Racial Difference in Retail Prices Paid*

R. Andrew Butters†

Daniel W. Sacks‡

Boyoung Seo§

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Abstract

We document racial differences in retail prices paid for physically identical products. Black households pay 2.4 percent higher prices than white households, and Hispanic households pay 0.8 percent higher prices. This difference suggest that conventional measures of racial income differences understate real racial income inequality. The racial price gap is not explained by differences in household income, composition, or education. Instead three factors explain the entirety of the racial price gap: black and Hispanic households buy smaller packages with higher unit prices, benefit less from coupons, and live in high price zip codes. We find suggestive evidence that carrying and transportation costs, not supermarket access, are important underlying factors.

JEL codes: J15, D63
Key words: racial disparities, real income inequality, retail prices

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†Business Economics & Public Policy, Kelley School of Business, Indiana University (rabutter@indiana.edu).

‡Business Economics & Public Policy, Kelley School of Business, Indiana University (dansacks@indiana.edu).

§Business Economics & Public Policy, Kelley School of Business, Indiana University (seob@indiana.edu).

1 Introduction

In 2020, median income among non-Hispanic white households was $75,000, and among black households it was $47,000 (U.S. Department of Commerce, Bureau of the Census, 2020). This racial income gap has narrowed slowly across generations (Margo, 2016), much more slowly than would be expected given the intergenerational mobility of white Americans (Chetty et al., 2020). Yet as large and as persistent as this gap is, we show that, as typically measured, the income gap between black and white Americans understates racial differences in real income, because black households pay higher retail prices for physically identical goods.

Racial differences in prices paid can arise for multiple reasons. In some contexts such as housing and employment, explicit discrimination contributes to racially disparate outcomes (e.g., Yinger (1986); Christensen and Timmins (2018); Bertrand and Mullainathan (2004); Pena (2018); Kline et al. (2021)). Our context is retail stores with posted prices, where explicit discrimination is unlikely, at least for a given product in a given store. Instead differences in prices can arise for at least two reasons. First, retailers differ substantially in the prices they charge for a given product (Hitsch et al., 2017), and households differ in their access to low-priced supermarkets (e.g., Baker et al. (2006); Allcott et al. (2019)). Second, retailers commonly offer both quantity-based discounts and temporary promotional prices, and households may differ in their ability to take advantage of these low prices, because of differences in wealth, liquidity, or the ability to hold or carry inventory (e.g. Hamilton and Darity Jr (2009); Kuhn et al. (2020); Ganong et al. (2020)).

We investigate racial differences in retail prices paid using transaction-level data from 175,000 households in the Nielsen Consumer Panel. These data record household demographic characteristics as well as the prices paid and quantities purchased at the individual bar code level for all retail purchases. Focusing on 27,000 products commonly purchased across racial and income groups, we develop a household-specific relative price index. The relative price index measures how much the household paid for its groceries, relative to what it would pay if it faced average prices but kept its composition the same. The relative price index has a welfare interpretation: by what percent would a household

be willing to reduce its grocery spending to pay the average prices, relative to the prices it actually paid for the products it purchased. It can be aggregated and compared across households, and we use it to measure racial differences in retail prices paid.

We find that non-Hispanic black households pay prices about 2.4 percent higher than non-Hispanic white households, and Hispanic households pay prices about 0.8 percent higher than non-Hispanic white households. Thus, if black households paid the same prices as white households, but otherwise did not alter the products they purchased, they could purchase 2.4 percent more groceries. The black-white price gap persists over time, appears in nearly all states, and all product categories. The Hispanic-white price gap is also wide spread but smaller and less ubiquitous. The racial price gaps are not explained by income; it remains at each level of self-reported income. Thus, even holding income fixed, real purchasing power is lower in black households than white household. The racial price gaps are also not explained by demographic factors such as age, education, or family size; adjusting for these factors makes little difference to the estimated racial price gaps.

Three factors combine to explain the entirety of the racial price gaps: location, package size, and coupon use. Controlling for location by a set of zip code fixed effects reduces the black-white price gap by half. Comparing prices paid relative to product and package size mean, the estimated racial price gap falls substantially. Package size is important because we show that within-product elasticity of price with respect to size of -0.3, and (again within-product), black households are more likely than white households to buy smaller packages. While our main price measures net out coupon discounts, comparing prices paid gross of coupons also substantially reduces the racial price gap. When we account for zip code fixed effects, package size, and couponing, the racial price gap falls to a precise zero for both black and Hispanic households.

We provide suggestive evidence on the mechanisms underlying the importance of package size and location. While location matters for the racial price gap, this is primarily not because of access to supermarkets. Controlling for access to supermarkets, or adjusting for supermakret purchase, makes little difference. Instead it seems that home and car ownership rates are particularly important for explaining the racial price gap. We

interpret these results as evidence that carrying costs and storage costs may be driving forces.

Our results suggest that conventional estimates of the black-white income gap, which do not adjust for differences in prices paid, understate the real income gap, because at any income, the higher prices paid by black households imply lower purchasing power. Deriving the quantitative implications of our results requires an assumption on how representative our products are of the broader universe of retail and non-retail price gaps. Extrapolating to all expenditures, our results imply that real income gaps are six percent larger than conventionally measured gaps. Extrapolating only to non-automobile retail purchases, our results imply real income gaps about 1.7 percent larger than conventionally measured.

Our results primarily contribute to the large literature on racial inequality. This literature has established the magnitude and persistence of racial income inequality (e.g., Margo (2016); Bayer and Charles (2018); Chetty et al. (2020), and investigated many potentially contributing factors, including among other factors labor market discrimination (e.g., Darity and Mason (1998); Altonji and Blank (1999); Bertrand and Mullainathan (2004); Pena (2018); Kline et al. (2021)) parental income (e.g., Rothstein and Wozny (2013)), and educational quality (e.g., Card and Krueger (1992); Neal and Johnson (1996), neighborhood quality and segregation (e.g., Wilson (2012); Chetty et al. (2020), tax and transfer policies (e.g., Sullivan and Ziegert (2021)), and cultural factors (e.g., Austen-Smith and Fryer Jr (2005)). Brouillette et al. (2021) develop a measure of relative welfare of black and white Americans that accounts for differences in life expectancy, consumption, leisure, and inequality, but do not account for differential prices. Within this large literature, our work is especially closely related to recent, innovative work by Avenancio-Leon and Howard (2019)—who document that black and Hispanic households pay higher property tax rates than white households for the same public services, because black houses are assessed at relatively high values—and by Dorsey and Wolfson (2021), who document racial differences in prices paid for solar panel installation, a context where personalized pricing and discrimination are in principle possible. Our findings of differences in retail prices paid for physically identical goods echo their findings, although our context is

wholly different, as is our mechanism.

Our work also complements a literature investigating inflation heterogeneity in urban economics and macroeconomics. This literature has investigated how prices vary across income and location (Diamond, 2016; Handbury and Weinstein, 2015; Handbury, 2019), and how inflation varies by income (Kaplan and Schulhofer-Wohl, 2017; Jaravel, 2019, 2021). Our work contributes to this literature in two ways. First, this literature primarily documents price and inflation heterogeneity between higher and lower income households, whereas we focus explicitly on race, and the racial price inequality we document is distinct from income-based price inequality. Second, this literature constructs price indices for different groups to reflect their different consumption patterns, finding that heterogeneous inflation is driven by different inflation rates for different products. In our context, the price inequality we document is driven by different prices paid for *identical* products.

2 The Nielsen Consumer Panel

We use Nielsen Consumer Panel (HMS) data from 2006 to 2018. The primary purpose of the HMS data is collect a household panel of retail transactions. Participating households use scanners to record all of their retail purchases, transaction by transaction. In 2006 the Panel consisted of about 40,000 households, and since 2007 it has included about 61,000 households annually. The sample is refreshed annually. Panelists are selected according to a stratified random sampling scheme so that, properly weighted, the panel is representative at the National level, and also representative of each of 52 major markets (defined by Nielsen).

The HMS data include transactions in 10 broad categories which Nielsen calls departments. The departments include food, non-food grocery, as well as the non-grocery departments "Health and Beauty Aids" and "General Merchandise." The information from each transaction includes the exact barcode purchased (i.e., the UPC), quantity, coupon value, and store identifier. Nielsen does not release store level identifiers, but does provide encrypted store and chain identifiers, as well as information on retail channel (exam-

ple categories include mass merchandise, grocery, convenience, bodega, and warehouse club). Prices are recorded in two ways. If the transaction occurs at a store that provides data to Nielsen's Retail Scanner database, Nielsen imputes the price paid as the weekly average price paid for that UPC. If the store is not part of the Retail Scanner database, panelists are asked to report the price they paid. We work with prices net of any discounts reported by panelists. These discounts include discounts applied at the register (such as loyalty cards or store-run "buy one get one free promotions") as well as other discounts (such as manufacturer's coupons).

In most of our analysis we focus on the price per unit of commonly purchased products. Following Hitsch et al. (2017), we define a product by its physical features. Specifically, we group UPCs into products that share identical brand and UPC descriptions. Within a product and across UPCs, all variation is in package size (6 vs. 36 pack) or package material (e.g., can vs. bottle). For example, a 6 pack of Scott Unscented Toilet Paper and a 36 pack of Scott Toilet Unscented Toilet Paper would be the same product, but different manufacturers (Charmin) or descriptions (Scott's Comfort Plus) would be different products.[1] Our analysis excludes private label brands because these are not necessarily identical products across retailers. Nielsen provides standard units at our product level (e.g., counts of rolls of toilet paper), and for each transaction, we obtain the price per unit by dividing by unit size.

We focus on commonly purchased products to ensure that the products we study are purchased by all racial and income groups. We define commonly purchased products as follows. First, we identified the 50,000 most frequently purchased products separately by each of four racial groups (non-Hispanic Black, non-Hispanic White, Hispanic, and other races) and each of three income categories (high, mid, and low income).[2] The intersection of these seven sets—that is, the products commonly purchased by all racial groups and by all income categories—consists of 27,429 products. Roughly half of the commonly purchased products from each racial and each income group overlap with another.[3] Among

[1] Hitsch et al. (2017) call this grouping "brand," but we call it "product" to emphasize that the grouping pools physically identical products.

[2] We excluded private label products as the content of the products may differ depending on the retailer.

[3] The *ranking* of these products likely differs across racial and income groups (Bertrand and Kamenica, 2018), but their inclusion among the top 50,000 does not.

the 27,429 commonly purchased products there are an average of 5 UPCs and 3 pack sizes per product. These products represent 66% percent of all purchases, and 42% of overall spending in HMS. Annual spending on our commonly available products averages about $2,000.

Households report demographic information annually, including information on race/ethnicity, as well as income, age, education, and household composition. We use this information to define four mutually exclusive and exhaustive race/ethnicity categories: non-Hispanic Black, non-Hispanic White, Hispanic, and all other (including unreported). For simplicity we sometimes refer to these categories as "race" and we sometimes refer to white and black (omitting the "non-Hispanic" qualifier). Income, age, and education are reported in binned categories. When multiple heads are present, we take the maximum age and education reported for each.

Our analysis sample consists of all participating households, except for a small number of households who never reported any grocery products. Our final sample consists of 345 million product-level purchases made by 175,428 households. Summary statistics are given in Table 1. Seventy-one percent of the sample is non-Hispanic white, 11 percent is non-Hispanic black and 12 percent Hispanic. These line up reasonably closely with the national averages. In the 2017 5-year ACS estimates, 62 percent of Americans reported themselves as non-Hispanic white, 12 percent non-Hispanic black and 18 percent reported themselves as Hispanic (U.S. Department of Commerce, Bureau of the Census, 2017), with some discrepancy possibly reflecting the fact that the sampling frame of HMS and the ACS are somewhat different. The average household has 2.6 members including 1.5 adults, and reports income of $52,300. Total spending per year on our focal products is just under $2,000 per household, meaning in aggregate the households in our sample spent about $1.5 billion annually on the products we study.

3 Using household specific price indices to measure racial price differences

We develop a microfounded, individual-level price index that summarizes price difference paid by different households and adjusts for detailed differences in the composition of purchases. The price index measures the prices a given household pays for its groceries, relative to the average price paid for those groceries in all transactions. We therefore call it a relative price index.

3.1 Model

Consider a household purchasing with income y facing prices p and purchasing the utility maximizing bundle of goods let x. Let dp_j be the difference between the price the household pays for j, p_j, and the average price paid, $\bar{p}_j$. If dp_j is not too large, then by the envelope theorem, the change in utility is $\lambda x_j dp_j$ (where λ is the marginal utility of income) and the willingness to pay for such a price change, WTP_j, is

$$WTP_j = x_j dp_j = x_j p_j \frac{dp_j}{p_j} \approx x_j d\ln p_j. \tag{1}$$

Aggregating across a vector of small price changes dp, the willingness to pay is

$$WTP(dp) \approx \sum_j x_j p_j d\ln p_j. \tag{2}$$

Scaling by total expenditures e, we have:

$$\frac{WTP}{e} \approx \sum_j \frac{x_j p_j}{e_i} = \sum_j s_j d\ln p_j \equiv w(dp) \tag{3}$$

In words, $w(dp)$ equals the expenditure-share weighted average change in log prices induced by dp. It is approximately the household's willingness to pay (as a fraction of its expenditures) to face the average prices paid instead of the prices it actually paid.

We call $w(dp)$ the relative price index. This price index varies in the population for

two reasons: the willingness to pay for any set of price changes depends on preferences, and dp varies with actual prices paid. Nonetheless, $w(dp)$ can be aggregated or compared across household, because it is a money metric, we can aggregate across households and compare at the individual or group level.[4]

3.2 Operationalization

We measure the relative price index $w(dp)$ at the household-year level. Doing so requires that we measure, for each household i, product j, and year y, expenditure shares s_{ijy} and log price deviations $d\ln p_{ijy}$. We measure expenditures shares as the spending by i on product j in year y as a share of its total expenditures among our 27,000 commonly purchased products.

To measure $d\ln p_{ijy}$, we start at the transaction level with $\ln p_{iujty}$, the log price per unit paid by household i for UPC u and product j in transaction t and year y. Here u refers to the most detailed product classification (including packaging and size), whereas product j refers to our coarser product definition which aggregates over packaging and size. At the transaction level, we define

$$d\ln p_{iujty} = \ln p_{iujty} - \overline{\ln p}_{jy},$$

where $\overline{\ln p}_{jy}$ is the average unit price paid for product j across all transactions in year y. So $d\ln p_{ijty}$ measures how much more or less i paid per unit of j in transaction t, relative to the average payment in y. We aggregate across transactions to obtain the household-product price deviation $\overline{d\ln p}_{ijy}$, defined as the simple average across transactions (within household-product-year) of $d\ln p_{iujty}$.

We then aggregate across products, following the model, to obtain our baseline price index w_{iy}:

$$w_{iy} = \sum_{jt} s_{ijy}\overline{d\ln p}_{ijy}. \tag{4}$$

[4]When we aggregate across households, we typically weight each household equally, although it would be more appropriate to weight them by their expenditures, and we show robustness to expenditure weighting.

w_{iy} is equal to the expenditure share weighted average (log) difference in prices paid by i and average prices paid for the same products in year t.[5] It is also the percent increase in expenditures of household i and year y from the price it paid, relative to average prices, at fixed purchases. Under utility maximization w_{iy} is approximately household i's willingness to pay to face average prices instead of paid prices, as a share of expenditures.

Our relative price index can differ across households for a variety of reasons. We emphasize that differences in the composition of goods purchased—including category differences or quality differences within a category—do not lead to variation in w_{iy}, because we measure prices relative to product-year means. While compositional differences do not lead to variation in our price index, several other factors do. We highlight four potentially important factors. First, households pay lower unit prices if they buy larger package sizes (Figure 5). Second is retail channel: super markets, drug stores, convenience stores, and mass merchandise stores differ in both package size availability and prices of a given size potentially vary with retail channel. Third, households may differ in their tendency to use coupons or loyalty cards. Fourth, for a given store and package size, prices vary over time as promotional pricing becomes available. Households may differ in their tendency to stock up on products during promotional pricing periods. w_{iy} captures all these differences.

Our baseline relative price index, w_{iy}, measures household-year level prices relative to product-year averages. At times we construct alternative indices, including household-department specific ones (recall that a department is the broadest product category), and price indices relative to product-year-package size, or product-year-channel. These latter indices adjust for differences in package size or retail channel (supermarket, drug store, etc.). Finally while our baseline index is based on prices net of discounts from coupons, we also construct price indices based on gross prices (excluding coupons).

Measuring racial price gaps: To measure racial price gaps, we use regression to

[5]One concern about this measure is that some products may not be purchased at all by a given race; in that case, $d \ln p_{ijty}$ averages to zero within racial group, and our measure of racial price differences is potentially attenuated. We alleviate this concern by focusing on products commonly purchased by each race/income group over the entire sample period; by construction, our product set is limited to products with positive sales in each race-income group over the entire sample period. It is possible that some race/income groups have zero purchases of a given product in a given year, but this is relatively rare, as Appendix Table A.1 shows.

aggregate w_{iy} across households and to adjust for observed differences. Specifically, we estimate

$$w_{iy} = \beta_0 + \beta_1 Black + \beta_2 Hispanic + \beta_3 OtherRace + X_{iy}\theta + \epsilon_{iy}. \quad (5)$$

The omitted race-ethnicity is non-Hispanic white, and we define Black as non-Hispanic. Our interest is in β_1 and β_2, which we refer to as the black-white and Hispanic-white price gaps. Our baseline measure of these gaps omits all controls and pools all years. In some specifications we stratify on year, income, department, or state. In others we adjust for covariates X_{iy}: income (indictors for each level of self-reported income), demographics (indicators for age, number of adults in the household, number of children, marital status, and educational attainment), area fixed effects, or area characteristics.

3.3 Discussion

The construction of our relative price index balances two competing objectives. On the one hand, our model implies that we should focus on price differences between products that are perfect substitutes in consumption. Thus we measure prices paid at the detailed product level. This level of detail is important because compositional differences can spuriously generate price differences. These composition differences can arise for example from the fact higher income households buy higher quality goods, even in narrowly defined product categories (Broda et al., 2009; Handbury and Weinstein, 2015). On the other hand, compositional differences across households could reflect differences not in preferences but in prices or availability. Adjusting too extensively for composition effects might therefore mask some price differences. Our measure balances these concerns in a conservative way. In particular, we control for very detailed product characteristics, leaving primarily store, package size, and discount-pricing related factors as the main sources of price variation for a given product-year. We think it is unlikely that preferences for store, packaging, or size differ systematically with race. It is possible that some of the observed differences in the composition of purchased products reflects differences in prices (or availability) rather than differences in preferences. If so, our estimates understate racial price differences.

Our approach avoids estimating a complete demand system while still yielding welfare-relevant price indices. An alternative approach would be to specify and estimate demand systems which allows for racially heterogeneous preferences. Dubois et al. (2014) take this approach to decompose international differences in food purchases into differences in prices and preferences, and Allcott et al. (2019) similarly explain cross-income differences in nutrition. The demand system approach would allow us to account for price-driven differences in the composition of products purchased. However, our approach has several virtues relative to estimating a fully specified demand system. First, it is simple and fast to implement. Second, while our price indices have a microfoundation, even without a model they remain interpretable. Third, it avoids biases from a misspecified demand system, which could be likely when studying a large number of product categories and a highly detailed product classifications. Finally, our approach does not require instruments for identification.

4 Documenting and explaining racial differences in prices paid

4.1 Documenting racial differences in prices paid

We report racial differences in prices paid in Table 2. The first column of Panel A reports the average differential household price index for black and Hispanic households, relative to white households. Black households pay an average of 2.4 percent more for their products than they would pay if they faced the same prices as white households.[6]

The racial price gap appears in each year of our data, across the income distribution, in most product categories, in most states of the country, and for most broad product categories. We estimate the racial price gap separately in each year of our data, and plot the results in Figure 1. The estimated black-white gap always falls between 2.5 percent and to 3.5 percent, and is significantly different from zero in each year of the survey. The

[6]Here we pool race/ethnic groups for parsimony and power. Appendix Table A.2 reports differences across the most detailed race-ethnicity cells possible.

Hispanic-white gap varies somewhat more, from about zero in 2011 to 2 percent in 2018; it is significantly different from zero in eight of our 13 years of data.

We plot average price paid by race and income in Figure 2. The figure shows average price paid (residualized net of product-year fixed effects and normalized to mean zero) for each category of income and race. In each income category we observe that black and Hispanic households pay higher prices than white households. The average within-income difference is 2.7 percent for black households and 1.1 percent for Hispanic households.

We report the racial price gap in each of Nielsen's departments in Figure 3. The black-white price gap is positive in each department and statistically significant in 9 of the 10. It ranges from about half a percent in packaged meat to almost four percent in health and dairy. Importantly, we estimate a fairly similar price gap in non-food categories (general merchandise, non-food grocery, health & beauty) as in food categories, implying that the package size effects we document below are not limited to food products where package size might affect consumption utility. For Hispanic households the racial price gap is smaller and not always positive; it is positive and significant in five of 10 departments, and negative (and significant) in three.

The black-white price gap is also geographically ubiquitous. To show this, we estimate separate racial price gaps in each of the 40 states with at least 50 observations each of black, white and Hispanic households.[7] This approach conditions on location and so in principle it potentially "over controls," in the sense that racial sorting along geographic lines may contribute to differences in prices paid. We show below, however, that controlling for state fixed effects has a small effect on racial price gaps. We report the distribution of state-specific estimated price gaps in Figure 4. The black-white price gap shows up as positive in 38 of the 40 states. The difference is positive and statistically significant at the 5 percent level in 23 of these states. The Hispanic-white price gap is less universal, though still common. We estimate a positive price gap between Hispanic and non-Hispanic white households in 23 of the 40 states, and a significant and positive gap in seven states.

[7] We limit to these states to avoid the problems of extreme estimates in small markets.

4.2 Explaining racial differences in prices paid: location, coupons, and package size

We investigate possible explanations for this price gap in the remaining columns of Table 2. We begin by ruling out differences in income or demographic characteristics. In column (2) of Table 2 we present price differences that adjust for a set of dummy variables for each bin of reported income. This adjustment makes no difference to the estimated racial price gap, despite the large income differences by race, because income is only weakly related to prices paid. For example, quadrupling income—going from the $25,000 bin to the $100,000 bin—is associated with a 2 percentage point decrease in prices for black households, and a 1 percentage point increase for white households.[8]

We turn to the role of demographic characteristics in Column 3. We adjust for demographics with a set of indicators for age of head, marital status, number of children, and households size, as well as indicators for each level of educational attainment. The age and household composition controls are meant to adjust for the fact that grocery demand and ability to buy in bulk likely differ with household characteristics. The educational controls address the fact that higher-educated shoppers are more likely to purchase generic brands (Bronnenberg et al., 2015) and, in general, may be more informed shoppers. These demographic adjustments make essentially no difference to the estimated racial difference in price pays: after controlling for age, family composition, and education (as well as income), the estimated black-white income gap falls to 2.1 percent, and the Hispanic-white price gap actually increases to 1.2 percent.

Still another possible explanation for the black-white price gap is differential use of "warehouse clubs", such as Costco. These grocery stores offer low prices in exchange for an annual membership fee, so if warehouse club use differed along racial lines, differential prices paid on the margin would overstate differences in expenditures (because our price measure does not include the annual fee). We show in Panel A of Appendix Table A.3 that the estimated racial price gap is quite similar when we exclude warehouse purchases.

[8]The estimate reported here differs slightly from the average difference reported in Figure 2, because in the figure we implicitly control for a full set of race-by-income interactions, whereas here we only control for a common income effect.

More generally we find that retail channel choice—supermarket vs. convenience store—is not a primary explanation of the racial price gap, which falls only slightly (to 2.0 percent, from 2.4) after we residualize out product-year-by-retail-channel fixed effects instead of product-year fixed effects alone. (See Panel B of Appendix Table A.3.)

While income, demographics, and even retail channel explain little of the racial price gap, three factors combine to explain the entirety of it: location, package size, and coupoining. Location effects are potentially important because prices and economic circumstances vary systematically across places (e.g. Chetty et al. (2014); Handbury and Weinstein (2015); Diamond (2016)), and there are longstanding, strong racial sorting patterns in the United States, even conditional on income (e.g. Logan and Parman (2017); Bayer et al. (2021)). We show the importance of location by adjusting the racial price difference for a set of increasingly detailed location fixed effects, reported in columns (4), (5), and (6) of Table 2. State fixed effects make little difference, consistent with the evidence in Figure 4 that most states exhibit a black-white price difference. Including fixed effects for Nielsen's markets also reduces the racial price gap only slightly. This is perhaps unsurprising because markets are fairly large, close to metropolitan areas, and they offer highly heterogeneous shopping opportunities across neighborhoods. In the final column we therefore include fixed effects for zip codes; doing so reduces the black-white gap more substantially. For example, comparing columns (3) and (6) shows that detailed location controls reduce the black-white price gap by 40 percent. Much of the observed racial price differences is therefore due to racial sorting across neighborhoods, within states or broad geographic areas.

The second feature that explains the racial price gap is package size. Package size discounts are a pervasive feature of retailing. For example, in our data we estimate an elasticity of unit price with respect to package size of -0.33, meaning for a fixed product, doubling the package size reduces the unit price by about a third, as we illustrate in Panel A of Figure 5. However, black households tend to buy smaller package sizes than white households, as can be seen from the race-specific distribution of package size (relative to product mean) plotted in Panel B of the figure.[9]

[9]To construct this figure, we first calculate product level mean log size. Then for each barcode we cal-

To show the importance of package size, we estimate racial differences in prices paid after residualizing out fixed effects for product-year-package size. We show these results in Panel B of Table 2. Looking within package-size but otherwise introducing no controls, the black-white price gap falls by almost half, to 1.4 percentage points, although the Hispanic-white gap remains essentially unchanged. Additional controls for demographics do not much change the gap. Controlling for zip code fixed effects and holding fixed package size, the black-white price gap falls to 0.6 percentage points, a quarter of its original level. The Hispanic gap also falls by about half. Thus the combination of location and package size explains a large share of the black-white price gap and the white-Hispanic gap.

The third and final feature that explains the racial price gap is coupons: black and Hispanic households benefit less from them than do white households. To show this, in Panel C of Table 2 we report price differences net of coupons. Without adjusting for anything else, the black-whit price gap falls by 0.6 percentage points and the Hispanic-white gap falls by 0.03 percentage points. We see slightly smaller declines in the price gaps after adjusting for income, demographics, and zip (i.e. comparing column 6 between panels A and C).

In panel D we show the combined importance of pacakge size, coupons, and location by looking at pre-coupon prices relative to product-size-year mean prices, and (in columns 4-6) adjusting for location fixed effects. Couponing and package size combined (but without adjusting for location) explain about 60 percent of the black-white price gap and a quarter of the Hispanic-white gap. Adjusting also for income and emographics makes little difference. Adjusting for zip code fixed effects brings both racial price gaps to 0.1 percent, much smaller than their baseline values. This final estimate is fairly precise; its 95 percent confidence interval is about (-0.001, 0.003).

culate log size relative to its product-level mean. Pooling all bar codes, we calculate deciles of the residual size distribution, and we bin the data into these deciles. Then using the transaction level data we calculate the average log price (residualized net of product-year mean, as in our main analysis), and the race-specific transaction share, in each decile of residual package size.

4.3 Understanding location effects

Our results show that zip code fixed effects account for a large share of racial differences in prices. Zip codes reflect a large bundle of attributes including access to stores, wealth, and ability to carry and store groceries, all of which could potentially influence retail prices paid. To investigate the importance of these individual attributes, we re-estimate the racial price gap, but adjusting for zip code-level characteristics, individually and then jointly. We focus on supermarkets and drug stores per thousand residents, as measures of store access; zip code median income (in $10,000s), median house prices (in $100,000s), and home ownership rates, as measures of area wealth; and car ownership rates as measure of carrying and storage capacity. Each of these characteristics is strongly associated with race (even after adjusting for income), as we show in Appendix Figures B.1 and B.2.

While many zip code-level observations have a statistically significant association with prices, the results in Table 3 suggest an important role for car ownership in particular. The table reports the estimated coefficient, its standard error, and the coefficient times the standard deviation of each zip code characteristics. Car ownership stands out as a particularly characteristic: adjusting for car ownership alone has a larger effect on the racial price gap than does the full set of zip code fixed effects. Further, the magnitude of its association is strongest, unconditional or conditional on the other characteristics, and the adjusted R^2 is highest from including just car ownership, among models with only a single zip code characteristic. Home values and home ownership also appear important, but area income does not. Putting these results together, we view this table as providing suggestive evidence that carrying capacity and storage costs—rather than store access, income, or wealth—are important features making it difficult for black households to take advantage of low unit prices for large packages, and more generally making it difficult to stock up on products when their prices are low. However, we caution that this exercise does not account for many unobserved, zipcode level confounders, and relies on linearity assumptions to adjust for observed confounders, so we view these results as suggestive.

It is perhaps surprising that supermarket and convenience store access do not appear

to contribute more strongly to the racial price gap, in light of the facts that (1) package size is important, (2) supermarkets generally offer larger package sizes than convenience stores, and (3) there is a strong association between zip code racial composition and convenience stores per capita (Appendix Figure B.1 and B.2). However, it turns out that retail channel—supermarket, convenience store, and so on—is not *per se* important for the racial price gap. In particular, we find that racial price gaps are largely unchanged even after we residualize out product-year-channel fixed effects (Appendix Table A.3).

5 Implications and conclusions

Overall we document that black households pay prices 2.4 percent higher, and Hispanic households 0.8 percent higher, than white households, holding fixed the composition of products purchased. These higher prices are driven not by differences in income, education, or household size, not by retail channel choice, such as purchasing in grocery stores or warehouse club stores. but by differing locations and package size. Instead, the higher prices are explained by the facts that black and hispanic households disproportionately live in areas where all people pay higher prices, buy small package sizes with high unit prices, and do not benefit from coupons.

None of these three factors—location, size-based discounts, or coupon use—is an ultimate explanation, since each ultimately reflects potentially endogenous choices. We find suggestive evidence that car ownership in particular, and likely storage and transportation costs in general, are important contributing factors to the racial price gap. This result is only suggestive because it relies on cross-sectional correlations. We view it as an important task for future work to use quasi-experimental variation to down the importance of cars, or other factors in general.

These price differences are likely welfare relevant. We say this, first, because it is unlikely that households differ in the utility they derive from package sizes; black households are unlikely to disproportionately prefer small packages. Second, it is also unlikely that the high retail prices experienced by black households are made up for by low prices elsewhere. We show directly that the black-white price gap is not driven by differential

use of warehouse clubs. It is possible in principle that black households pay higher retail prices but lower housing prices in exchange. This, too, appears unlikely: relative to white households, black households have fewer location options, and hence less ability to tradeoff amenities for house prices. For example, as Bayer et al. (2021) show, in most US cities, it is difficulty "to choose a neighborhood that simultaneously provides even moderate levels of both median income and the share of Black neighbors" (p. 12). Ongoing discrimination in the housing market (as documented by Christensen and Timmins (2018, 2021)) makes it especially unlikely that higher retail prices paid by black households reflect different choices along the same amenity-housing price trade-off faced by white households. Further, this hypothesis is inconsistent with our finding that access to supermarkets, or retail channel more generally, statistically explains for little of the racial price gap.

This difference in prices paid exacerbates the substantial differences in household incomes by race in determining real racial income inequality. For example, in 2020, median income among non-Hispanic white households was $74,912, and among black households it was $46,600 (U.S. Department of Commerce, Bureau of the Census, 2020), a difference of 47 log points. If our estimate—which derives from commonly purchased retail products only—is reflective of *all* differences in prices paid across all goods and services, then differences in prices paid increase racial income inequality by about 5 percent. Extrapolating, more conservatively, to non-automobile retail spending in general, which accounts for about a third of all household spending (calculated from U.S. Bureau of Labor Statistics (2021)), our price differences imply that conventional estimates of the black-white income gap understate real income inequality by about 1.7 percent.

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Table 1: Summary statistics

Variable	Mean	SD	p10	p50	p90
White	0.71				
Black	0.11				
Hispanic	0.12				
Other Race	0.06				
Less Than High School	0.03				
High School	0.27				
Some College	0.32				
College	0.25				
Post College	0.13				
Married	0.50				
Household size	2.55	1.46	1.00	2.00	5.00
# Adults	1.49	0.50	1.00	1.00	2.00
Age	48.72	12.09	30.00	50.00	65.00
Household income	52304	30649	15000	50000	100000
Expenditures on focal products	1973	1296	657	1685	3641
# Observations	777,559				
# Households	175,428				

Notes: Table reports summary statistics on the indicated variables for the analysis sample, which consists of Nielsen panelists in 2006-2018. Household income is a categorical variable referring to income two years prior to the expenditure year; we convert it to a continuous variable by imputing at the left endpoint. p10/p50/p90 refer to the 10th, 50th, and 90th percentiles. Total expenditures refer to spending on our 27,429 modal products. Spending and income are measured in $1000s.

Table 2: Racial price differences, adjusting for covariates, location, couponing, and size

Controls	None (1)	Income (2)	Demographics (3)	State (4)	Market (5)	Zip (6)
A. Y=log price relative to product-year mean						
Black	0.024	0.023	0.021	0.021	0.018	0.012
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Hispanic	0.008	0.009	0.012	0.010	0.009	0.006
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
# Households	175,428	175,428	175,428	175,428	175,428	171,110
B. Y=log price relative to product-size-year mean						
Black	0.014	0.015	0.013	0.014	0.010	0.006
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Hispanic	0.009	0.009	0.012	0.008	0.007	0.004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
# Households	175,428	175,428	175,428	175,428	175,428	171,110
C. Y=log pre-coupon price relative to pre-coupon product-year mean						
Black	0.018	0.018	0.016	0.016	0.013	0.008
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Hispanic	0.005	0.005	0.009	0.007	0.006	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
# Households	175,428	175,428	175,428	175,428	175,428	171,110
D. Y=log pre-coupon price relative to pre-coupon product-size-year mean						
Black	0.009	0.009	0.008	0.009	0.005	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Hispanic	0.006	0.006	0.008	0.005	0.004	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
# Households	175,428	175,428	175,428	175,428	175,428	171,110
Controls						
Income		Yes	Yes	Yes	Yes	Yes
Demographics			Yes	Yes	Yes	Yes
State FE				Yes		
Market FE					Yes	
Zip code FE						Yes

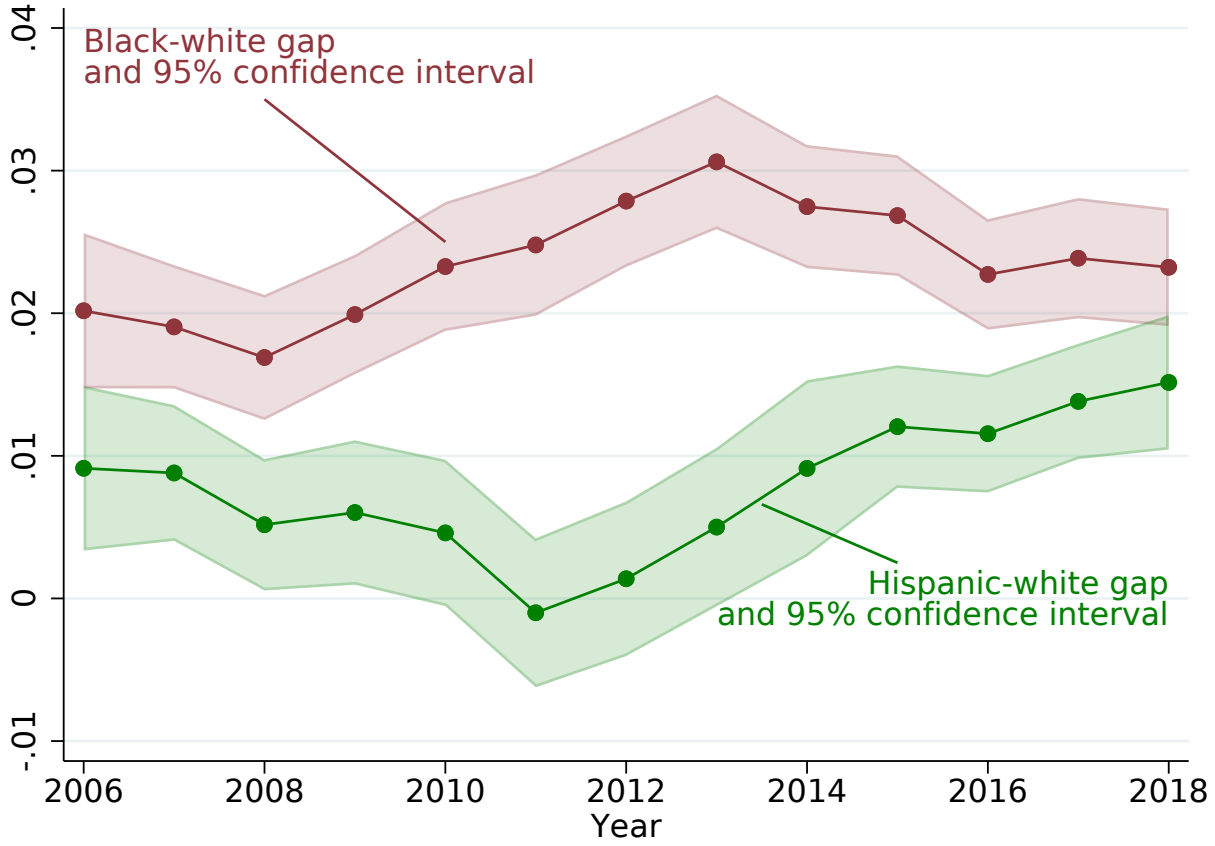
Notes: The dependent variable is the household-level price index, relative to the indicated mean; see Section 3 for details. Table reports the coefficients on indicators for non-Hispanic black and Hispanic (mutually exclusive; the omitted category is non-Hispanic white, and we also include an "all other race/ethnicity" category). Income controls are indicators for binned income amounts; demographics are indicators for educational attainment, household size, married, age of head, and number of children; location controls are fixed effects as indicated . Robust standard errors, clustered on household, in parentheses.

Table 3: Understanding the importance of zip code

Area controls	none (1)	FE (2)	Stores (3)	Income (4)	Home value (5)	Home own % (6)	Car % (7)	All (8)
Black	0.021	0.012	0.020	0.022	0.024	0.014	0.008	0.012
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Hispanic	0.012	0.007	0.012	0.012	0.006	0.007	0.006	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Supermarkets			-0.039					-0.023
			(0.007)					(0.005)
			[-0.003]					[-0.002]
Convenience			0.008					0.010
			(0.004)					(0.001)
			[0.006]					[0.004]
Median income				0.002				-0.000
				(0.000)				(0.000)
				[0.003]				[-0.001]
Median house price					0.011			0.009
					(0.000)			(0.001)
					[0.017]			[0.014]
Home ownership						-0.073		0.018
						(0.003)		(0.004)
						[-0.012]		[0.003]
Car ownership							-0.206	-0.171
							(0.006)	(0.007)
							[-0.022]	[-0.018]
Adjusted R^2	0.020	0.223	0.024	0.021	0.045	0.032	0.062	0.074
# Households	175,428	173,885	174,700	174,668	174,133	174,696	174,686	174,130

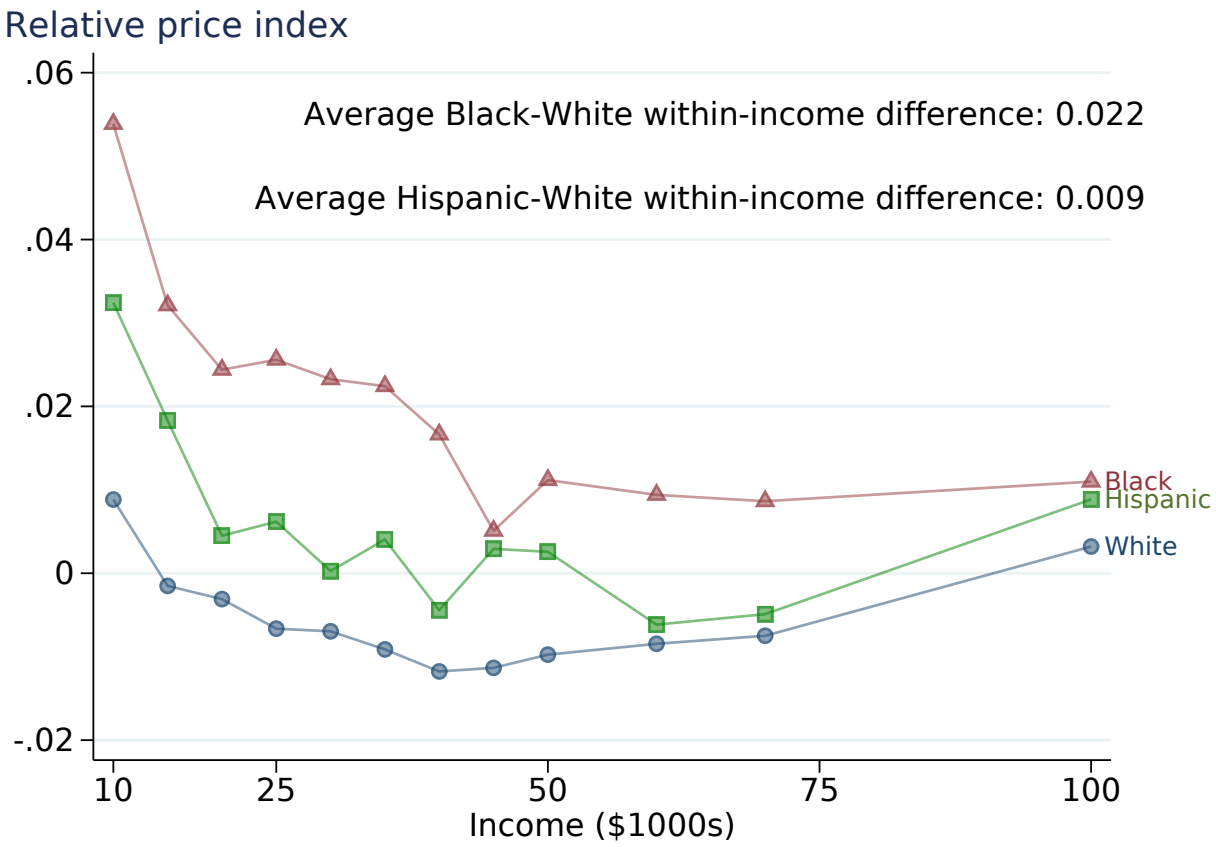
Notes: Table reports the coefficients from a regression of our relative price index on the indicated variables. See Section 3 for details on the construction of the price index. The omitted racial category is non-Hispanic white. All specifications include an indicator for other racial categories, as well as income and demographic controls (see notes to Table 2). Robust standard errors, clustered on household, in parentheses. The number in brackets gives the implied effect of a one standard deviation change in the indicated variable.

Figure 1: Racial differences in prices paid, by year



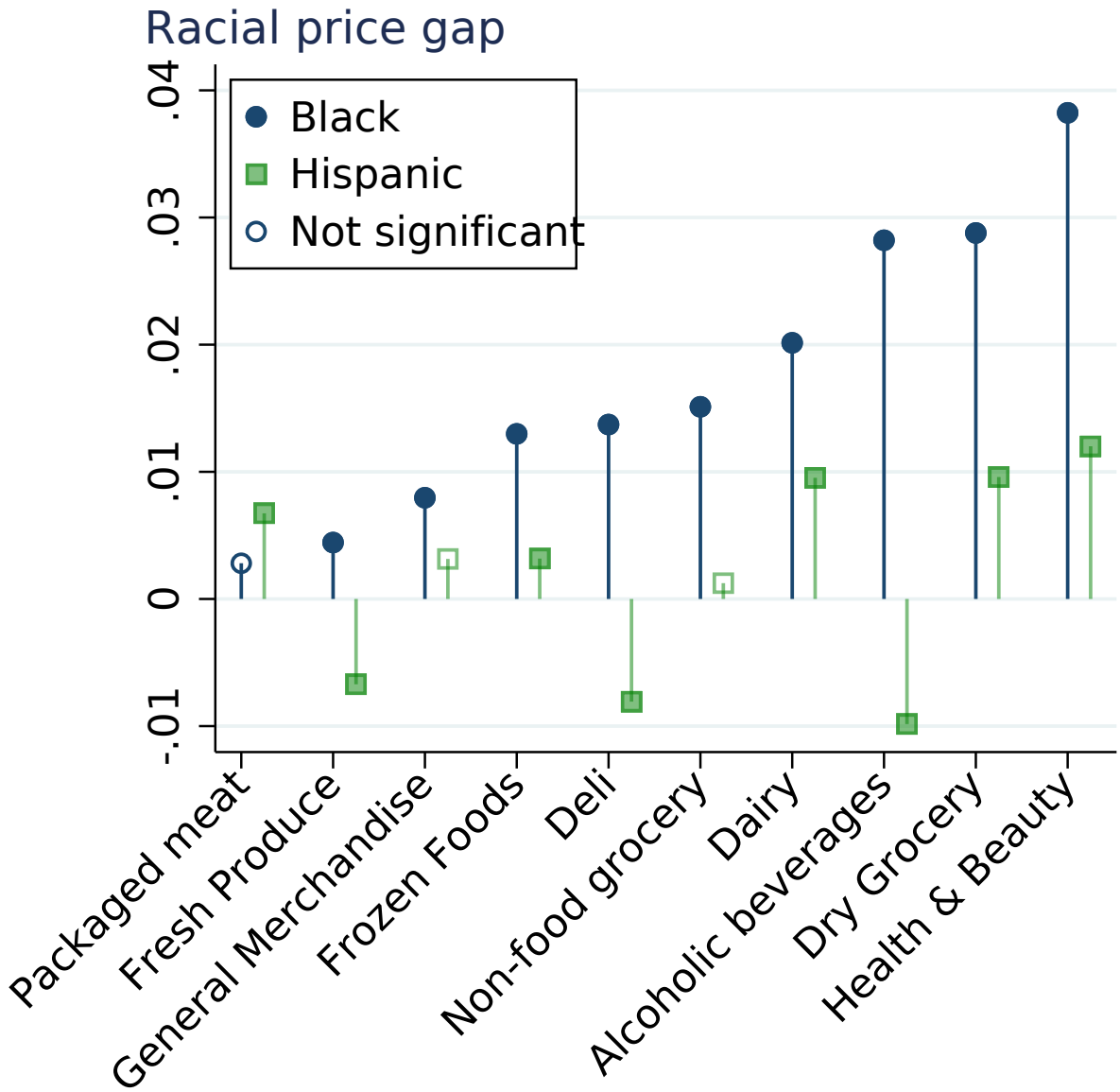
Notes: Figure plots the annual estimate of the average racial price gap. The racial price gap is defined as the difference in average relative price index by racial category. See Section 3 for details on the construction of the price index. The shaded regions indicate 95% confidence intervals, calculated from robust standard errors clustered on household.

Figure 2: Racial differences in prices paid, by income



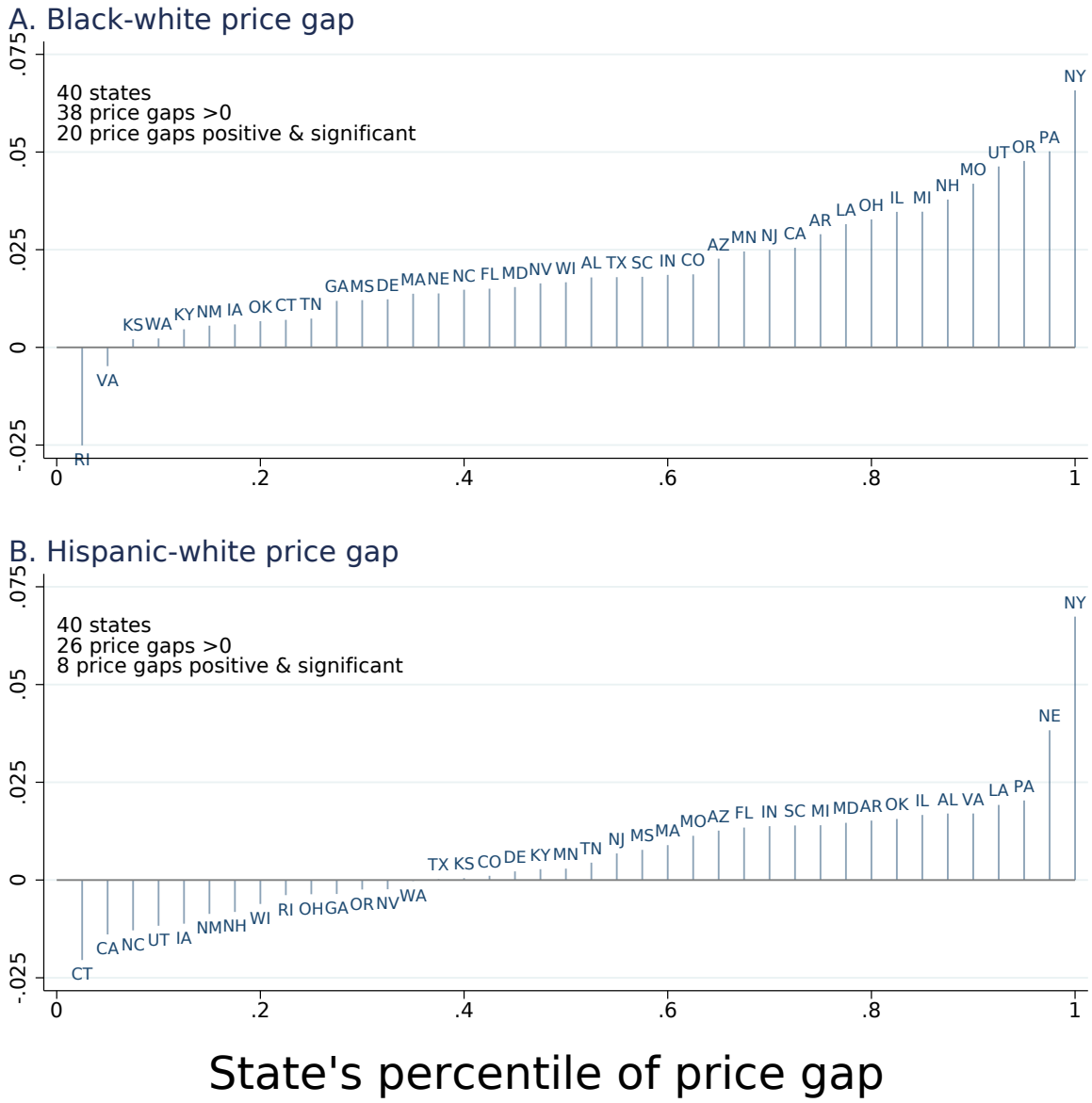
Notes: Figure plots the average relative price index for the indicated income level and race. See Section 3 for details on the construction of the price index.

Figure 3: Racial differences in prices paid, by department



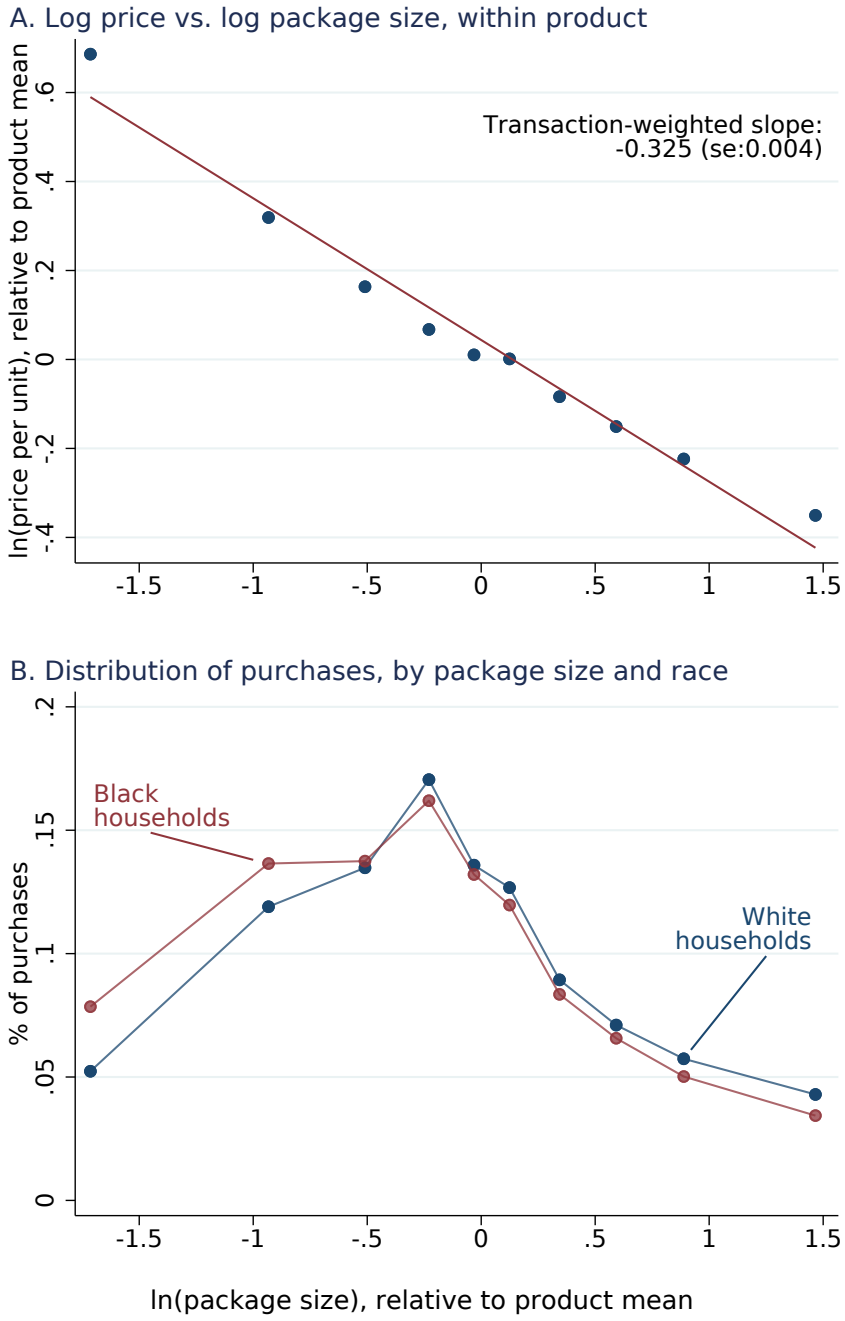
Notes: Figure plots the average racial price gap, by department (broad product category). The racial price gap is defined as the difference in average relative price index by racial category. See Section 3 for details on the construction of the price index. Hollow symbols indicate statistically insignificant differences.

Figure 4: Racial differences in prices paid, by state



Notes: Figure plots the distribution of estimated price gap between black and white households, and between Hispanic and non-Hispanic white households, across the 40 states with at least 50 observations each of white, black, and Hispanic households. The racial price gap is defined as the difference in average relative price index by racial category. See Section 3 for details on the construction of the price index.

Figure 5: Price per unit decreases with package size, but black households are relatively likely to buy small packages



Notes: Each bin in a figure is a decile of residual log package size, calculated as log size relative to average log size for the given product. In calculating these deciles we use barcode-level data. Panel A plots average price (net of product-year fixed effects) against average residual size in each decile. Panel B plots the race-specific purchase rates in each decile.

A Appendix Exhibits

Table A.1: Counts of product-year cells with positive purchases

	Number with positive sales	Zero sales share rate
in entire HMS	181,253	0
among non-Hispanic Black	179,938	0.0073
among non-Hispanic White	170,428	0.0597
among Hispanic	168,213	0.0719
among other races	166,849	0.0795

Notes: Table reports the count of products and product-years with positive sales, among the 27,429 products among the top 50,000 in each broad race-ethnicity and income category. Each row reports the number of product-years with positive sales, and the zero sales rate, i.e. the fraction of product-years with zero sales among the indicated group.

Table A.2: Price differences net of product-year fixed effects, by detailed race-ethnicity

Controls	None	Income	Demographics	Zip
	(1)	(2)	(3)	(4)
Black, non-Hispanic	0.024	0.023	0.021	0.013
	(0.001)	(0.001)	(0.001)	(0.001)
Asian, non-Hispanic	-0.008	-0.009	-0.009	-0.023
	(0.002)	(0.002)	(0.003)	(0.002)
Other, non-Hispanic	0.019	0.018	0.017	0.009
	(0.003)	(0.003)	(0.003)	(0.002)
White, Hispanic	0.003	0.004	0.007	0.004
	(0.002)	(0.002)	(0.002)	(0.001)
Black, Hispanic	0.033	0.033	0.037	0.019
	(0.005)	(0.005)	(0.006)	(0.004)
Asian, Hispanic	-0.001	0.000	0.004	-0.001
	(0.008)	(0.008)	(0.008)	(0.005)
Other, Hispanic	0.011	0.013	0.016	0.007
	(0.002)	(0.002)	(0.002)	(0.002)
# Households	175,428	175,428	175,428	171,110
Controls				
Income		Yes	Yes	Yes
Demographics			Yes	Yes
Zip code FE				Yes

Notes: The dependent variable is the average log price paid at the household-year level, after residualizing out product-year fixed effects. Table reports the coefficients on indicators for each self-reported race/ethnicity category. Income controls are indicators for binned income amounts; demographics are are indicators for educational attainment, household size, married, age of head, and number of children; location controls are fixed effects as indicated . Robust standard errors, clustered on household, in parentheses.

Table A.3: Robustness of racial price gap to adjusting for channel or excluding warehouse store purchases

Controls	None (1)	Income (2)	Demographics (3)	State (4)	Market (5)	Zip (6)
A. Y=log price net of product-year fixed effect (baseline)						
Black	0.024	0.023	0.021	0.021	0.018	0.012
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Hispanic	0.008	0.009	0.012	0.010	0.009	0.006
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
# Households	175,428	175,428	175,428	175,428	175,428	171,110
B. Y=log price net of product-year fixed effect, excluding warehouse purchase						
Black	0.022	0.023	0.020	0.021	0.017	0.011
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Hispanic	0.013	0.013	0.016	0.011	0.011	0.007
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
# Households	175,420	175,420	175,420	175,420	175,420	171,102
C. Y=log price net of product-year-channel fixed effect						
Black	0.020	0.020	0.018	0.018	0.016	0.011
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Hispanic	0.010	0.010	0.012	0.008	0.008	0.005
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
# Households	175,428	175,428	175,428	175,428	175,428	171,110
Controls						
Income		Yes	Yes	Yes	Yes	Yes
Demographics			Yes	Yes	Yes	Yes
State FE				Yes		
Market FE					Yes	
Zip code FE						Yes

Notes: The dependent variable is the average log price paid at the household-year level, after residualizing out product-year fixed effects. In panel B we limit the sample to purchases occuring outside of warehouse-club type stores, and in panel C we residualize out product-year-channel fixed effects. Table reports the coefficients on indicators for non-Hispanic black and Hispanic (mutually exclusive; the omitted category is non-Hispanic white, and we also include an "all other race/ethnicity" category). Income controls are indicators for binned income amounts; demographics are are indicators for educational attainment, household size, married, age of head, and number of children; location controls are fixed effects as indicated . Robust standard errors, clustered on household, in parentheses.

B Zip code racial composition and characteristics

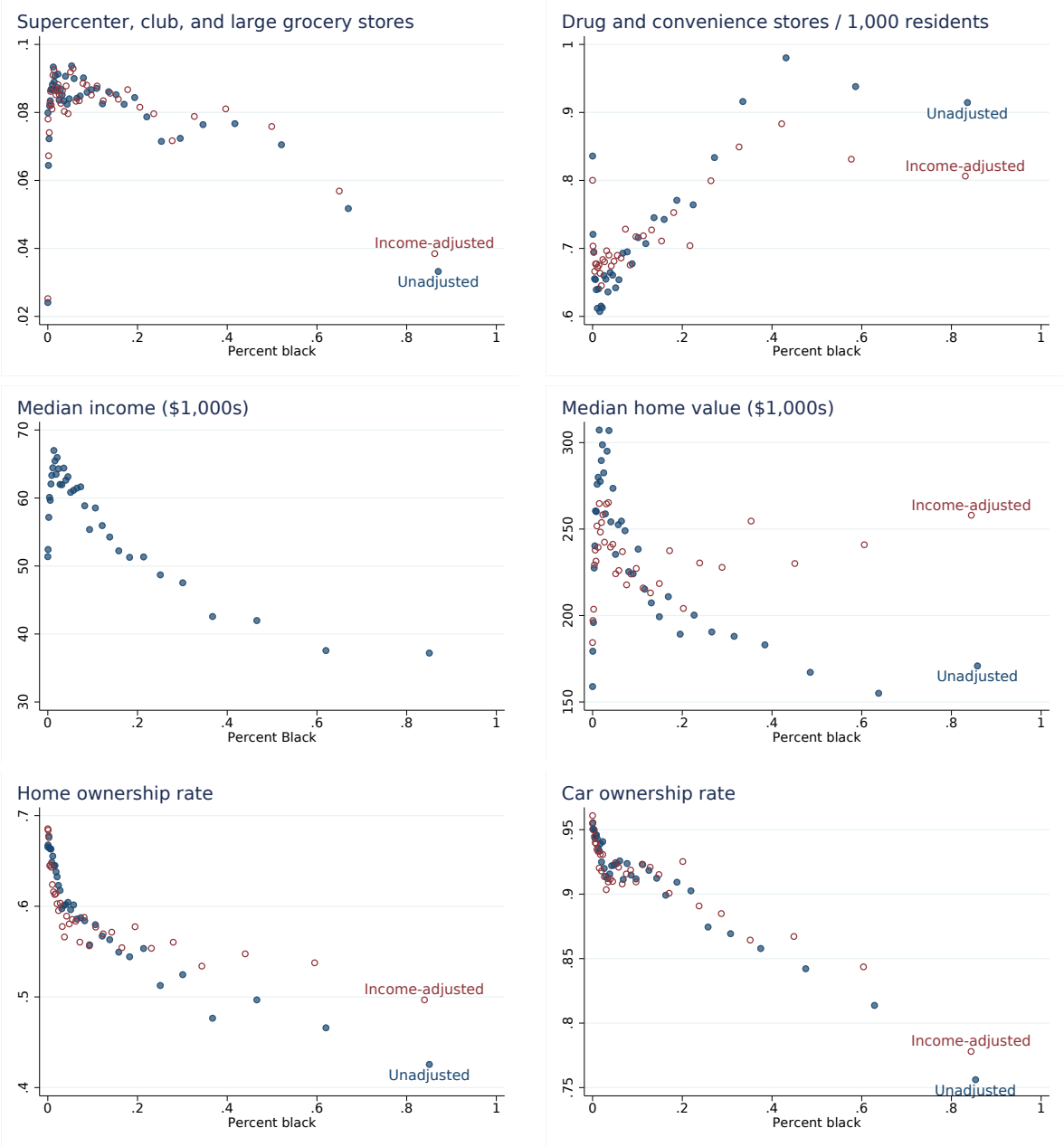
We study zip code racial composition and characteristics using data from the County Business Patterns database and the American Community Survey (ACS). From the County Business Patterns dataset, we construct measures of the number of large grocery, supercenter and club stores per capita as well as the number of gas and convenience stores per capita for each zip code area in 2016. These measures are defined using the criteria of Allcott et al. (2019). From the ACS, we collect the 2011 5-year estimates of demographic characteristics including: the median income, median home value, home ownership, as well as car ownership, defined as the fraction of occupied homes with at least one car.

Figure B.1 show the association between zip code average characteristics and the share of the population that is black. Each point in the scatter plot is an equally sized bin. We report unadjusted averages as well as averages adjusted for differences in zip code median income (except when we study median income itself). We select the number of points to plot, and we adjust for income, using the procedures and software of Cattaneo et al. (2019, 2021). We present analogous binned scatter plots by Hispanic share in Figure B.2.

We see, first, that large supermarkets are less common in zip codes with large black population shares, and drug and conveniences stores are more common. This association does not primarily reflect area income, despite the strong association between grocery store channel and income documented by Allcott et al. (2019); we see a negative association between large supermarkets and black share even after adjusting for income. Second, we also see area income, home value, home ownership, and car ownership. Zip codes with larger black population face several challenges in obtaining low price groceries: they have less access to low-price retailers, lower income, and less home and car ownership.

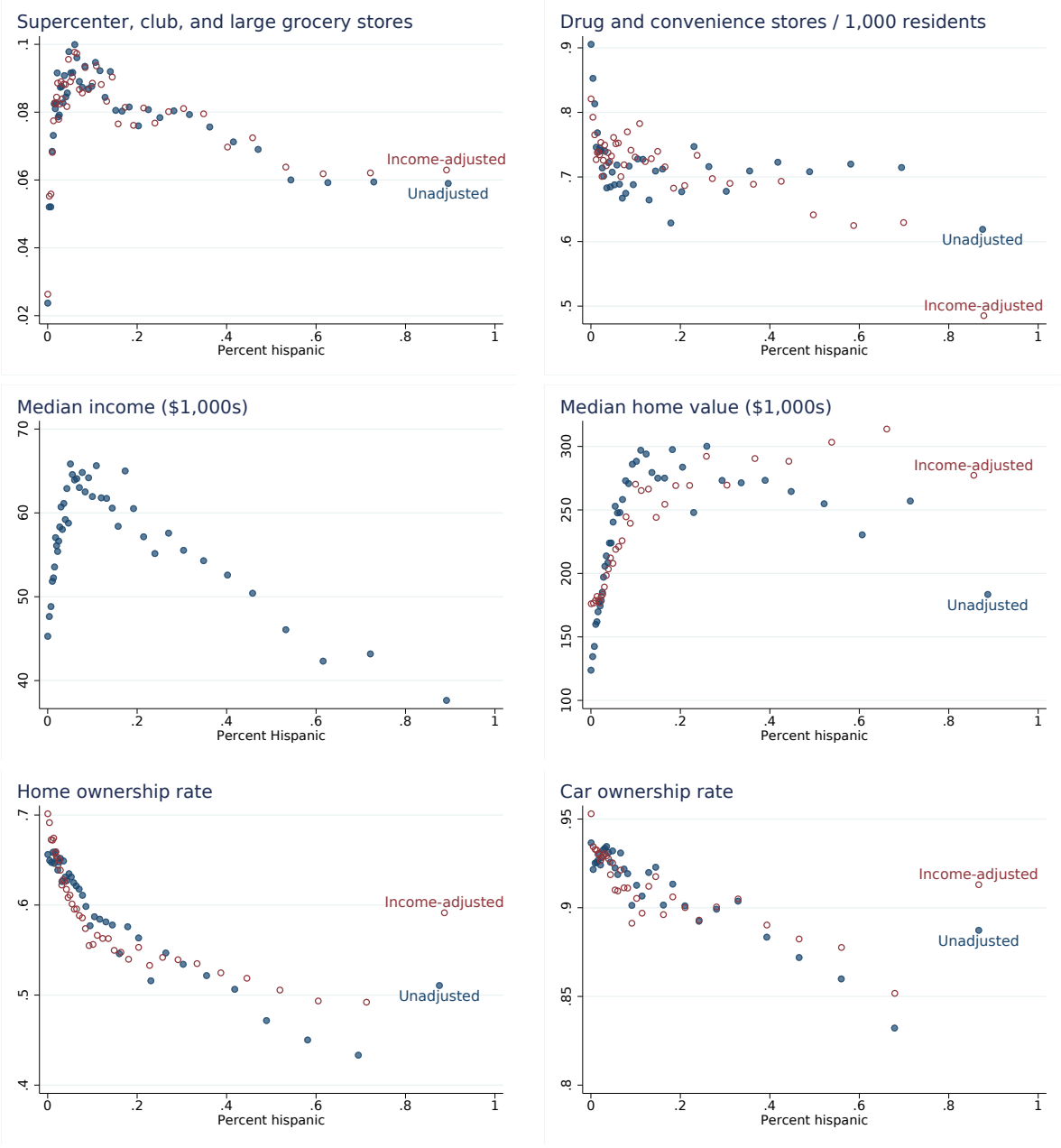
The patterns for Hispanic households are similar, although less extreme, and more sensitive to income adjustments. Neighborhoods with the highest Hispanic share have fewer large supermarkets, lower income, lower home value, lower home ownership, and less car ownership, than neighborhoods with low Hispanic populations.

Figure B.1: Zip code level characteristics by black share



Notes: Each panel displays a binscatter of a zip code area level statistic on the share of that zip code area's population that is black. In each case (except for the median income panel), both the raw binscatter and the binscatter after controlling for the role of zip code area median income are displayed. In the top two panels, the number of large grocery/supercenter stores per capita and drug/convenience stores per capita gathered from the zip code version of the County Business Patterns data for 2016 are displayed. In the middle two panels, the median zip code area income and median home value amongst owner occupied units for the zip code area gathered from the 2011 American Community Survey (ACS) are displayed. In the bottom two panels, the share of owner-occupied units and the share of households with access to at least one car gathered from the 2011 ACS are displayed.

Figure B.2: Zip code level characteristics by hispanic share



Notes: Each panel displays a binscatter of a zip code area level statistic on the share of that zip code area's population that is hispanic. In each case (except for the median income panel), both the raw binscatter and the binscatter after controlling for the role of zip code area median income are displayed. In the top two panels, the number of large grocery/supercenter stores per capita and drug/convenience stores per capita gathered from the zip code version of the County Business Patterns data for 2016 are displayed. In the middle two panels, the median zip code area income and median home value amongst owner occupied units for the zip code area gathered from the 2011 American Community Survey (ACS) are displayed. In the bottom two panels, the share of owner-occupied units and the share of households with access to at least one car gathered from the 2011 ACS are displayed.