The Mechanics of Demand

The Slutsky equation clarifies the complicated effects of price changes

Eugen Slutsky's best-known contribution to economics is the eponymous equation (also called the "Slutsky decomposition") often taught to college undergrads in microeconomic theory courses. The equation provides a framework for analyzing how a change in the price of a good affects a consumer's demand for it and for other goods. Today Slutsky's insight is a pillar of modern demand analysis—essential for figuring out how consumers will react when, for example, a food company raises the price of its breakfast cereal or how higher grain prices will affect development efforts in the Third World.

Though a price rise generally decreases the quantity demanded and a price drop has the opposite effect, Slutsky pointed out that exactly how demand plays out depends on consumers' budgets and their preferences for various goods. Economists had long known this, but before Slutsky, there wasn't a workable theory of the interactions. "A little bad psychology, ... a dash of bad philosophy and ethics, and liberal quantities of bad logic," was how economist Paul Samuelson characterized the approach of researchers at the time. In contrast, he praised Slutsky's 1915 paper, "On the Theory of the Budget of the Consumer," for at last bringing mathematical rigor to demand analysis.

Similarly, economist John Hicks, who with R.G.D. Allen rediscovered Slutsky's finding 19 years later, wrote that it "may be regarded as the Fundamental Equation of Value Theory," that is to say, the keystone of microeconomics.

Curiously, Hicks, Samuelson and other leading economists of the 20th century were unaware of Slutsky's breakthrough until the 1930s, largely because his article was published amid the turmoil of World War I—in Italian. Slutsky wrote the original in German, but because it built on work by the great Italian economist Vilfredo Pareto, he had it translated for the same Italian journal that had published Pareto's work.[1]

Income and substitution

To understand Slutsky's contribution, it helps to consider a real-life example. Imagine that the price of movie tickets falls. Assuming no other changes in your overall budget, you can now afford to go to the movies more often. But maybe you'd rather spend your newfound wealth on other things—more home movie rentals, for instance, or nonentertainment purchases such as clothing and food.

Slutsky realized that a change in the price of a good affects consumption in two distinct ways. First, if the price of a movie ticket drops, consumers may buy more movie tickets and fewer goods that serve as substitutes for a cinema outing, like DVD rentals. This is the "substitution effect," well-known to economists at the time Slutsky wrote.

Second, a change in the price of a good you buy affects your overall purchasing power—a consequence called the "income effect." Cheaper movie tickets leave more cash in your pocket, essentially raising your income. Feeling flush, you could go to the movies more often, but you might opt instead to buy other things, like restaurant meals or concert tickets.

The interplay of the income and substitution effects is complex. Which effect exerts the greater influence depends on individual circumstances. If you already go to the movies frequently, a small drop in ticket prices probably won't convince you to buy even more movie tickets, so the substitution effect—shifting from rental DVDs to movies—will be negligible. By comparison, the income effect will be large: The money you save on cheap movie tickets will enable you to purchase other things entirely.

However, if you hardly ever go to the movies, lower ticket prices won't make you feel much richer; after all, you weren't spending much on them before the price change. But you're more likely to consider a night at the movies instead of waiting for the DVD. In this case, the substitution effect swamps the income effect.

Confused? Unfortunately, it gets even more complicated. Some pairs of goods are not substitutes for one another but instead are "complements"—they tend to be purchased together, like movies and popcorn. Also, there are classes of goods that differ from "normal goods." For example, "inferior goods" are those that people buy less of as incomes rise (think canned meat versus steak).

The brilliance of the Slutsky equation is that it can incorporate all these different types of relationships

and clarify how a price change actually will affect demand for a variety of products. (For a more detailed explanation of Slutsky's decomposition, see this issue of the *Region* online at minneapolisfed.org.)

Slutsky goes to market

A major qualification to Slutsky's theory is that it deals with the behavior of individuals, not groups. But economists want to understand market behavior—the interactions of many individuals. What impact, for example, will rising energy prices have on national food expenditures?

"The theory applies to individuals, and you have to make quite rigid assumptions in order to extend the Hicks-Allen-Slutsky equation to the market," said John Chipman, an emeritus professor of economics at the University of Minnesota who worked on such "aggregation problems" in the 1970s. One rigid assumption is that all individuals have identical preferences and that individual demands can be added up to derive aggregate market demand.

This assumption clearly isn't realistic, but it can work surprisingly well in practice. By plugging data on household income and spending into Slutsky's framework, economists have been able to make useful inferences about the structure of demand and predict with reasonable accuracy how future price changes will affect that demand.

Slutsky didn't fully explain the mystery of consumer behavior. Subsequent research has refined the mathematical details of the theory and made it easier to estimate real-world demand. But most modern models still incorporate Slutsky's framework for analyzing consumer choice. Nearly a century after he developed it, Slutsky's equation remains a cornerstone of microeconomics.

—Joe Mahon

Endnote

[1] Chipman, John, and Lenfant, Jean-Sébastien. 2002. "Slutsky's 1915 Article: How It Came to Be Found and Interpreted." *History of Political Economy* 34 (3).

stream of erratic shocks that constantly upsets the continuous evolution, and by so doing introduces into the system the energy necessary to maintain the swings."[7] He mimicked such shocks with a "stochastic difference equation"—a mathematical apparatus still used today to simulate the impact of chance events on economies.

While Western economists were pondering the meaning of Slutsky, the man himself had abandoned economics to apply his statistical acumen to hydrology and meteorology. In 1928, Stalin had released a five-year master plan for controlling every aspect of the Soviet economy. When Kondratiev dared to criticize the plan, the Conjuncture Institute was shut down, and its former director imprisoned and later executed. Slutsky realized that continuing to work in economics—even on abstruse theoretical topics—was too dangerous under Stalin's rule, said John Chipman, an economics professor at the University of Minnesota who has studied Slutsky's career.

"He saw what happened to Kondratiev," Chipman said in an interview. "I think it's incontrovertible that Slutsky switched fields in order to preserve his life." Tellingly, in his 1938 autobiography, written as part of a job application, Slutsky skips over his two-year tenure at the Conjuncture Institute.

In the 1930s and during World War II, working in government research posts, Slutsky studied weather patterns instead of business cycles. In his last years, he performed important but laborious duty in statistics, preparing tables of probabilities for various distribution functions. When he died at age 67 of lung cancer, his obituary was written by the great Soviet mathematician Andrey Kolmogorov.

Business cycles revisited

After World War II, economists largely lost interest in business cycles. In an era of rising global prosperity, the emphasis was on measuring economic growth and fine-tuning it by applying Keynesian stabilization policy. In the United States, the Cowles Commission for Research in Economics developed complex macroeconomic models designed to identify optimum levels of government spending and taxation to achieve economic growth and full employment. In the 1960s, economic advisers to the Kennedy administration shaped tax