Convenient Prices and Price Rigidity:
Cross-Sectional Evidence[*]

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Abstract

This paper provides cross-sectional evidence of *convenient prices*—prices that simplify and expedite transactions, reducing the time costs from physically making a transaction. Firms may wish to set convenient prices for items that (1) are typically purchased with cash; (2) are sold alone or with a few similar items; and (3) are high-traffic transactions, i.e., require queuing or are frequently purchased. I collect a new data set and find broad support for the use of convenient prices in locations where making a rapid transaction is important. Convenience also appears to predominantly affect goods and services with above-average price rigidity.

Keywords: convenient prices, price rigidity, price points, 9-ending prices

JEL classifications: E31, D11, D21, C2, L11, M31

I   Introduction

In certain situations, firms have incentives to set prices that are easy to transact. Movie ticket prices are typically multiples of whole or half dollars. Most vending machine prices are multiples of quarters. The prices of items at concession stands have similar characteristics. These examples illustrate the use of *convenient prices*—prices that simplify and expedite transactions relative to other nearby prices through their ability to reduce the frictions associated with the physical act of executing a transaction. This paper presents cross-sectional evidence on the use of convenient prices.

I identify three conditions that give firms a priori incentives to set convenient prices, especially when these conditions are met simultaneously. First, transactions must be made primarily in cash. When making purchases with another medium of exchange, such as credit or debit cards, no price simplifies and expedites transactions more than any other. Second, items that are sold alone or with a few similar items are conducive to convenient prices, since in these cases the firm has the most control over making an entire transaction convenient. Third, convenience should be an important consideration for high-traffic transactions, which manifest themselves in transactions that often entail queuing (e.g., waiting in line at a concession stand or for movie tickets) or are repeated on a very frequent basis (e.g., buying a morning paper at a newsstand). In such situations, the trivial time costs associated with making an individual sale can quickly aggregate to impact the firm's price-setting decision.

Guided by the above criteria, I assemble a data set to estimate convenience's influence on price-setting. The data set includes products (e.g., movie tickets, newspapers, coffee, public transportation fares, and typical "convenience-store" products such as single-serving-size drinks, candy, and snacks) and points-of-sale (e.g., convenience stores, vending machines, concession

stands, and dance clubs and bars) for which there are a priori reasons to expect convenience to affect pricing in some circumstances. For the sake of comparison, some of these products were also observed in establishment-types where convenience would not be expected to matter.

To quantify convenience, I assume that every price has an associated level of *relative inconvenience* based on the minimum number of pieces of money required to make a transaction at that price. For example, a price of 26¢ (a quarter plus a penny) is more inconvenient than 25¢ (a quarter) since it requires an extra unit of money. I compare pricing behavior along two lines: the level of relative inconvenience, in terms of pieces of money; and the percentage of the time that firms use *monetary convenience points*—those prices that minimize inconvenience relative to other nearby pricing options. Continuing the example, 25¢ is a monetary convenience point since other proximate prices require more than one piece of money.

I find that the vast majority of firms with incentives to charge convenient prices, based on the criteria enumerated above, do set relatively convenient prices in practice. On average, prices at establishment-types where one would expect convenience to matter require one to two fewer pieces of money compared with prices at points-of-sale where convenience would not be expected to matter. In addition, the price of an item sold at a point-of-sale where convenience should matter is approximately 55 percentage-points more likely to be a monetary convenience point than the price of the same or similar item sold in a location where convenience should not matter. This is true even for large (±10%) neighborhoods around the current price. These findings suggest that the convenient prices in this study are set for transaction motives rather than for psychological reasons—though the motives may be related.

Convenient prices also have implications for the study of price rigidity at the micro level, in particular for very sticky prices. Bils and Klenow (2004) and Nakamura and Steinsson (2008)

show that stickiness in the prices underlying the U.S. Consumer Price Index (CPI) varies tremendously across categories, but it is not clear why some prices are so rigid. In this paper, I provide evidence of a connection between above-average rigidity and the use of convenient prices. Such a connection is important because, as demonstrated by Aoki (2001) and Carvalho (2006), sticky prices can have an outsized influence on monetary policy and the aggregate price level, respectively. Furthermore, convenient prices can provide an explanation for the sticky-price "call option" criticized by Hall (2005) precisely because, in situations where facilitating a rapid transaction is important, it is neither expedient nor efficient to bargain over prices.

The structure of the paper is as follows. Section II presents a theory of convenient prices and suggests a priori conditions under which we would expect them to be prevalent. Section III details the data. Section IV estimates the impact of convenience on pricing. Section V discusses the findings and their implications, and Section VI concludes.

II   A Theory of Convenient Prices

Consider a world in which all transactions are made using cash as the medium of exchange. In this world, the monetary units in circulation define the set of possible prices firms can charge. The smallest denomination presents a "cent constraint" that limits the fineness of this set.

The spacing of denominations makes certain transactions easier to execute than others. Prices that coincide with a monetary unit the buyer is carrying produce the fastest and simplest of transactions—one requiring a single piece of money. Charging other prices increases the number of monetary units needed to make a purchase or sale. Nevertheless, the monetary denominations will make some of those prices more attractive than others for similar reasons. This is the basic

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idea behind convenient prices. In general, convenient prices are those prices that facilitate rapid, easy-to-make transactions, especially relative to other nearby pricing options.[1]

Convenient prices reduce the frictions associated with the physical act of making a transaction when cash is the medium of exchange. Through their ability to expedite transactions, they reduce the time costs of making a transaction and waiting in line. Convenient prices also reduce the amount of change involved in a transaction. This lowers inconvenience costs for customers who dislike change, reduces time costs for sellers who must verify and count cash-on-hand, and lessens the probability of the seller making errors and returning the wrong change.[2]

Thus, under certain circumstances firms have incentives to charge convenient prices to reduce transaction costs and increase profitability. Because these prices more effectively reduce transaction costs than other nearby pricing options, convenient prices are a natural source of price rigidity. While the dynamics generated by convenient prices—periods of price rigidity with discrete changes—can resemble those generated by models of costly price adjustment, the underlying mechanism and rationale differ. Knotek (2008) models a firm that incorporates convenience into its pricing decisions and shows the price dynamics that occur in such a setting.

When and Where Should Convenience Affect Pricing?

The reduced transaction costs associated with convenient prices benefit both buyers and sellers of a product. But when are these benefits large enough that they influence the firm's

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[1] This paper is concerned with convenient transactions. For goods that are purchased singly, the cost of the transaction is the same as the price of the good (inclusive of any tax)—hence a convenient transaction and a convenient price are synonymous.

[2] Rotemberg (2007) discusses some psychological-type costs, such as regret and anger, associated with purchases and how these costs can affect firms' pricing decisions. Becker (1965 and 1971, chapter 3), Bender (1964), and the queuing literature—discussed below—also work with the secondary costs of making transactions.

pricing decision? The preceding discussion suggests three conditions that give firms a priori incentives to set convenient prices, especially when met simultaneously.

(1) Convenient prices should be more important for cash transactions than for those made using another medium of exchange. There are obvious time costs associated with cash transactions, such as the buyer taking out and counting money, and searching for change; and the seller verifying the amount, putting it in the register, and returning change. (The seller may face other costs associated with collection and processing after the transaction as well.) By contrast, the transaction costs of other payment types—e.g., credit or debit cards—are independent of the price. Relatively inexpensive goods and services should have more convenient prices than expensive items, since the latter are more likely to be paid for via alternative methods.

(2) Convenience should be important for items that are typically sold alone or with a few similar items. When a transaction involves multiple goods, relatively inconvenient individual prices may sum to a convenient transaction price as well as the reverse. By contrast, with a single good the firm can more easily make the entire transaction convenient.

(3) Convenient prices should be important for high-traffic transactions, which require queuing or are frequently repeated. In a queue, the amount of time spent physically making a transaction is a negative externality. By reducing transaction times, convenient prices reduce an individual's total waiting time multiplicatively. Shorter transaction times also benefit sellers, allowing them to move more people through the line and make more sales with fewer servers. The Appendix illustrates how convenient prices can factor into a common queuing model.

Similarly, convenient prices produce time-cost savings for sellers, and time- and inconvenience-cost savings for buyers, in transactions that are frequently repeated. Since prices for consumer goods do not change continuously, the time costs from this repetition can be

explicitly incorporated into the price-setting problem and favor the use of convenient prices. Customers may also tire of expending too much time on—or carrying excessive amounts of change from—transactions that are repeated frequently.

Measuring Convenience

To quantitatively measure convenience, I assume that every price p has associated with it a level of *relative inconvenience*, $n(p)$, which is the minimum number of monetary units needed to make a purchase at that price. The more pieces of money needed to make a transaction at price p, the higher is the value of $n(p)$, and the higher is that price's inconvenience. The positive relationship between the number of pieces of money and inconvenience is natural based on the effects that more monetary units have on the secondary costs enumerated above.

I consider two measures of relative inconvenience. The first, denoted $n(p)$, is the minimum number of common coins and bills that can be used, in any combination, to form p, allowing for the possibility that the buyer can receive change from the seller. The second, $n^+(p)$, assumes that the consumer brings only bills to make a purchase. Thus, it is the minimum number of common bills that can be given to the seller, plus the minimum number of common coins and bills returned to the buyer as change to form p.[3] Using the minimum number of monetary units in both cases simplifies computation of the relative inconvenience measures and captures the lower bound on inconvenience for a given price for all transactions, which would be made by heterogeneous real-world consumers bringing a variety of monetary combinations.

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[3] Common coins are pennies, nickels, dimes, and quarters. Common bills are the one, five, ten, and twenty dollar bills. In the empirical section, some items require the exact amount using common coins; others require the exact amount using common coins or bills. When either criterion is satisfied, the relative inconvenience measures are adjusted automatically.

Table 1 presents examples of the measures. For instance, a price of 95¢ requires 2 pieces of money under either metric: the buyer gives the seller one dollar and the seller returns a nickel. A price of 96¢ requires 3 pieces of money using the $n(p)$ metric—the buyer would give one dollar and one penny and the seller would return a nickel in change—but 5 pieces of money with $n^+(p)$—the buyer would bring one dollar to the transaction and the seller would return 4 pennies.

Convenient Prices versus Price Points

Convenient prices are usually round prices that match monetary denominations or are simple combinations of them. Setting convenient prices is rational through their ability to reduce transaction costs. By contrast, prices that are "price points"—also known as just-below, customary, magic, charm, odd, or 9-ending prices—are slightly less than round numbers. The marketing and retailing literatures typically propose departures from pure rationality to explain their occurrence: consumers truncate or underestimate price points—due to rational inattention, limited recall, or the desire to simplify price comparisons—or associate price points with sales.[4] Hence price points are the complement of convenient prices.[5] However, little attention has focused on conditions under which price points should be effective or observed.

As such, the three above criteria may shed light on this phenomenon as well since price points may be more effective in other circumstances. For example, with high prices customers may be concerned they are getting the best deal possible, and price points—through their association with sales—may reduce customer anxiety. Price points may be more effective when using a payment method other than cash, since it is more difficult to truncate or underestimate a

[4] For truncation/underestimation, see, e.g., Georgoff (1970) and Schindler and Kirby (1997). For the association with sale prices, see, e.g., Schindler (1991).
[5] However, both convenient prices and price points may have implications for price rigidity. See Kashyap (1995) and Levy et al. (2006).

cash purchase due to the physical act of paying and receiving change. When purchasing many items, a consumer may reduce the time and mental processes necessary to comparison shop by using left-to-right, digit-by-digit comparison until the first difference is noticed (e.g., Brenner and Brenner 1982, Thomas and Morwitz 2005). This price truncation provides incentives for firms to use price points when consumers purchase many items. Finally, repeated transactions are more likely to be recalled accurately by consumers—and known to be regular (as opposed to "sale") prices.

III   Data

Convenience has implications based on the product and point-of-sale attributes associated with certain transactions. For this reason, I assemble a new data set of cross-sectional observations collected between August, 2004, and April, 2005. The data set has several important features. First, it predominantly includes products and points-of-sale for which there are a priori reasons to expect that convenient prices should be utilized. Second, because this study is concerned with the convenience of making a transaction, inclusive of sales tax, care has been taken to identify goods for which tax is added to the posted price. Third, where possible, products sold in locations where convenient prices should appear were also observed in locations where we would not expect them to be important. For instance, items purchased alone in situation A but with many other items in situation B, or usually purchased with cash in situation C but with credit cards in situation D, may help in explaining how convenient pricing depends on conditions at the point-of-sale.

Finally, the majority of the goods and services prices in the data set were collected in and around Ann Arbor, Michigan. This is partly because obtaining the above information required

collection by hand. It is also because the area surrounding the University of Michigan is useful for studying convenience. With approximately 40,000 students, there is large demand for inexpensive food and drink products that can be purchased quickly between classes and a large number of establishments serving this demand. Home games during the college football season also produce natural conditions for studying the incidence of convenient prices.[6]

The data set contains 1,653 observations—a sizable number for a hand-collected data set compared with the studies listed in Bergen et al. (2008). The data fall into 17 establishment-type groups and 19 product groups, which are aggregates of more than 200 establishments and more than 500 products. Thus a data point consists of a price observation, an establishment-type group dummy, a product-group dummy, and a dummy variable indicating whether taxes are included in the posted price or not. Table 2 lists the product and establishment-type groups.

The majority of the goods and services in the product groups are relatively inexpensive. In addition, most are typically purchased alone or with a few other items and satisfy the requirement that cash is the primary means of payment. Many of the items are often sold in queues (e.g., concession items) or are purchased on a frequent basis (e.g., coffee). For some, there are benefits from making rapid transactions (e.g., taxi drivers and barbers explicitly face lost revenue by spending time physically making a transaction).

In general, the establishment-type groupings are easily associated with product groups. Vending machines, concession stands, coffee shops, and convenience stores sell snack and drink products purchased on a frequent basis. Convenience stores (including those in gas stations) are locations where convenient prices may be important, as consumers stop there for an item or two

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[6] One drawback to the data set is that scanner data could not be used. The majority of establishments surveyed do not have scanners—specifically because convenient prices should be important for rapid, cash-based, hand-to-hand transactions. Scanner data were not collected from the establishments that have scanners for the sake of comparison.

when they are interested in making a fast transaction.[7] The "market concession stands" group

refers to stands at an outdoor farmer's market, featuring fresh produce, baked goods, and

flowers. Of the numerous stands on a given day, most sell a few items and virtually all

transactions are made in cash. The product category associated with these stands is the "Other

food products (fruits, vegetables, etc.)" category.

Most purchases at fast food restaurants include multiple items, and customers' selections

vary widely. Additionally, the sum of multiple rounded post-tax prices for individual goods is

not necessarily the rounded post-tax sum of the bundle. To deal with these issues, I survey the

fast food restaurants' "combos"—complete meals including drinks which are more

representative of actual purchases than single items. This is the "fast food (combos)" category.

To facilitate comparison with the above, I include two other establishment-type groups

where convenience should *not* be important: "superstores"—which includes grocery stores and

megastores, such as Wal-Mart and Target—and "apparel stores/bookstores." In a superstore,

customers are likely to buy many items, often paying via some means other than cash, and the

time costs from physically making a transaction are small relative to those incurred from

shopping. Hence there is no reason to expect convenience to affect pricing in superstores. Since

superstores carry a wide range of the products listed in Table 2, they are ideal for making

comparisons with establishment-types in which we would expect convenient prices to appear.

The latter category of apparel stores (e.g., Macy's) and bookstores is included for

comparison with the pricing of University of Michigan apparel and souvenirs at concession

stands and vendors before, during, and after college football games, when convenience should

affect pricing. By contrast, convenience is unlikely to affect traditional apparel stores, where

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[7] Some of the prices included in this study are set, regulated, or overseen by various levels of government. This may imply that they are not "profit-maximizing," yet they may still be affected by convenience considerations.

there are fewer customers, each of whom spends a considerable amount of time shopping, and transactions are often executed with credit or debit cards.

Taxes and Pricing

Taxes do not play a central role in many studies; those of 9-ending prices, for instance, ignore taxes and focus on posted prices. In this paper, however, taxes are important. The issue of making a convenient transaction relates to the final cost of purchasing a good, inclusive of applicable sales taxes, and not necessarily to the posted price.

To differentiate between these concepts, the *posted price* is the price that appears on the price tag, signboard, or menu for an item. The *transaction price* refers to how much it costs a customer to purchase the good or service: it is the "out-the-door" price, inclusive of any taxes. All prices in this study are transaction prices, with the exception of the prices of fruits and vegetables that are sold per pound and are exempt from sales tax in Michigan. Because the weight of these products is a random variable, the per-pound prices are used for simplicity.

The majority of the goods and services included in this study were surveyed in Michigan, where the sales tax rate is 6%. While some firms in the sample include sales tax in their posted prices, others do not. Section IV discusses the role that this decision plays in pricing. In addition, some of the retail items included in this study are exempt from sales tax, including newspapers, unprepared food, and soft drinks and water in cans and bottles.[8]

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[8] Sales tax laws vary by state and often locality. During the time frame when the sample was collected, 31 other states and the District of Columbia did not charge tax on unprepared food and drinks consumed off-premises, similar to Michigan, affecting nearly 80% of the U.S. population. Also, note that the state of Michigan requires a deposit on all soft drinks and beer sold in aluminum cans or bottles, regardless of size. Other drinks—e.g., bottled water—are exempt. When necessary, can and bottle deposits are included in the transaction prices in this study.

IV   Convenient Prices and Their Impact on Price-Setting

As a first pass through the data, I divide the observations into two groups. The first group is the

prices for which *convenience should matter* based on the preceding discussion. This includes

observations from the following points-of-sale: vending machines, concession stands,

convenience stores, coffee shops, market concession stands, movie theatres, dry cleaners, dance

clubs and bars, taxi services, parking lots, public transportation, barbershops, toll roads, the U.S.

Post Office, and fast food restaurants. The second group is the points-of-sale for which

convenience should not matter. This includes superstores and apparel stores/bookstores.

Figure 1 plots the frequency distributions of price endings (i.e., the cents' digits) for these

groups. The results are striking. For cases when we expect convenience to affect price-setting,

four price endings dominate: 00¢, 50¢, 75¢, and 25¢. These price endings account for 22%,

16%, 12%, and 7%, respectively, of all prices. In other words, 4% of possible price endings—

those that correspond to using only bills or quarters in transactions—are used by more than 57%

of the goods and services in this group. The data show a preference for prices ending in 0¢ or 5¢

throughout the entire range, effectively implying that pennies need not be used in transactions.

By contrast, there are other distinctive pricing patterns when we expect convenience should not

matter. Here, we see the dominance of 9-ending prices, with prices ending in 99¢ used for more

than 30% of these goods and prices ending in 49¢ used for more than 10%.[9]

The high incidence of posted prices ending in 0, 5, and 9 has been documented by other

authors. Hanna and Dodge (1995) use these three endings to divide retail prices into two groups:

odd prices that end in 5 and 9 and denote a bargain, and even prices that end in 0 and imply high

quality. In this study, the price tendencies group themselves into "those not requiring pennies"

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[9] While the figures show the distribution of transaction price endings which include tax, many of the prices collected at superstores were tax-exempt food and beverages; hence these are also posted prices.

(0s and 5s) when we expect that convenience should matter, and "those requiring pennies" (9s) when convenience should not matter.

It is doubtful that this is coincidence. Prices that require only bills may lead to faster transactions than those requiring coins. Alternatively, transactions that can be executed with few large denomination coins are simpler than those requiring a number of small denomination coins.

To pursue this idea, Figure 2 presents distributions of transaction prices as multiples of currency units, separated by establishment-type groups. Most locations where convenience should matter rely on prices that are multiples of quarters or dollars; because the goods and services included in this survey are inexpensive, few are multiples of larger bills. Locations such as dance clubs and bars, barbershops, and movie theatre ticket lines only charge prices that require bills and quarters. Vending machines, most of which accept nickels, typically prefer prices that are multiples of quarters. To the extent that a consumer has a higher probability of carrying quarters than nickels, this simplifies transactions for the buyer; since quarters have a higher value-to-size ratio than nickels, this is beneficial to the seller when collecting change.

There are, however, exceptions where convenient prices should be common and we see many prices requiring pennies. The transaction prices of goods in coffee shops and fast food restaurants require pennies nearly three-fourths of the time. This is comparable to the two control establishment-type groups where convenience should not matter. Convenience stores, concession stands, and the U.S. Post Office also sell items whose transaction prices require pennies, though to a lesser degree.

<u>Comparing When Convenience Should and Should Not Matter</u>

I consider two regressions to compare points-of-sale where convenience should matter with those for which convenience should not matter. The first uses the *level* of relative inconvenience, $n(p)$ or $n^+(p)$, since firms concerned with convenience have incentives to charge transaction prices requiring fewer monetary units than other firms. I consider the regression

$$n(p_i) = p_i * \alpha_1 + \sum_{j=1}^{S} \text{EST}_{j,i} * \alpha_{2,j} + \sum_{j=1}^{R} \text{PROD}_{j,i} * \alpha_{3,j} + error, \qquad (4.1)$$

where p_i is the price for observation i, which is part of product group r and is sold in establishment-type s; $\text{EST}_{j,i}$ is an establishment-type dummy equal to one for $j=s$ and zero otherwise, where S is the number of establishment-type groups; and $\text{PROD}_{j,i}$ is a product dummy equal to one for $j=r$ and zero otherwise, where R is the number of product groups.

Table 3 presents results for (4.1) and its counterpart using $n^+(p)$. Convenience should not matter for the boldfaced locations—superstores and apparel stores/bookstores—and they form the basis for comparison; to this end, the superstore EST dummy is the omitted variable. After controlling for differences in price levels and product groups, most goods' prices in settings where convenience should matter require fewer monetary units than the goods' prices in establishment-types where convenience should not matter, as evidenced by the negative (and significant) coefficients on the establishment-type group dummies. Treating relative inconvenience as count data produces qualitatively similar results.

The second set of regressions considers the frequency with which different establishment-types charge prices that minimize relative inconvenience. A price is a *monetary convenience point* if no other proximate price requires fewer monetary units to make a transaction—i.e., it locally minimizes the level of relative inconvenience $n(p)$. Establishment-

types that take convenience into account when setting prices should use more monetary

convenience points than points-of-sale for which convenience should not matter. In addition, the

more important convenience is in making a transaction, the greater should be the neighborhood

in which the current price is the inconvenience minimum.

To this end, I consider four measures of proximity: Is the current price relatively more

convenient than other prices (1) 1¢ higher or lower than the current price? (2) 1% higher or

lower than the current price? (3) 5% higher or lower? (4) 10% higher or lower?[10] For k=1,2,3,4,

let $y_{i,k}$ equal one for observation i if the answer is "yes" and zero otherwise. Then the probability

of observing $y_{i,k}$=1 depends on the establishment-type of the firm selling the good or service, the

type of product being sold, and the price level.

$$\Pr\left(y_{i,k}=1\right)=F\left(p_i * \beta_1 + \sum_{j=1}^{S} \mathrm{EST}_{j,i} * \beta_{2,j} + \sum_{j=1}^{R} \mathrm{PROD}_{j,i} * \beta_{3,j} + error\right) \qquad (4.2)$$

There is no constant to allow for comparisons between the estimated coefficients on the

establishment-type dummies EST.

I assume that $F(\cdot)$ can be approximated by the normal distribution $\Phi(\cdot)$ and estimate (4.2)

with a probit regression for each of the four measures. Table 4 presents results for $n(p)$; those for

$n^+(p)$ are similar. A clear pattern again emerges. Most of the establishment-types where

convenient prices should matter are either excluded from the regressions because they perfectly

predict "success"—i.e., y=1 for all observations—or have estimated coefficients that are positive

across the different measures. Both results imply a propensity for using monetary convenience

points. The establishment-types where convenience should not matter—superstores and apparel

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[10] While a 1¢ change is not large in percentage terms for most of the goods and services in this study, it can have psychological ramifications—e.g., to go from a 99¢ price ending to an even dollar price ending—even though the effect of this difference is open to debate. See, e.g., Ginzberg (1936), or Schindler and Kibarian (1996) and references therein.

stores/bookstores—either perfectly predict "failure" (y=0) or have insignificant estimated coefficients, suggesting convenient prices are unimportant.

After controlling for establishment-type and product groups, higher prices tend to reduce the probability of using monetary convenience points. One explanation for this finding is that, at higher prices, cash is less likely to be used as the medium of exchange and convenient prices are less important. Consumers may also be more responsive to pricing points at higher prices, leading to more just-below prices—which are relatively inconvenient as a matter of design.

Measuring the Impact of Convenience on Pricing

To measure convenience's impact on pricing, I compare the pricing patterns of the same or similar goods that are sold in establishment-types where there are a priori reasons to believe convenience should matter with those from establishment-types where convenience should not matter. Figure 3 plots frequency distributions of price endings for four product groups—single-serving drinks (Coca-Cola, Pepsi, and bottled water); candy bars, gum, and snacks; other food products (fruits, vegetables, etc.); and single packs of cigarettes—sold in both settings. When convenience should matter, nearly all transaction prices for the former three categories are multiples of at least a nickel, and more often they are multiples of larger denominations. When convenience should not matter, 9-ending prices are common for the same items. Since most of these items are exempt from sales taxes, this is evidence of the frequent use of odd prices.

The results for single packs of cigarettes are not as distinctive. Transaction prices ending in 75¢ constitute one-third of observations when convenience should matter, but many prices require pennies. After-tax price endings in establishments without a priori incentives to charge convenient prices are widely distributed with no discernible pattern. Importantly, these

phenomena may be related to the fact that posted cigarette prices usually exclude sales tax, a

point explored in the next section.

To quantitatively estimate the influence of convenience on pricing, I set the convenience

indicator CONV equal to one for observations from establishment-types where convenience

should matter and zero for observations from establishment-types where convenience should not

matter. I modify (4.1) to allow for product-group-specific comparisons when convenience

should matter for pricing with when it should not,

$$n(p_i) = p_i * \gamma_1 + \text{CONV}_i * \gamma_2 + \sum_{j=1}^{R} \text{PROD}_{j,i} * \gamma_{3,j} + error . \tag{4.3}$$

I also modify (4.2) to compare the incidence of monetary convenience points when convenience

should matter with when it should not, again controlling for product groups,

$$\Pr\left(y_{ik} = 1\right) = \Phi\left(p_i * \delta_1 + \text{CONV}_i * \delta_2 + \sum_{j=1}^{R} \text{PROD}_{j,i} * \delta_{3,j} + error \right). \tag{4.4}$$

Table 5 presents average statistics across product groups. Table 6 and Table 7 present

regression results for (4.3) and (4.4), respectively. On average, prices at establishment-types

where convenience should matter require one to two fewer pieces of money compared with

prices at firms where convenience should not matter.[11] Treating relative inconvenience as count

data yields similar results.[12] The price of an item sold at a point-of-sale where convenience

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[11] I also consider regressions in which the dummy CONV interacts with the product dummies. For the regression using $n(p)$, cigarette prices in a location where convenience should matter require 0.60 fewer pieces of money (standard error 0.24) than cigarette prices where convenience should not matter. This is the smallest estimate. On the high end, University of Michigan apparel and souvenir prices sold where convenience should matter require 2.97 fewer pieces of money (standard error 0.34) than the same products' prices sold where convenience should not matter. For results using $n(p)$, the average saving is 1.35 pieces of money, while the average saving for results using $n^+(p)$ is 2.19 pieces of money.

[12] An alternative to (4.3) is setting $z_i = n(p_i) - 1$ and considering the regression $E(z_i|X_i) = \exp[X_i B]$, where $X_i B$ is the right-hand side of (4.3). Treating z_i as count data exploits the discrete nature of relative inconvenience while simultaneously ruling out negative regression realizations of $n(p_i)$, but at the cost of sacrificing some interpretability. For $n(p_i)$, a Poisson regression produces a coefficient on CONV of −0.47 (standard error 0.04). At the mean sample values of the explanatory variables, this implies a reduction of 1.13 pieces of money associated with the CONV

should matter is approximately 55 percentage-points more likely to be a monetary convenience point than the price of the same or similar item sold where convenience should not matter. This is true even for large (±10%) neighborhoods around the current price.

These facts suggest the prices in this study are convenient transaction prices and are not purely convenient psychological prices—though psychological factors may explain part of the phenomenon. Some authors ascribe prices ending in 0 and 5 to the latter theory. For instance, Schindler and Kirby (1997) attribute the use of round-number prices to their "high cognitive accessibility." Effectively, the decimal system makes people comfortable dealing with round numbers, such as whole dollars, and simple fractions like one-half (50¢). Pricing according to this convention takes advantage of this fact. Jones (1896) also stressed the strong psychological role behind round prices, though he acknowledged a transaction motive in some instances.[13]

For the observations collected from points-of-sale where convenience should matter, the average price is $4.76 (standard deviation $6.16) and the median price is $2.50. Thus for most items there are several nearby prices with the same final digit—or several others with similar endings (e.g., a multiple of a quarter)—that may be psychologically convenient. Yet the above findings show that firms with incentives to set convenient prices select pricing options that minimize the number of pieces of money. This suggests that the convenient prices identified in this paper are not simply psychologically "attractive" prices. This documented broad use of relatively convenient prices formalizes and expands upon similar findings for newspapers (Knotek 2008), bottles of Coca-Cola (Levy and Young 2004), street cars (Watkins 1911), and "cheap confections" (Galbraith 1936).

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dummy. The reduction is 1.49 pieces of money for the $n^+(p)$ measure, using a negative binomial regression to account for overdispersion.

[13] Round numbers are common in currency markets (Osler 2003), stock prices (Kandel et al. 2001), and interest rates (Kahn et al. 1999), for non-transaction motives.

Nevertheless, it may be impossible and unnecessary to separate convenient transaction prices from convenient psychological prices. Laboratory memory studies show that round prices are more accurately recalled than odd prices (e.g., Schindler 1984, Schindler and Wiman 1989). For some of the goods in this survey, accurate recall can facilitate fast repeat transactions. Thus, psychologically convenient prices can yield convenient transactions as well.

Coffee, Fast Food, and Taxes

Coffee shops and fast food restaurants have incentives to charge prices that simplify and expedite transactions, yet both set many non-convenient prices in practice. A number of factors can explain this, such as a desire to leave small change in customers' hands that can be left as a tip, or that the perceived psychological benefits of price points outweigh the transaction benefits of convenient prices. National advertising campaigns or regional pricing decisions often dictate pre-tax prices, which do not take varying state and local taxes into account.

This last point brings up a common feature among these establishment-types: coffee shops and fast food restaurants charge sales tax on top of posted prices. By contrast, many—though not all—of the locations where convenience should matter sell products that are exempt from sales tax or typically include sales tax in posted prices. To see how taxes affect convenience, I add to regressions (4.3) and (4.4) a dummy variable TAXEXTRA equal to one if sales tax is added to the posted price to obtain the transaction price and zero otherwise.

Table 6 and Table 7 present the regression results. The transaction prices of items that require adding sales tax to the posted price are less convenient than cases in which the posted price includes relevant taxes. Charging sales tax on top of a posted price adds more than two pieces of money to every transaction—after controlling for differences in prices, product groups,

and whether a good is sold in a location where convenience should matter—and is associated with lower probabilities of monetary convenience points. In some ways, this is not surprising, since including taxes in posted prices is more "convenient" for customers since they see the price they need to pay. Customers can make faster transactions if they need not wait for the cashier to calculate the tax-inclusive price.

Why do these firms not post prices so that the after-tax transaction price is convenient? Psychological factors offer one explanation. Half of the posted prices that require additional sales tax end in 9, and 90% end in 0, 5, or 9.[14] Obtaining more convenient transaction prices without including tax in the posted price would require more prices ending in 1, 3, and 6 than the 1% of prices currently ending in these digits. Alternatively, firms could include sales tax in their posted prices and use relatively convenient and psychologically attractive 0 and 5 price endings. However, firms posting tax-inclusive prices are at a disadvantage compared with competing firms that post pre-tax prices, since the latter appear lower to an inattentive consumer.[15] Chetty et al. (2009) show that explicitly including sales tax in posted prices reduces demand, consistent with the notion that consumers typically ignore sales taxes when shopping. Hence, the lack of widespread convenient prices in competitive industries where psychological prices dominate and posted prices do not include tax may not be surprising.

This reasoning explains why convenient prices may be more common in countries with a VAT, where posted prices include the tax. In this case, firms need not worry about playing a pre- versus post-tax pricing game and can set prices that are simultaneously convenient and psychologically attractive. A number of recent studies using micro price data from the

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[14] The vast majority of the 0- and 5-ending pre-tax prices would not be monetary convenience points compared with other nearby options: only 37% within the ±5% and 18% within the ±10% neighborhood.

[15] While undertaking this study, Pizza Bob's—an Ann Arbor pizzeria and sandwich shop whose transaction prices are all multiples of quarters and dollars—announced that it was changing its menu from post-tax transaction prices to pre-tax prices (that translated to the same post-tax prices) to facilitate "easier comparison" with its competition.

Eurosystem Inflation Persistence Network—e.g., Álvarez and Hernando (2004), Veronese et al. (2005), Lünnemann and Mathä (2005), among others—use the broader category of attractive prices (consisting of convenient prices, price points, and round prices) to help explain the pricing behavior they observe. Hoffmann and Kurz-Kim (2006) document that the fraction of convenient prices remained virtually unchanged in Germany before and after the euro changeover, at around 25% of prices, whereas the fraction of 9-ending prices fell off dramatically. It is worth noting, however, that these papers look at micro data underlying consumer price indices and do not focus on point-of-sale characteristics. Thus, it is unclear whether a given price is "convenient" for transaction purposes in the spirit of this paper or simply ends in 0 or 5 for psychological purposes. Knotek (2008) presents more evidence on the importance of convenience in the context of the euro changeover.

V   Discussion and Implications

Convenience matters for other items that either were not surveyed or do not fit nicely into the analysis. Lottery ticket prices are one example. Two-thirds of ticket prices for drawing or instant games in Michigan and surrounding states match the values of common bills—$1, $5, $10, and $20—and very few games require coins. Beyond vending machines, other machine-based transactions are inherently affected by issues of convenience, whether through charging prices that coincide with commonly carried coins to simplify transactions for customers or that simplify coin and bill collection after the fact—or both. Coin laundries provide one notable example of this through their reliance on quarters, but arcade games, pinball machines, pay phones, novelty machines, juke boxes, and coin-operated car washes also fall into this category.

An omitted set of transactions are those made in the underground economy. While illicit goods and services are not part of the legitimate economy, these transactions are made on a frequent basis. They clearly satisfy the conditions such that they should be priced conveniently: transactions are made in cash, and facilitating rapid transactions can be important for obvious reasons. Work that is done in the informal economy—especially off-the-books services—could also be included in this group.

When the incentive to set and maintain a convenient price is strong enough, firms may prefer to adjust their products along a broadly construed "quality margin"—including changes in the size, weight, contents, characteristics, or service associated with purchasing a good—rather than changing a convenient price. This can have a large impact on consumer utility in some cases, such as when Pepsi doubled the size of its bottles but left its traditional, convenient nickel price unchanged in 1934.[16] In other cases, slight changes to product quality may go unnoticed by consumers who focus attention on the product's price.[17]

On the other hand, advances in the field of payments are beginning to confer the benefits of convenient prices without limiting firms' flexibility in terms of pricing. Credit and debit card issuers are increasing their exposure to the cash-heavy establishments with inexpensive products that are the focus of this paper, promoting "contactless" credit-card systems that allow quick authentication or not requiring a signature for small-change transactions. Fast food restaurants now promote their ability to accept credit and debit card payments.

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[16] From http://www.pepsi.com. Cf. the Coca-Cola Company, which was careful to maintain the quality and size of its product over the duration of its Nickel Coke era, as documented in Levy and Young (2004).

[17] The marketing and retailing literatures offer evidence of price as an indicator of quality, since the latter may be difficult to measure or recall (e.g., Tull et al. 1964). Hanna and Dodge (1995) give the example of the Hershey Chocolate Company, which adjusted the size of its chocolate bars fifteen times but only changed the bars' prices four times during the 1970s and 1980s.

Nevertheless, cash purchases remain important for many goods and services: an Aite Group (2005) study finds that about 95% of transactions less than $10 are made in cash. And convenient prices have implications for the study of price rigidity at the micro level, in particular for prices exhibiting above-average rigidity. Bils and Klenow (2004) present the average frequency of price changes for 350 categories of goods and services included in the U.S. CPI. Price stickiness varies tremendously across categories, with some prices unchanged for 80 months on average while others change virtually every month. Part of this variation is attributable to differences in product turnover and the importance of raw materials, but it is not clear why these variables would lead some goods and services to have such sticky prices.

Table 8 lists the 25 categories with the lowest average monthly frequencies (the "sticky categories") along with the 25 categories with the highest frequencies (the "flexible categories") from their appendix table. The categories affected by convenient prices, as documented in this paper, are set in boldface. The difference between the sticky categories and the flexible categories is stark. Nine of the twenty-five sticky categories are affected by convenience. Several others are set by various levels of government, typically at round prices (e.g., whole dollars) which are generically convenient—either psychologically or for transaction motives if made in cash. In fact, most of the goods and services identified in this paper as affected by convenient prices are located toward the sticky end of the spectrum. This suggests that convenience plays an important role in generating above-average price rigidity at the micro level.

By contrast, none of the flexible categories are affected by convenient prices in most circumstances (i.e., outside of farmers' markets, which comprise a tiny amount of such purchases). Twelve of the categories are food stuffs (fruits, vegetables, and meat products), which typically exhibit 9-ending prices and are usually priced per pound in a supermarket.

Pricing this way with heterogeneous items that are not perfectly divisible virtually ensures that the total cost will be random. Four of the categories are automotive fuels, of which the prices for regular, mid-grade, and premium unleaded gasoline are priced per gallon. Of course, gasoline is also often priced in fractions of a cent—making the price of exactly one gallon of gasoline both inconvenient and nonsensical.[18]

VI   Conclusion

This paper finds broad support for the use of convenient prices in locations where making rapid transactions is important. In these settings, goods that are tax-exempt or whose prices are quoted inclusive of tax typically have more convenient prices than do the transaction prices of other goods. Convenient prices are also prevalent for many of the consumer goods and services with the stickiest prices in the U.S. economy.

At present, there are still unanswered questions regarding convenient prices. In terms of empirical work, this study and newspaper data in Knotek (2008) focus primarily on U.S. data. Further empirical work for other countries with distinct monetary systems and distinct propensities for using cash in transactions is desirable. Looking into the future, as cash is used for fewer purchases, this will diminish convenient prices' role in transactions. To the extent that convenience helps generate price rigidity, such changes have the potential to increase price flexibility among the stickiest consumer price sectors. The macroeconomic ramifications of removing such stickiness are worth consideration.

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[18] While gasoline *prices* are inconvenient, this does not mean that gasoline *purchases* are inconvenient. Consumers have the ability to seek out convenient transaction prices for their entire purchase. An interesting test of convenience as a psychological concept versus convenience as a transaction motive would be to examine whether customers paying for gasoline in cash are more likely to "round off" purchases than are those who pay using a credit or debit card, where the final cost is irrelevant.

Finally, while a number of sticky goods and services tend to exhibit convenient prices, casual observation and data presented herein suggest that price points are endemic at the flexible end of the spectrum. The fact that round, convenient prices are more likely to be recalled than price points (Section IV) raises the possibility that customer recall and memory may play an important role in explaining price rigidity and flexibility at the microeconomic level.

VII Appendix: Convenient Prices in a Queuing Model

To illustrate a theoretical application of convenience, consider a standard queuing framework where service is first-come, first-served. Inter-arrival durations between customers are random and exponentially distributed with parameter λ. Service times are exponentially distributed with parameter μ, thus the mean service time is $1/\mu$ and traffic intensity is $\rho = \lambda/\mu$. To ensure the queue does not grow without bound, assume that $\rho < 1$. In the stationary equilibrium, the mean queue length is $\rho/(1-\rho)$ and the average total time to complete a transaction is $1/(\mu-\lambda)$.

To capture the ability of convenient prices to simplify transaction times and maintain tractability, suppose that $\mu = \bar{\mu}/f\left(n(p)\right)$, where the increasing function $f(\cdot)$ maps relative inconvenience into service times. The more monetary units that are required to execute a transaction at price p, the greater is the relative inconvenience measure $n(p)$, and the greater is the mean service time at that price. It then follows that charging more convenient prices reduces traffic intensity, queue lengths, and waiting times in the steady state.

Following De Vany (1976), I modify the model to include balking and assume that $\lambda = \lambda(p)$, where p is the price of the good (or service) and $\lambda' < 0$. While the customer knows the price, there is uncertainty regarding the length of the queue. Let the most recent arrival be the qth customer in the system. If the customer joins the queue, he purchases the good for price p and

obtains consumer surplus $R(p)$, with $R' < 0$. The ex ante cost to the consumer is the expected time

spent waiting in line and making the transaction: if the unit cost of time is w, this expected cost is

wq/μ. Customers who decide not to enter the queue obtain a net benefit normalized to zero.

It follows that an arriving customer balks if he is the Bth customer in the system, where

$$B = \left\{ \left(\frac{R(p)*\bar{\mu}}{w*f\left(n(p)\right)}, \frac{R(p)*\bar{\mu}}{w*f\left(n(p)\right)}+1 \right] \cap \mathbb{N} \right\} \tag{7.1}$$

and $\mathbb{N}$ is the set of natural numbers. On average, the proportion of arrivals who balk is

$\beta = \rho^B(1-\rho)/(1-\rho^{B+1})$. The remaining $1-\beta$ join the queue, implying mean effective demand is

$\tilde{\lambda}(p) = \lambda(p)(1-\beta)$. Given effective demand and an increasing cost function $c\left(\tilde{\lambda}(p)\right)$, steady-state

expected profits for the firm are

$$E\left(\Pi\right) = p\tilde{\lambda}(p) - c\left(\tilde{\lambda}(p)\right). \tag{7.2}$$

While a thorough treatment and parameterization of the model is beyond the scope of this

paper, several points are noteworthy. First, changes in price affect the line length at which a

consumer balks, through their effects on consumer surplus and waiting time in (7.1). A price

increase (decrease) which is associated with an increase (decrease) in relative inconvenience will

cause a customer to balk at a shorter (longer) line. However, a higher price that leads to faster

transactions may increase the balking threshold if consumer surplus is little affected. Second,

when the unit cost of time w is very large (e.g., during a sporting event), the multiplicative

interaction between w and $f\left(n(p)\right)$ in (7.1) magnifies the benefits of setting relatively

convenient prices. Finally, convenient prices work through their effect on demand, as customers

internalize the queuing externality (i.e., waiting time), in (7.2). With a large number of cash

transactions, the firm's costs—partly comprising cashiers' and managers' time spent counting

money, reconciling cash-on-hand with receipts, acquiring more change, etc.—would also likely

be an increasing function of $n(p)$. This would doubly boost the firm's incentives to set relatively

convenient prices over other nearby options.

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Figure 1: Frequency Distribution of Price Endings

(a) Convenience Should Matter
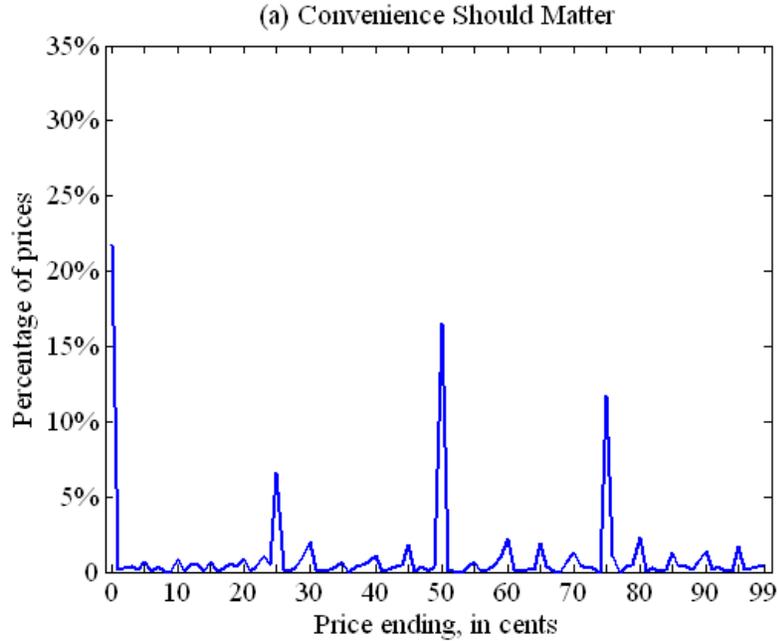
Note: Includes all price data from vending machines, concession stands, convenience stores, coffee shops, market concession stands, movie theatres, dry cleaners, dance clubs & bars, taxi services, parking lots, public transportation, barbershops, toll roads, the U.S. Post Office, and fast food restaurants.

(b) Convenience Should Not Matter
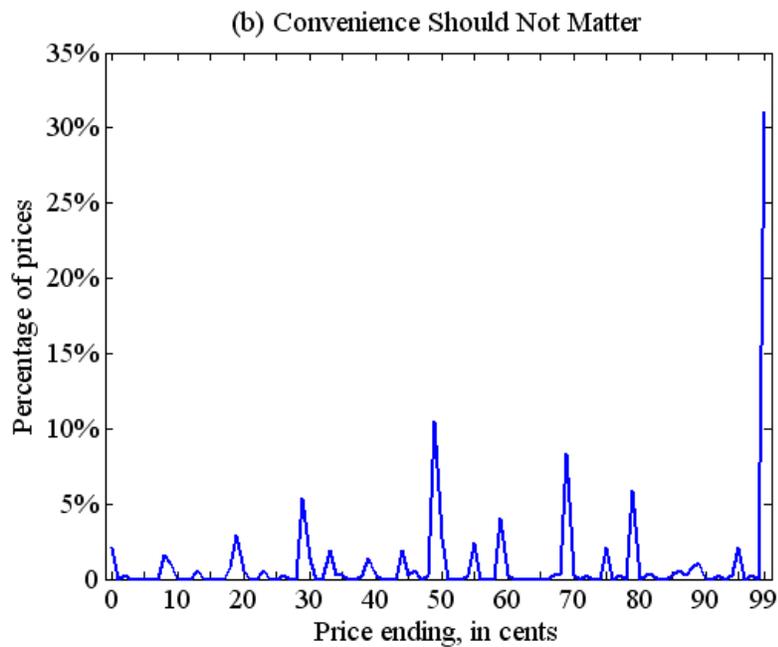
Notes: Includes all data from superstores and apparel stores/bookstores.

Figure 2: Distributions of Prices as Multiples of Currency Units (by establishment-type)

Legend: □ Require pennies ■ Multiples of a nickel □ Multiples of a dime ▨ Multiples of a quarter ■ Multiples of bills ($1, $5, etc.)

Y-axis: Percent of prices (0% to 100%)

Categories: Vending machines, Concession stands, Convenience stores, Coffee shops, Market concession stands, Movie theatres, Dance clubs/bars, Dry cleaners, Taxi services, Parking lots, Public transportation, Barbershops, Toll roads, Post office, Fast food restaurants, Apparel stores/bookstores, Superstores

Figure 3: Frequencies of Price Endings, Convenience Should Matter v. Convenience Should Not Matter (by product)

(a) Drinks (Coke, Pepsi, bottled water)

(b) Other food products (fruits, vegetables, etc.)

(c) Candy bars, gum, snacks

(d) Cigarettes (single pack)
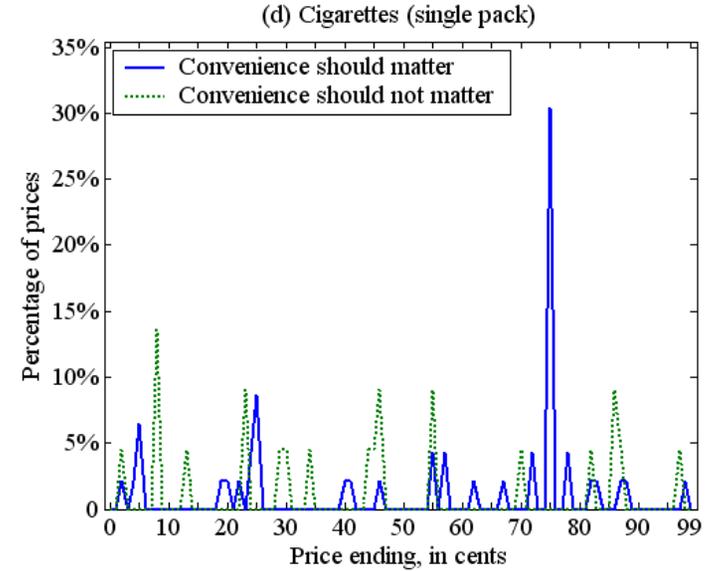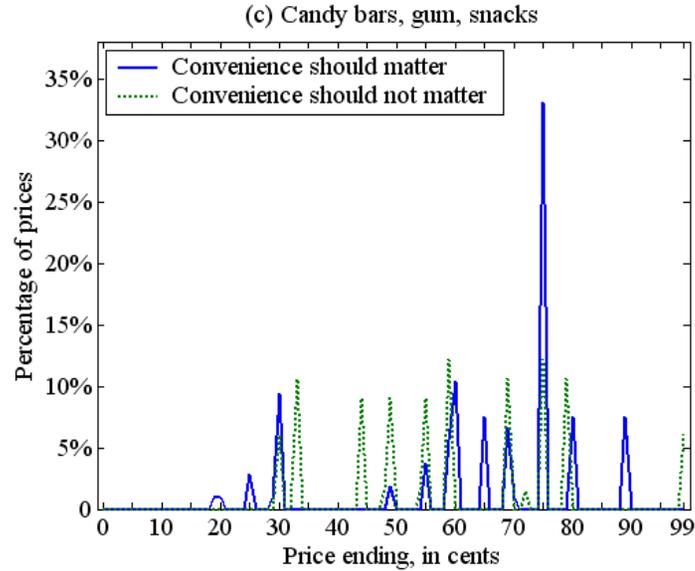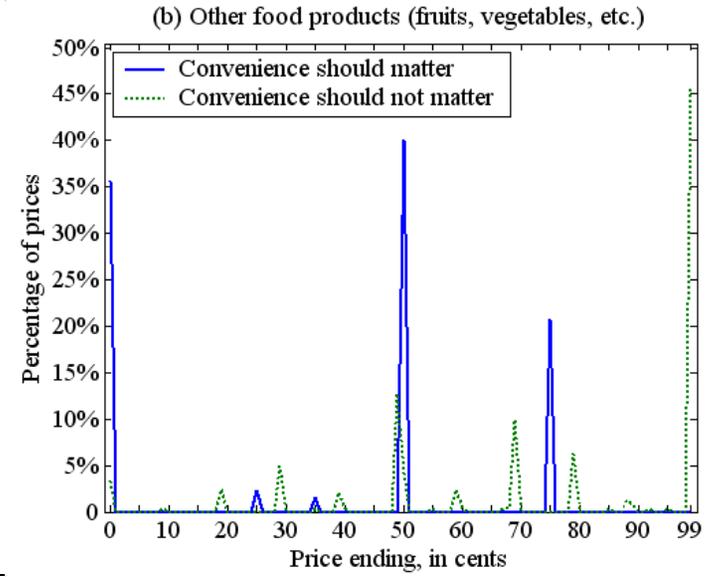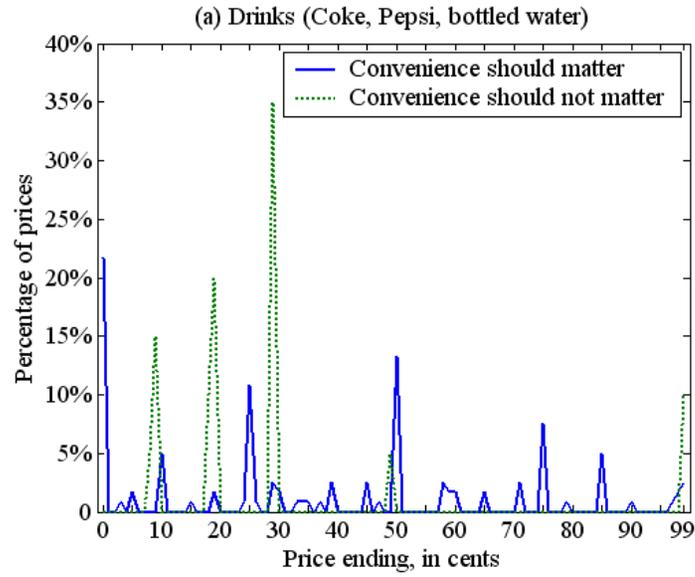
Table 1: Relative Inconvenience for Select Prices, \$0.95–\$1.25

p	$n(p)$	$n^+(p)$
\$0.95	**2**	**2**
\$0.96	3	5
\$0.97	4	4
\$0.98	3	3
\$0.99	2	2
\$1.00	**1**	**1**
\$1.01	2	11
\$1.02	3	10
\$1.03	4	9
\$1.04	3	8
\$1.05	**2**	**7**
\$1.06	3	11
\$1.07	4	10
\$1.08	4	9
\$1.09	3	8
\$1.10	**2**	**7**
\$1.11	3	10
\$1.12	4	9
\$1.13	5	8
\$1.14	4	7
\$1.15	**3**	**6**
\$1.16	4	10
\$1.17	5	9
\$1.18	5	8
\$1.19	4	7
\$1.20	**3**	**6**
\$1.21	4	9
\$1.22	5	8
\$1.23	4	7
\$1.24	3	6
\$1.25	**2**	**5**

Table 2: Establishment-Type and Product Groupings

Establishment-Type Groupings		
1. Vending machines	7. Dance clubs & bars	13. Toll roads
2. Concession stands	8. Dry cleaners	14. U.S. Post Office
3. Convenience stores	9. Taxi services	15. Fast food restaurants
4. Coffee shops	10. Parking lots	16. **Apparel stores/bookstores**
5. Market concession stands [a]	11. Public transportation	17. **Superstores**
6. Movie theatres [b]	12. Barbershops	

Product Groupings		
1. Coffee, tea, bagels	8. Movie tickets	14. Taxi rates
2. Drinks (Coca-Cola, Pepsi, bottled water)	9. Club & bar products	15. Flat taxi rates (Ann Arbor to DTW)
3. Concession items (food, no drinks)	10. Cigarettes (single pack)	16. Fares for public transportation
4. Candy bars, gum, snacks	11. Haircuts	17. Parking rates
5. Fast food (combos)	12. Dry cleaning	18. Postage
6. Other food products (fruits, vegetables, etc.)	13. University of Michigan apparel and souvenirs	19. Toll roads & toll bridges
7. Newspapers (single copy)		

Notes: [a] denotes stands set up for an outdoor farmers market. [b] denotes movie tickets only—concession items sold at movie theatres appear under the "concession stand" category. Establishment-types in **bold** should not be affected by convenience.

Table 3: Relative Inconvenience as a Function of Establishment-Type

| | Dependent variable | |
	$n(p)$	$n^+(p)$
Price	0.039###	0.030###
	(0.007)	(0.010)
Constant	**4.86**###	**5.65**###
[Superstores]	**(0.57)**	**(0.61)**
Establishment-types		
Taxi services	−3.09***	−3.59***
	(0.71)	(0.78)
Parking lots	−2.76***	−3.01***
	(0.59)	(0.67)
Dance clubs & bars	−2.51***	−3.14***
	(0.60)	(0.66)
Barbershops	−2.27***	−2.90***
	(0.66)	(0.70)
Public transportation	−2.09***	−2.54***
	(0.63)	(0.70)
Dry cleaners	−2.05***	−2.66***
	(0.59)	(0.63)
Movie theatres	−1.79***	−1.90***
	(0.61)	(0.69)
Toll roads	−1.62***	−1.62***
	(0.58)	(0.63)
Market concession stands	−1.19***	−1.20***
	(0.11)	(0.15)
Vending machines	−1.01***	−1.79***
	(0.14)	(0.26)
Convenience stores	−0.84***	−1.32***
	(0.11)	(0.20)
Concession stands	−0.67***	−2.52***
	(0.20)	(0.32)
U.S. Post Office	−0.55	−0.29
	(0.63)	(0.81)
Fast food restaurants	−0.18	0.77
	(0.59)	(0.65)
Apparel stores/bookstores	**1.43**###	**1.77**###
	(0.50)	**(0.65)**
Coffee shops	1.67###	1.30###
	(0.25)	(0.38)
Observations	1653	1653
$\bar{R}^2$	0.31	0.34
F statistic	46.01###	36.74###

Notes: See equation (4.1). ### denotes statistically greater than zero at the 1% level; *** denotes statistically less than zero at the 1% level. Robust standard errors are in parentheses. Superstores' dummy EST is omitted to prevent collinearity. PROD categories not dropped due to perfect collinearity, while not reported, are jointly significant at the 1% level. Locations in **bold** should not be affected by convenience.

Table 4: Probabilities of Monetary Convenience Points, as a Function of Establishment-Type

Current price compared with other prices:	(1) 1¢ higher/lower	(2) 1% higher/lower	(3) 5% higher/lower	(4) 10% higher/lower
Price	−0.053***	−0.038***	−0.085***	−0.091***
	(0.010)	(0.009)	(0.023)	(0.029)
Establishment-types				
Dance clubs & bars	+	+	+	1.95###
				(0.47)
Vending machines	+	+	+	1.18##
				(0.57)
Market concession stands	+	+	4.26###	2.67###
			(0.56)	(0.56)
Parking lots	+	+	1.56###	1.20###
			(0.32)	(0.30)
Barbershops	+	+	2.85###	0.72
			(0.69)	(0.70)
Movie theatres	+	+	0.22	0.26
			(0.35)	(0.37)
Public transportation	+	1.21###	1.13###	1.05###
		(0.34)	(0.34)	(0.33)
Taxi services	+	0.71###	1.92##	0.69##
		(0.28)	(0.84)	(0.30)
Dry cleaners	+	0.47###	−0.26	−0.37
		(0.19)	(0.24)	(0.28)
Concession stands	1.95###	1.64###	2.37###	1.68###
	(0.29)	(0.29)	(0.42)	(0.53)
Convenience stores	1.38###	1.01###	1.91###	1.22###
	(0.32)	(0.32)	(0.42)	(0.52)
Toll roads	2.81###	1.70###	0.51###	0.05
	(0.27)	(0.13)	(0.15)	(0.16)
U.S. Post Office	1.21##	0.64	–	–
	(0.66)	(0.50)		
Apparel stores/bookstores	1.04###	–	–	–
	(0.35)			
Superstores	−0.03	−0.09	0.41	−0.21
	(0.31)	(0.31)	(0.41)	(0.52)
Coffee shops	−0.22	−0.53	−0.60	−1.26**
	(0.38)	(0.38)	(0.54)	(0.62)
Fast food restaurants	−0.63***	−0.95***	−1.81***	–
	(0.18)	(0.20)	(0.40)	
Observations	1299	1373	1568	1479
Pseudo-R^2	0.46	0.37	0.43	0.36

Notes: See equation (4.2). ### or ## denotes statistically greater than zero at the 1% or 5% level; *** or ** denotes statistically less than zero at the 1% or 5% level. "+" denotes the category is omitted because it perfectly predicts $y=1$; "–" denotes omitted because it perfectly predicts $y=0$. Robust standard errors are in parentheses. The constant is suppressed for the sake of comparison. PROD categories not dropped due to perfect collinearity, while not reported, are jointly significant at the 1% level. Locations in **bold** should not be affected by convenience.

Table 5: The Impact of Convenience on Pricing—Product Group Comparisons

	Drinks (Coca-Cola, Pepsi, bottled water)	Concession souvenirs (clothes, hats, footballs, etc.)	Candy bars, gum, snacks	Other food products (fruit, vegetables, etc.)	Cigarettes
Convenience should matter					
Average $n(p)$	3.03	2.00	2.66	2.43	3.78
(Standard error)	(1.38)	(0.33)	(0.07)	(0.08)	(0.20)
Convenience should not matter					
Average $n(p)$	3.75	5.30	3.35	3.62	4.36
(Standard error)	(0.79)	(0.25)	(0.11)	(0.07)	(0.14)
As a percentage of observations, the current price is relatively more convenient than other prices:					
Convenience should matter					
(1) 1 cent higher/lower	75.0%	100.0%	76.4%	100.0%	54.3%
(2) 1% higher/lower	75.0%	100.0%	78.3%	100.0%	39.1%
(3) 5% higher/lower	67.5%	100.0%	75.5%	99.3%	4.3%
(4) 10% higher/lower	50.0%	75.0%	63.2%	92.6%	0.0%
Convenience should not matter					
(1) 1 cent higher/lower	0.0%	39.1%	27.3%	9.9%	22.7%
(2) 1% higher/lower	0.0%	0.0%	57.6%	11.2%	0.0%
(3) 5% higher/lower	0.0%	0.0%	27.3%	9.1%	0.0%
(4) 10% higher/lower	0.0%	0.0%	18.2%	8.3%	0.0%

Notes: Each product category is divided into two groups: (1) items sold in establishment-types where there are a priori reasons to believe convenience should matter for pricing decisions ("convenience should matter"), and (2) items sold in establishment-types where convenient prices should not be important ("convenience should not matter"), as defined in Section IV. In the bottom part of the table, relative convenience is defined using $n(p)$. Results using $n^+(p)$ are qualitatively similar.

Table 6: The Impact of Convenience on Pricing—Relative Inconvenience

	Results for $n(p)$	Results for $n^+(p)$	Results for $n(p)$	Results for $n^+(p)$
Price	0.043###	0.034###	0.035###	0.023###
	(0.008)	(0.010)	(0.007)	(0.009)
CONV	−1.03***	−1.39***	−1.00***	−1.36***
	(0.08)	(0.12)	(0.07)	(0.12)
TAXEXTRA	–	–	2.36###	3.31###
			(0.11)	(0.18)
$\overline{R}^2$	0.23	0.24	0.36	0.37
F statistic	38.08###	33.52###	61.74###	48.24###

Notes: See equation (4.3) and the text for details. CONV is a dummy taking on the value of one if observation i is sold in an establishment-type where convenience should matter, as defined in Section IV, and zero otherwise. TAXEXTRA is a dummy taking on the value of one if observation i requires that sales taxes be added to the posted price, and zero otherwise. ### or *** denotes statistically greater or less than zero at the 1% level. PROD categories not dropped due to perfect collinearity, while not reported, are jointly significant at the 1% level.

Table 7: The Impact of Convenience on Pricing—Monetary Convenience Points

Current price compared with other prices:	(1) 1 cent higher/lower	(2) 1% higher/lower	(3) 5% higher/lower	(4) 10% higher/lower	(1) 1 cent higher/lower	(2) 1% higher/lower	(3) 5% higher/lower	(4) 10% higher/lower
Price	−0.051***	−0.039***	−0.086***	−0.090***	−0.040***	−0.033***	−0.077***	−0.082***
	(0.010)	(0.009)	(0.022)	(0.029)	(0.009)	(0.009)	(0.021)	(0.026)
CONV	2.28###	2.16###	2.49###	2.27###	2.33###	2.18###	2.49###	2.27###
	(0.13)	(0.12)	(0.14)	(0.15)	(0.13)	(0.13)	(0.14)	(0.15)
TAXEXTRA	–	–	–	–	−2.33***	−2.34***	−3.56***	−3.15***
					(0.18)	(0.18)	(0.40)	(0.32)
Average marginal effect from CONV	0.59	0.61	0.54	0.49				
Average marginal effect from TAXEXTRA when:								
CONV=0					−0.27	−0.23	−0.14	−0.08
CONV=1					−0.65	−0.72	−0.77	−0.64
Pseudo-R^2	0.41	0.34	0.34	0.27	0.51	0.43	0.48	0.40

Notes: See equation (4.4) and the text for details. CONV is a dummy taking on the value of one if observation i is sold in an establishment-type where convenience should matter, as defined in Section IV, and zero otherwise. TAXEXTRA is a dummy taking on the value of one if observation i requires that sales taxes be added to the posted price, and zero otherwise. Results use the measure $n(p)$; those using $n^+(p)$ are similar. ### or *** denotes statistically greater or less than zero at the 1% level. The average marginal effect from CONV is the average change in $\Pr(y_{i,k}=1)$ going from CONV=0 to CONV=1, evaluated at the mean price for each product group and weighted by product-group shares. The average marginal effect from TAXEXTRA is the average change in $\Pr(y_{i,k}=1)$ going from TAXEXTRA=0 to TAXEXTRA=1, evaluated at the mean price for each product group, CONV=0 or CONV=1, and weighted by product group shares. PROD categories not dropped due to perfect collinearity, while not reported, are jointly significant at the 1% level.

Table 8: Frequency of Price Changes by Good/Service Category

Sticky categories	Frequency	Months	Flexible categories	Frequency	Months
Coin-operated apparel laundry and dry cleaning	1.2%	79.9	Regular unleaded gasoline	78.9%	0.6
Vehicle inspection	1.4%	69.9	Mid-grade unleaded gasoline	77.5%	0.7
Driver's license	1.8%	56.3	Premium unleaded gasoline	76.2%	0.7
Coin-operated household laundry and dry cleaning	2.1%	46.4	Tomatoes	71.0%	0.8
Intracity mass transit	2.5%	40.2	Airline fares	69.1%	0.9
Local automobile registration	2.8%	34.8	Utility natural gas service	64.2%	1
Legal fees	2.9%	34.3	Lettuce	62.4%	1
Vehicle tolls	3.2%	31.2	Eggs	61.8%	1
Safe deposit box rental	3.3%	30.2	Other motor fuel	61.8%	1
Newspapers	3.3%	29.9	Other fresh fruits	59.7%	1.1
Alterations and repairs	3.3%	29.4	Automobile rental	56.8%	1.2
Automobile towing charges	3.4%	28.7	Girls' dresses and suits	55.1%	1.2
Parking fees	3.7%	26.8	Oranges	54.7%	1.3
Haircuts and other barbershop services for males	3.9%	25.5	Chuck roast	54.3%	1.3
Beauty parlor services for females	4.3%	22.9	Round roast	53.1%	1.3
State automobile registration	4.3%	22.7	Other fresh vegetables	52.8%	1.3
Services by other medical professionals	4.5%	22.0	Fuel oil	52.5%	1.3
Hearing aids	4.7%	20.8	Ham (excluding canned)	50.4%	1.4
Shoe repair and other shoe services	4.8%	20.4	Women's dresses	48.5%	1.5
Garbage and trash collection	4.9%	20.0	Boys' sweaters	48.4%	1.5
Pet services	4.9%	19.7	Sirloin steak	48.4%	1.5
Taxi fare	5.0%	19.7	Round steak	48.2%	1.5
Care of invalids, elderly and convalescents in the home	5.1%	19.1	Pork chops	47.9%	1.5
Household laundry and dry cleaning, excluding coin-operated	5.1%	19.0	Women's suits	47.3%	1.6
Watch and jewelry repair	5.2%	18.5	Potatoes	47.3%	1.6

Notes: Data from Bils and Klenow (2004) appendix. Sticky (flexible) categories are the twenty-five good or service categories with the least (most) frequent average price changes. Frequency is the estimated average monthly frequency of price changes over 1995–7. Months is the mean duration between price changes. Categories in **bold** are affected by convenient prices, as documented in the text.