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.”

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.” 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.

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. 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.

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.

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.
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

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. 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.

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


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.

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Endnotes
5 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.

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