1 Extended Abstract

We study the dynamics of Amazon’s fulfillment center network and how it relates to variation in sales tax laws across states. In most cases, a firm is not required to charge sales tax to a consumer unless the firm operates a ‘nexus’ in the state in which the consumer resides. A fulfillment center usually constitutes a ‘nexus’, meaning Amazon must weigh the costs and benefits of expanding their network of warehouses. On one hand, building a new fulfillment center provides faster and cheaper delivery to consumers living nearby. On the other hand, it forces Amazon to charge sales tax to residents of the state where it the warehouse is built, eliminating any price advantage they previously held over other online and offline retailers. The primary goal of this paper is to examine this trade-off as Amazon expanded its network of warehouses from the years 2008 to 2012.

Specifically, we ask two questions: (1) what are the scale effects of the network expansion? and (2) are their distortions caused by the variation in the sales tax laws across states? The aim of the first question is estimate the cost-saving due to an expanded network of distribution centers, while the aim of the second is to demonstrate that the existing tax laws result in ‘sub-optimal’ fulfillment location choices, in terms of delivery costs and speed. To answer these questions, we first estimate a model of online retail demand using data from comScore. The comScore web behavior database provides a complete history of online transactions for a sample 100,000 household from the years

*All correspondence may be addressed to the authors via e-mail at houde@wharton.upenn.edu, pwnewberry@psu.edu, or kseim@wharton.upenn.edu.
2008 to 2012. In the model, a household decides how much of their income to spend on Amazon each year, considering both the speed of delivery and the tax rate. Information on the locations and opening dates of Amazon’s fulfillment centers along with federal, state and local sales tax rates, allow us calculate the distance to closest fulfillment center, which proxies for delivery time, and the tax rate charged to each household for an Amazon purchase.

One challenge we face is the fact that we observe many households who do not purchase any goods online in a given year. We therefore model demand as a Heckman two-stage selection model, where a first-stage selection equation determines whether or not consumers purchase goods online as a function of local offline options. Results indicate that the likelihood of purchasing online goods decreases with the number of offline options. In the second stage, we estimate the amount of expenditures on Amazon conditional on purchasing online goods as a function of the distance to the closest fulfillment center, the sales tax, consumer characteristics, and time and state effects. We find that households who are closer to a fulfillment center tend to spend more at Amazon, while those who are charged sales tax spend less. This is in line with our priors about how consumers react to delivery speed and taxes.

Using these results we conduct two simulation exercises. In the first exercise, we estimate how much expected revenue Amazon would have earned in 2012, had it kept its distribution network at its 2008 level. The difference between this value and the observed value can be thought of as a lower-bound cost saving due to the expansion of the network. In the second exercise, we estimate the expected revenue of Amazon in 2012 under Wal-Mart’s distribution center network in 2012. We then compare this to the expected revenue assuming Amazon’s 2012 network and a tax regime where Amazon must charge sales tax on all transactions. The idea behind this exercise is to compare revenues under a common tax policy, but with one company setting their network ‘optimally’, and the other ‘sub-optimally’. We use Wal-Mart’s distribution network as the ‘optimal’ network because they are required to pay sales tax in all states (i.e., they have outlets in all states). This exercise allows us to get a measure of the distortion in revenue caused by variation in tax laws, in terms of the revenue lost by being further away from consumers.

Preliminary results suggest that Amazon saved at least 123 million dollars in revenue in 2012.
with an expanded network, which is about 3% of total revenue. This number does not include the
future savings due to network expansion, meaning total savings are likely significantly higher. For
the second simulation exercise, we find that sales taxes lead to a distortion of nearly 95 million
dollars in revenue. That is, the fact that Amazon considers the tax implications in its choice of
network leads to a loss of 2% of revenue, in terms of the demand effects of being further away from
consumers.