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What Foot Traffic Reveals About Demand

Marina Azzimonti, David Wiczer, and Yang Xuan. “Estimating Demand Shocks from Foot Traffic: A Big-Data Approach.” Federal Reserve Bank of Richmond Working Paper No. 26-05, March 2026.

How do economists measure sudden changes to demand and estimate how firms respond to those shocks? In manufacturing, factories and warehouses generate detailed records of production, making it easier to trace changes to supply and demand. But in the business-to-consumer economy — which adds more value to GDP than manufacturing and accounts for about one-third of U.S. employment — demand is intrinsically determined by the flow of customers, which is influenced by various factors.

This makes demand in consumer-facing industries remarkably difficult to measure and to separate into its two drivers: exogenous shocks (unexpected shifts in customer numbers due to weather, local events, or changing tastes) and firms’ own strategic choices. Previously, economists relied on annual sales figures released with substantial delays, which may be impacted by firms’ behaviors. A new working paper by Marina Azzimonti of the Richmond Fed, David Wiczer of the New York Fed, and Yang Xuan of Louisiana State University in Shreveport takes a closer look using high-frequency foot traffic data.

The authors constructed a detailed dataset of monthly visitor counts at individual businesses via SafeGraph, a firm which aggregates anonymized cellphone location data. They narrowed the sample to nearly 6,000 branded establishments in the retail, service, and health sectors across Manhattan, Brooklyn, and the Bronx from 2018 through 2019. The focus on brands such as Macy’s or Starbucks let

the authors control for business-level differences like pricing, promotions, and advertising, assuming variation in foot traffic from one Starbucks to another reflects local demand, not a manager’s marketing ability.

To tell those stories apart, the authors built a model that separates brandwide decisions from the local variation reflecting actual demand. The authors then characterized each establishment by three metrics: average annual growth, monthly volatility, and average foot traffic.

Based on these three characteristics, a clustering algorithm — an unsupervised machine learning technique that categorizes data points into groups by similarity — identified three distinct types, or clusters of firms, each with its own characteristic pattern of demand. “High-traffic” establishments experience steady streams of visitors, “fast-growing” locations show strong year-over-year expansion, and “low-traffic” stores have visitor counts that are smaller and more erratic.

In the high-traffic group, a strong month tends to be followed by another strong month: Roughly 80 percent of a demand shock persists into the next period. Low-traffic establishments show the opposite pattern: One month’s demand shock barely predicts anything about the next. Fast-growing locations sit in between, with about 60 percent of each demand shock persisting into the next month. The magnitude of shocks also differs substantially across groups. Low-traffic establishments experience much larger fluctuations, with the standard deviation of shocks roughly twice that of high-traffic establishments, indicating greater demand volatility. Importantly, the three clusters cut across industry categories and brands, betraying latent diversity in these demand processes that cannot be explained by sector,

strategy, or geography alone.

A popular assumption in macroeconomic modeling is that every firm within a sector or region draws demand shocks from a common probabilistic process. But a model that pools all firms in the sample into a single group yields a demand shock persistence of 71 percent, overstating persistence at low-traffic stores and understating it at high-traffic stores, misrepresenting the population as a whole.

These differences in demand behavior directly affect how firms invest. When a business decides whether to make a costly investment, such as opening a new location, hiring additional workers, or expanding capacity, it weighs the upfront cost against the value of future profits. When demand shocks are persistent, those expected future profits are more certain. For high-traffic businesses, a moderately good present may justify paying the cost. When shocks are transient, as they are for low-traffic businesses, the same decision requires much stronger current conditions because good news today reveals less about the future.

Understanding the investment behavior of consumer-facing firms in response to demand shocks matters for policymakers interested in shaping that behavior. Azzimonti, Wiczer, and Xuan show that compared to their three-cluster model, a model with a singular demand process systematically overpredicts movement in aggregate investment when treatments such as deregulation, innovation subsidies, or monetary policy adjustments shift the cost of investing. When businesses face very different demand dynamics irrespective of sector, locale, and brand strategy, policymakers must account for this underlying heterogeneity or risk misjudging the economy’s response to policy. **EF**