

## Buyers' Ability and Willingness to Shop Around: An Explanation for Price Dispersion

By Karl Rhodes and Nicholas Trachter

For many years, economists have observed substantial and pervasive price dispersion—wide variations in price for the same product. Some economists have attributed price dispersion to “ignorance in the market,” a lack of information among buyers and sellers. More recently, economists at the Richmond Fed and the University of Pennsylvania have developed a model that combines price dispersion theory with intertemporal price discrimination theory to suggest that buyers’ differing ability and willingness to shop around might explain price dispersion.

For centuries, economists have adhered to the law of one price, the theory that the same good should sell for the same price in all locations of a free and efficient market. But real world observations of substantial and pervasive price dispersion have contradicted this theory too often to be explained away as brief deviations from equilibrium.

A famous early challenge to the law of one price occurred in 1961, when the late George Stigler published “The Economics of Information.” On the first page, the University of Chicago economist wrote, “It is important to emphasize immediately the fact that [price] dispersion is ubiquitous even for homogenous goods.” Stigler further declared that “price dispersion is a manifestation—and, indeed, it is the measure—of ignorance in the market.”<sup>1</sup>

In 1977, building partly on Stigler’s insight, economists Steven Salop (currently of Georgetown University) and Joseph Stiglitz (now at Columbia University) published a model of

price dispersion under the title “Bargains and Ripoffs.”<sup>2</sup> Their model featured two types of buyers—those who “carefully and analytically gather the information required to make wise purchases” and those who are “less rational and calculating in their decisions.”

While the Salop-Stiglitz model helped explain spatial price dispersion (different prices at different stores), another model—developed by Hal Varian in 1980—began to address intertemporal price dispersion (different prices at different times within the same store). The University of California, Berkeley economist (now at Google) demonstrated that retailers could maximize their profits by holding periodic sales that would allow them to price discriminate between “informed” customers and “uninformed” customers.<sup>3</sup>

### Space and Time Converge

Over the years, models of price dispersion have tended to be spatial, while models of price discrimination have tended to be intertemporal.

Earlier this year, however, one of the authors of this *Economic Brief* (Trachter) worked with Guido Menzio, an economist at the University of Pennsylvania, to combine the insights from both theories into a unified model.<sup>4</sup> Their new framework attributes price dispersion primarily to differences among buyers' ability and willingness to shop around. The fact that some buyers shop at multiple stores drives spatial price dispersion, and the fact that some buyers shop at different times drives intertemporal price dispersion.<sup>5</sup>

Menzio and Trachter imagine a market for an indivisible good. On the demand side, some buyers purchase the good from only one seller, while other buyers shop around. In addition, some buyers shop only during the day, while others shop during the day and during the night. On the supply side, there are identical sellers, and each seller can vary the daytime and nighttime price of the good. (In describing their model, Menzio and Trachter use "daytime" as shorthand for convenient times and "nighttime" as shorthand for less-convenient times.)

Equilibrium in their model always features price dispersion among stores because sellers encounter some buyers who shop at only one store and other buyers who shop at multiple stores. This difference prompts sellers to periodically post lower prices (hold sales) to attract some portion of the shop-around crowd. Moreover, if the buyers who shop day and night also shop from multiple stores, then equilibrium also features price variation within stores because sellers can charge lower prices at night—to compete for some portion of the shop-around crowd—without losing revenues from their daytime customers.<sup>6</sup>

Menzio and Trachter's model—like other search-theoretic models—does not necessarily attribute failure to shop around to irrational behavior or lack of information. Of course, some buyers are irrational and uninformed, but others are rationally ignorant, meaning they simply have more rewarding ways of spending their time. For example, in a recent television commercial for Sprint, jetsetters on their way to a basketball game scoff at the idea of switching

cell phone service providers to cut their bills in half. The advertisement portrays the jetsetters as "stupid rich," but they are not necessarily uninformed or irrational. If they possess more money than they could spend in their lifetimes, their reluctance to invest time to save money makes sense. In other words, they are *able* to shop around, but they are not *willing* to do so because they value time more than money.

A more common example might be a high-powered corporate attorney who shops only at an upscale grocery store on Sunday afternoons. Perhaps she could save \$60 a week by shopping at several stores at a variety of times, but she earns \$600 per hour, so the opportunity cost of shopping around would be extremely high in her case.

### **Stocking Up on Ketchup**

Jetsetters and busy lawyers aside, price dispersion and price discrimination create plenty of opportunities for typical consumers to save significant amounts of money by shopping around, even for low-dollar items such as ketchup.

Martin Pesendorfer, currently a professor at the London School of Economics and Political Science, found wide variations in the price of ketchup in Springfield, Missouri, from 1986 through 1988, a time when data on retail sales was sparse. Pesendorfer observed that prices for 32-ounce bottles of Hunts and Heinz ranged from 89 cents to \$1.79 and from 79 cents to \$1.49, respectively. He used this price dispersion data to formulate a model of intertemporal pricing in which demand for ketchup accumulated while some shoppers waited for it to go on sale.

Pesendorfer chose to study ketchup partly because an unopened bottle of ketchup has a long shelf life. This fact allows some buyers in his model to stock up on ketchup when the price is low. Meanwhile, other buyers simply buy ketchup at whatever price is posted when their supplies are completely or nearly depleted. Pesendorfer called these buyers "store-loyal consumers," meaning those who are unable or unwilling to shop around.<sup>7</sup>

Ketchup prices reappeared in the literature last year when Menzio and Greg Kaplan, an economist at Princeton University, completed a study of price dispersion among 1.4 million goods in 54 U.S. markets from 2004 through 2009.<sup>8</sup> They found that the average standard deviation for the same good sold during the same quarter was 19 percent, and they highlighted Heinz ketchup as a “rather typical” example of the goods in their data. They observed that the price of a 36-ounce bottle of Heinz ketchup varied from 50 cents to \$2.99 in Minneapolis during the first quarter of 2007. (See Figure 1.)

Prices for ketchup and other goods are generally lower at discount grocery stores than they are at upscale grocery stores, but surprisingly, Kaplan and Menzio attributed only 10 percent of the overall price dispersion they found to the relative “expensiveness” of stores. They attributed the remaining 90 percent—in roughly equal shares—to differences in prices across comparable stores and to variations in prices within the same store. They further concluded that households with fewer employed members pay lower prices because they have more time to shop around and because the opportunity cost of time is generally lower for people who are unemployed or retired.

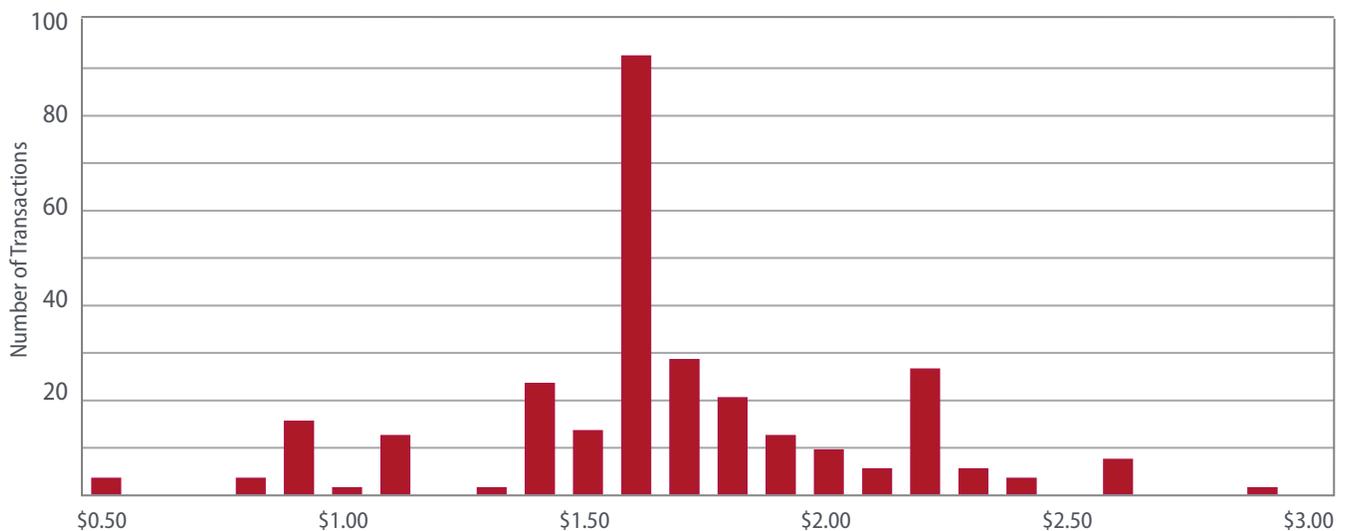
That labor-related finding echoes research published in 2005 and 2007 by economists Erik Hurst of the University Chicago and Mark Aguiar, currently of Princeton University. They found that people spend 17 percent less on food after they retire, but their consumption of food does not decline noticeably because they are able to substitute time for money by shopping around more and preparing more meals at home.

### Why Does Price Dispersion Matter?

New sources of price data—primarily from scanning billions of UPC labels—have fed the rapid growth of price dispersion research in recent years. In addition to supporting empirical studies, UPC data helps economists develop and improve theoretical models.

At the microeconomic level, understanding price dispersion and price discrimination helps sellers maximize profits and helps buyers maximize savings. At the macroeconomic level, more robust models of price dispersion and price discrimination could someday help economists measure inflation more accurately or better evaluate the stickiness of prices for monetary policy purposes. It would be interesting to study, for example, whether reductions in the labor force participation rate are restraining

**Figure 1: Price Distribution for a 36-Ounce Bottle of Heinz Ketchup**



**Sources:** Kilts-Nielsen Data Center at the University of Chicago Booth School of Business, as cited by Greg Kaplan and Guido Menzio in “The Morphology of Price Dispersion,” National Bureau of Economic Research Working Paper No. 19877, January 2014, Figure 1a, p. 12.

**Notes:** Chart depicts 279 transactions in the first quarter of 2007 in Minneapolis. The median price was \$1.66.

inflation by giving large numbers of buyers more time to shop around. More fundamentally, studying price dispersion helps economists gain greater understanding of market dynamics—the basic building blocks of economic inquiry. ■

Karl Rhodes is a senior managing editor and Nicholas Trachter is an economist in the Research Department of the Federal Reserve Bank of Richmond.

## Endnotes

<sup>1</sup> See George J. Stigler, “The Economics of Information,” *Journal of Political Economy*, June 1961, vol. 69, no. 3, pp. 213–225.

<sup>2</sup> The full citation is: Steven Salop and Joseph Stiglitz, “Bargains and Ripoffs: A Model of Monopolistically Competitive Price Dispersion,” *Review of Economic Studies*, October 1977, vol. 44, no. 3, pp. 493–510.

<sup>3</sup> See Hal R. Varian, “A Model of Sales,” *American Economic Review*, September 1980, vol. 70, no. 4, pp. 651–659.

<sup>4</sup> As examples of standard price dispersion theory, Menzio and Trachter cite Gerald R. Butters, “Equilibrium Distributions of Sales and Advertising Prices,” *Review of Economic Studies*, October 1977, vol. 44, no. 3, pp. 465–491; and Kenneth Burdett and Kenneth L. Judd, “Equilibrium Price Dispersion,” *Econometrica*, July 1983, vol. 51, no. 4, pp. 955–969. As examples of standard intertemporal price discrimination theory, they cite John Conlisk, Eitan Gerstner, and Joel Sobel, “Cyclic Pricing by a Durable Goods Monopolist,” *Quarterly Journal of Economics*, 1984, vol. 99, no. 3, pp. 489–505; and Joel Sobel, “The Timing of Sales,” *Review of Economic Studies*, July 1984, vol. 51, no. 3, pp. 353–368.

<sup>5</sup> In addition to intertemporal price discrimination, there are many other reasons why a merchant might charge different prices for the same good within a given timeframe. Examples include managing inventory, keeping up with inflation, or using “loss-leader” pricing designed to increase traffic in his store.

<sup>6</sup> For a more detailed explanation of this unified framework, see Guido Menzio and Nicholas Trachter, “Equilibrium Price Dispersion Across and Within Stores,” Federal Reserve Bank of Richmond Working Paper No. 15-01, January 2015.

<sup>7</sup> For more on the intertemporal pricing of ketchup, see Martin Pesendorfer, “Retail Sales. A Study of Pricing Behavior in Supermarkets,” *Journal of Business*, January 2002, vol. 75, no. 1, pp. 33–66.

<sup>8</sup> See Greg Kaplan and Guido Menzio, “The Morphology of Price Dispersion,” National Bureau of Economic Research Working Paper No. 19877, January 2014.

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