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done long after the fact, the findings can be both useful to policymakers and interesting to researchers.

I have tried to illustrate this theme by setting up a framework for evaluating monetary policy during the past few months. I found that three key interest rates—the interest rate on mortgages, the interest rate on medium-term Treasuries, and Libor—would essentially be no different had the counterfactual policy rather than the actual policy been followed. And with the counterfactual, the Fed would already have exited from its unprecedented actions. While the empirical results are preliminary, they are clear and consistent about the impact of policy on interest rates and the economy. Nevertheless, I would emphasize the particular empirical framework for monetary policy evaluation during this crisis as much as the empirical results.

¹ See Taylor (2009) for an analysis of policy during of the first three phases and Cogan, Cwik, Taylor, and Wieland (2009) for an analysis of fiscal policy during the fourth phase.

² For example, Taylor (1979) evaluated monetary policy during 1953–75, Feldstein and Stock (1997) during 1959–92, and Bernanke (2004) during the pre- and post-1984 periods.

³ See Svensson (2009) for a real time approach that adapts methodologies, such as the Taylor Curve, for use in the evaluation of Riksbank policy.

⁴ OIS is the Overnight Index Swap which measures the market expectation of the average federal funds rate during the maturity of the corresponding Libor interbank loans.

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Research Summaries

Search Technologies and Retail Competition

Glenn Ellison*

When the Internet first came into wide consumer use, one heard a lot about the promise of “frictionless commerce.” New search technologies would make it easy for consumers to find

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the exact product they wanted at the lowest possible price. Whether such a future comes to pass is obviously of great interest to consumers and online retailers. And, it may have dramatic effects on the traditional retail and media sectors. My recent research has included several projects that aim to improve our understanding of Internet search technologies and retail markets.

Price Search and Obfuscation

The desire to better understand where search frictions come from and how they may evolve motivates my work with Sara Fisher Ellison on Pricewatch. Pricewatch is a specialty search engine serving consumers who want to buy computer parts (such as memory upgrades or video cards) at

low prices from no-name e-retailers. One chooses the desired product from a menu on Pricewatch's first page — for example, 128 MB PC100 SDRAM memory module — and Pricewatch returns a list, sorted by price, of dozens of retailers carrying that product. A number of retailers have built businesses by serving Pricewatch consumers, and price competition occurs far more quickly this way than in the traditional retail sector: rankings on the Pricewatch list change throughout the day as firms raise or lower prices by a few dollars to move up or down.

Our choice to study this idiosyncratic environment may seem strange, but it illustrates how empirical work is often done in industrial organization. Developing theoretical models of the interactions between consumers and firms is the only way to address many important questions. Studying atypical environments can be a great way to get insights on how accurate models are. In our case, the simplicity of the business model of a Pricewatch retailer — basically, they just take memory modules off a shelf, put them in cardboard boxes, and mail them — makes it much easier to estimate profit functions. The frequent changes in relative prices let us estimate demand using (presumably random) short-term fluctuations. And, the generic nature of the products and retailers creates extremely price-sensitive demand, which highlights the role played by search frictions in sustaining price markups.

From our first look at the Pricewatch environment it was clear that the frictionless ideal had not been fully realized.¹ Yes, prices were very low and close together. But buying a product at the advertised price was rarely simple. Often, one had to search through multiple pages and read a great deal of fine print. Most striking was the litany of automated sales pitches encouraging one to upgrade to a superior product and/or buy additional add-ons to complement what one was trying to buy. We use the term “obfuscation” to describe practices by firms that increase

search frictions, and we view Pricewatch as a great environment from which to gain insights on the topic.

I explore these ideas in two theoretical papers as well as in the empirical work mentioned above. The first theoretical paper examines add-on pricing.² The ubiquity of add-on pricing in the Pricewatch universe mirrors what one sees in many traditional businesses with high fixed costs and minimal product differentiation: for instance, hotels have extremely high long-distance rates; rental car companies have high refueling charges; and bank accounts often have a remarkably long list of fees. This regularity is made more striking by the fact that arguably such fees should have no effect on equilibrium profits. If firms are able to earn an extra \$17 from each consumer by selling add-ons, then the equilibrium price in the market should simply end up \$17 lower, and nothing important will change. The model I develop for why add-ons may raise profits, though, is quite simple. There are two types of consumers: regular consumers and cheapskates, who have a higher marginal utility of income. Price cuts disproportionately attract cheapskates. Ordinarily, this is not a problem — a cheapskate's money is as good as anyone else's — but when a firm relies on selling add-ons for its profits, then it is a problem, analogous to adverse selection. The adverse selection is a disincentive to price-cutting, which leads to higher equilibrium markups. This paper also involves behavioral industrial organization — it notes that one way to make the add-on pricing individually rational rather than just collectively rational for the firms is to add a small population of irrational consumers who buy add-ons only when the high add-on prices are not advertised.

The second theoretical paper, written with Alexander Wolitzky, makes the level of search costs endogenous in a standard search-theoretic model. We discuss two mechanisms that may make it individually rational for firms to make searches more time consum-

ing.³ One mechanism assumes that some consumers don't want to spend much time shopping. In such a model, firms will have an incentive to make examining their product slightly more arduous than consumers expect, and to simultaneously raise prices. Because the time already spent examining a product is a sunk cost, it won't deter consumers from finishing their examination of a firm's product, but it will raise the perceived incremental cost of visiting another firm. The other mechanism that firms use is a signal-jamming model in which making search more arduous similarly makes continued search less attractive by increasing consumer expectations about how difficult future searches will be.

Our empirical work on the Pricewatch search engine exploits data that are unusually rich in some dimensions. Most notably, we were able to download the prices at which memory modules were available from dozens of firms indexed by Pricewatch at an hourly frequency over the course of a year. We then matched this to hourly quantity data from two e-retail websites that get most of their traffic from Pricewatch referrals. The price and quantity data make clear that Pricewatch dramatically reduces some search frictions. In one product category, we estimate that a firm that raises its prices by one percent will lose one-fourth of its sales. But the cost data make clear that search frictions are far from completely eliminated. Firms appear to maintain markups over marginal cost of 8–16 percent.

Further analyses indicate that each of the mechanisms discussed in the theoretical papers is operative. For example, we can measure the adverse selection problem that add-on pricing creates. A single-percent price decline can substantially reduce a firm's average margin because it raises total sales by 20 percent, but only increases sales of add-ons by about 10 percent. Indeed, the actual markups appear to be very consistent with the estimated magnitude of the adverse selection. Relative to the

search-cost model, we find that consumers have not found the most relevant information -- the prices at which they could have bought the product they ended up buying.

Overall, these results support the view that the equilibrium level of search frictions is determined by a balance of search technologies and firms' investments in obfuscation. This balance is reflected in the practices that have not received much attention, but have long been found in places like the hotel, rental car, and banking industries. Price search may become more efficient than it is in the current online world, but we would not expect that the "frictionless" ideal will be closely approached.

Sales Taxes and Online-Offline Competition

Sara Fisher Ellison and I have also used our Pricewatch data to examine the effects of sales taxes on e-retail sales.⁴ Sales tax policies are potentially important to the future of traditional and online retail. The status quo is that state governments are unable to compel retailers without a presence in their states to collect sales taxes or to provide information that would allow the state to levy "use taxes." As a result, an attractive feature of buying from small online merchants (or even Amazon) is the *de facto* tax free status of purchases. Not surprisingly, state governments and traditional retailers are unhappy about this situation and are pursuing a variety of avenues to change it.

Our work exploits another very nice feature of the online sales environment. The retailers listed on Pricewatch set prices at the national level. However, the tax-inclusive price a consumer would pay to purchase from each retailer depends on the consumer's location. Our sales data include the home-state of each purchaser, so rather than just observing national market shares as a function of national prices, we are able to simultaneously observe market shares in 50 different states as a function of 50 different tax-inclusive price orderings.

We analyze the data from a variety of angles. In one analysis, we collapse everything into a simple regression on a 51-observation state-level dataset. In another, we treat sales into each state in each hour as a separate observation and estimate a discrete choice model on a dataset with 800,000 observations. The results are fairly consistent. We find that consumers do not react as strongly to differences in sales taxes as they do to differences in pre-tax item prices. Nonetheless, we find that sales patterns are strongly influenced by taxes: a single percentage point higher sales tax rate leads to a 6 percent decrease in online sales by in-state merchants.

We make a number of other observations about online and offline retail. Geography still matters in e-retail for two reasons: consumers prefer purchasing from nearby merchants to take advantage of reduced shipping times; and, there is an additional preference for in-state merchants that offsets some of the tax disadvantage. We also look for effects of the variation in the online-offline price gap which occurs over the course of a week (because online prices adjust more rapidly to market conditions), but we fail to find evidence that consumers react to such transitory differences. This also could be a sign of "behavioral" consumers: consumers appear generally to be aware of the tax advantages of buying online, but do not exploit more subtle patterns that can be equally important in some circumstances.

Sponsored Search Auctions

If price search will not come to dominate the online (and offline) environment, what will? Today, most consumers find products either by visiting merchants they know and/or by using general search engines like Google. A common way to use Google is to search for the product one is interested in buying and then to examine the offers from merchants contained in the list of "sponsored links" presented above and alongside the unbiased search results.

One's first reaction may be that this process couldn't possibly be as efficient as searching for products via Pricewatch, but there is circumstantial evidence that it must be at least somewhat effective: enough consumers choose to search this way to generate \$10 billion dollars in annual revenues for the firms that sell-off the right to be a sponsored link. The functioning of this retail "platform" is also of interest to the traditional media that it is displacing, and to the increasing number of firms that rely heavily on online advertising.

Previous work on search engines has developed elegant auction-theoretic models of the process by which Google, Yahoo!, Bing, and others auction off the right to be a "sponsored link."⁵ My work with Susan Athey extends this research to explore the implications of the fact that service providers such as Google are not just auctioning generic "objects" — they are auctioning advertisements that derive their value from the fact that consumers believe that they are sufficiently likely to be valuable to make clicking on them worthwhile.⁶ Our approach assumes that potential advertisers are heterogeneous in the probability that they will be able to meet a consumer's need. The genius of the sponsored-search auction is that it may lead to a sorting equilibrium where the firms that are most likely to meet a consumer's need are able to outbid other firms on a per click basis. Hence, it is the fact that the auctioneer is collecting revenue that induces firms to reveal their quality, which allows consumers to search in a more efficient manner.

Although these auctions work well in a base case, the greater part of our paper explores various ways in which the considerations underlying auction design become more subtle. For example, reserve prices can increase the volume of trade by making clicking worthwhile, and using weights to adjust for differences in click-through rates is critical if one wants to approximate efficiency, but involves a number of

tradeoffs. In a short time, sponsored search has become one of the most active topics in computer science as well as in economics, and many new results are emerging.

¹ G. Ellison and S. F. Ellison, "Search, Obfuscation, and Price Elasticities on the Internet," NBER Working Paper No. 10570, June 2004, and *Econometrica* 77, 2009, pp.427–52.

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⁶ S. Athey and G. Ellison, "Position Auctions with Consumer Search," NBER Working Paper 15253, August 2009.

Measuring Tariff Evasion and Smuggling

Raymond Fisman*

Tales of bribery and corruption date back to the beginning of recorded history. By the time the historian Suetonius was at work documenting the antics of Roman leaders, his chronicles were filled with extorting senators, vote-buying Caesars, and judges-for-sale. Needless to say, we do not want for stories of venality and excess among latter-day Caesars and senators. Whether it's the U.S. Senate seat that Illinois Governor Rod Blagojevich allegedly tried to sell to the highest bidder last year, or the "Versailles in the jungle" built with billions that some say were embezzled by Zaire's Mobutu Sese Seko, the corruption narrative is alive and well today.

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Yet we are not satisfied by stories—we want to see it in the data. For one thing, talk is cheap, so we don't know how much to trust casual retelling or survey evidence, particularly in a sensitive and secretive domain such as corruption. (Think about the incentives for truth telling in response to the question, "How much did you pay in bribes last year?"). For well-documented instances of corruption, we only observe cases that come to light via enforcement efforts, so lack of any evidence of misbehavior could be taken of proof that corruption is nonexistent—or so ubiquitous that the enforcers are on the take themselves.

Recent years have seen a blossoming of corruption research in economics, focused on approaches to getting around the cheap talk problem in measuring illicit behavior. In a series of papers with Shang-Jin Wei, I have looked for ways of analyzing what happens when corruption meets globalization, by studying the role of smuggling and tariff evasion

in international trade. Our work more broadly informs the discussion on how tax rates affect tax evasion.

Our core methodology is based on the simple observation that shippers moving goods across international borders are asked not just once but twice about the contents of their containers: by export officials at one end and import authorities at the other. In both cases, false claims have real and material costs, ranging from the forfeiture of shipped goods to fines to prison time (and in some extreme cases, a death sentence). Yet the benefits of deceit often differ widely at the points of import and export. Where such benefits are low, we may plausibly take the reported figures at face value, and use them as a benchmark against which to compare the numbers that would-be smugglers report where deception is required to ply their trade.

The idea of comparing mismatched import-export data isn't new. Jagdish Bhagwati observed back in 1964 that