look at the empirical evidence. The remaining manufacturers that are not subject to the policy serve as the baseline control group. Using a difference-in-difference approach, I examine how truck registrations change differently among manufacturers and identify the effect of emission standards on truckers’ purchase decisions.