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Monetary Policy and Racial Inequality in Housing Markets: A Study of 140 US Metropolitan Areas

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Abstract

This paper investigates the differential impact of monetary policy on homeownership and housing returns among Black, Hispanic and White households. Using data on 13 million repeat sales from 1993 to 2020, we construct and analyze race-specific entries and exits of homeownership and housing returns for 140 metropolitan areas in the United States. Our findings reveal significant heterogeneity: for minority households, one unit of monetary tightening leads to a 15% lower housing return and a 31% lower entry into homeownership than White households. This heterogeneity primarily stems from the less favorable labor market responses of minority groups to contractionary monetary policy. These findings emphasize the unintended consequences of monetary policy on racial inequality in the housing market.

Topics: Central bank research; Housing; Monetary policy
JEL codes: E52, E40, R00

Résumé

Cet article porte sur l'impact différentiel de la politique monétaire sur l'accession à la propriété et le rendement de l'investissement résidentiel chez les ménages de personnes noires, hispaniques et blanches. À l'aide de données sur 13 millions de reventes de 1993 à 2000, nous analysons le nombre de nouveaux accédants à la propriété et de propriétaires qui revendent leur maison, et le rendement de l'investissement par groupe racisé dans 140 zones métropolitaines des États-Unis. Nous concluons qu'il existe une hétérogénéité importante : une unité de resserrement monétaire entraîne un rendement de l'investissement de 15 % inférieur et un taux d'accession à la propriété de 31 % inférieur chez les ménages des groupes minoritaires comparativement aux ménages de personnes blanches. Cette hétérogénéité est surtout attribuable à la réaction moins favorable du marché du travail chez les groupes minoritaires lors d'une contraction de la politique monétaire. Nous concluons que la politique monétaire a une incidence involontaire sur les inégalités raciales sur le marché du logement.

Sujets : Logement; Politique monétaire; Recherches menées par les banques centrale
Codes JEL : E52, E40, R00

Racial inequality remains a significant and persistent issue in the United States. Among various aspects of racial inequality, housing inequality stands out prominently. According to data from the 2023 U.S. Census Bureau, 75% of White individuals own homes, while the homeownership rates for both Black and Hispanic populations are under 50%.[1] The existing literature has demonstrated the significant impact of monetary policy on housing markets (see, e.g., Taylor (2007), Williams (2016)), but investigations into whether monetary policy influences housing market outcomes differently for various racial groups have been limited.[2] To address this gap, our paper makes the first attempt to document how monetary policy impacts minority homeownership and housing returns, compared with non-Hispanic White households. Our findings demonstrate that following contractionary monetary policy measures, minority households experience more significant reductions in new homeownership entries and face greater losses in terms of housing returns.

To examine the impact of monetary policy on racial disparities in the housing market, we compile an ownership-level dataset of 13 million repeat sales by linking CoreLogic housing and mortgage transactions data with racial and ethnic information from the Home Mortgage Disclosure Act (HMDA) report. Using this linked dataset, we create race-specific entries and exits of homeownership, as well as race-specific average housing returns for 140 metropolitan areas in the United States from 1993 to 2020. Applying the local projection method and the high-frequency identification of the monetary policy surprises, we then analyze the causal effects of monetary policy on these housing market variables for Black, Hispanic, and White homeowners.

First, we find that minority entries of homeownership exhibit more pronounced responses compared with White households after monetary policy tightening. Specifically, a one-unit monetary tightening shock results in a 19% decrease in housing entries for White households over 16 quarters, whereas the entries for Black and Hispanic households experience a substantial drop of 50%. Regarding exits of homeownership, our findings indicate that minority households respond to monetary policy shocks in a similar manner as non-Hispanic White households. Overall, our findings suggest that contractionary monetary shocks lead to relatively lower housing demand from minority households.

What might drive the racial disparities in housing demand after monetary policy shocks? We investigate two potential channels through which monetary tightening impacts minority housing

[1]The homeownership rates by race and ethnicity can be downloaded from the Federal Reserve Economic Data (FRED) website. The data series for non-Hispanic White, Black and Hispanic are NHWAHORUSQ156N, BOAAAHORUSQ156N and HOLHORUSQ156N, respectively.

[2]One notable exception is Bartscher et al. (2021), who discuss the effect of monetary policy on racial wealth inequality, including wealth from housing.

returns and homeownership: the financing channel and the employment channel. Our results indicate that while monetary tightening has a similar pass-through on purchase mortgage interest rates for both minority and White borrowers, it exerts a stronger influence on minority employment than on White employment. Specifically, 12 quarters after a one-unit contractionary monetary policy shock, employment for White workers falls by 4%, while the drops for Black and Hispanic workers are at 7.7% and 7.6%, respectively. Notably, these differing reactions at 12 quarters precede a decline in their homeownership entries at 16 quarters, indicating a probable link between labor market shifts and subsequent housing market results for minorities.

After observing a decline in housing demand from minority households following monetary tightening, we seek to explore two subsequent hypotheses. The first hypothesis is that a decrease in demand is linked to a drop in housing returns. The second hypothesis is that, in a frictionless market scenario, a decline in demand from minority households should uniformly influence the housing returns of both minority and White populations. We test these hypotheses by running a local projection with cumulative housing returns as the outcome variable. Our analysis shows that 16 quarters after a unitary monetary tightening event, cumulative housing returns for White households decrease by 41%. In contrast, returns for Black and Hispanic households drop by 58% and 53%, respectively. With diminished demand resulting in reduced returns, the impacts vary across racial lines, suggesting that monetary tightening could be a factor in widening differences in racial wealth.

Given that we find cumulative returns are lower for minority households than White households, we further disaggregate our analysis to take into account the fact that many U.S. housing markets are racially segregated. We categorize homeowners within the same city into three distinct groups based on the percentage of the non-Hispanic White population in their respective neighborhoods. Subsequently, we generate data on entries, exits of homeownership, and housing returns for nine combinations of racial and neighborhood demographics. We find that the responsiveness of housing returns among minorities to monetary policy is contingent upon the share of the White population in their neighborhood. Notably, housing returns for minorities in predominantly White neighborhoods exhibit less susceptibility to monetary policy shifts compared with those located in predominantly minority neighborhoods.

So far, our documentation primarily highlights disparities between racial groups.[3] Some might contend that the observed racial discrepancies in reactions to monetary policy arise purely from income disparities among these groups. To verify this, we conduct a detailed analysis focusing on

[3]To streamline, we will hereafter use the term "racial groups" to collectively denote both race and ethnicity groups.

racial interactions across specific income brackets. Utilizing income data of mortgage applicants provided by the HMDA, we compute entries and exits of homeownership and housing returns by race and three income groups for each city. We find that the heightened responsiveness of minority groups to monetary policy shocks remains evident even when considering specific income categories. This points to the existence of factors beyond income that contribute to the differential impact of monetary policy on housing outcomes among racial groups.

Lastly, we investigate the potential asymmetric effects of changes in monetary policy, specifically examining whether contractionary or expansionary monetary policy surprises influenced the heightened responsiveness of minority entries of homeownership and housing returns.. Our analysis reveals that contractionary surprises lead to increased responsiveness in minority entries of homeownership and housing returns, whereas the response of both minority and White homeownership and housing returns to expansionary surprises was largely similar.

Our research has significant implications for policymaking. It highlights the essential need to recognize the uneven effects of monetary policy, especially when tightened, on the housing results for minority households. Policymakers should be aware of these heterogeneous effects and may need to consider additional targeted policy measures to mitigate the unintended consequences of monetary policies. For instance, since minority groups exhibit heightened labor market responses to monetary policy, policymakers can explore initiatives to further support and improve labor market opportunities for these groups during tightening cycles. Implementing such targeted policies has the potential to reduce the adverse effects of monetary tightening on the labor and housing market outcomes of minority communities.

Our study contributes to the literature examining the impact of monetary policy on racial inequality. Previous studies have investigated the effects of monetary policy on poverty and income inequality (Romer and Romer, 1999), consumption inequality (Coibion et al., 2017), employment disparities (Bergman et al., 2022) and wealth differences (Bartscher et al., 2021). Additionally, some research has explored racial disparities in mortgage prepayments (Gerardi et al., 2023), unemployment rates and inflation (Lee et al., 2021). The distinct feature of our paper is its focus on the effect of monetary policy on racial disparity in housing returns and homeownership.

Our paper also contributes to the literature on racial inequality in housing. Previous studies have highlighted various disparities in the housing market experienced by minority groups. For instance, Bayer et al. (2017) find that Black and Hispanic homebuyers pay a premium of around 2% on home purchases, while Bayer et al. (2018) show that Black and Hispanic borrowers are more likely to receive high-cost mortgages. Additionally, Kermani and Wong (2021) demonstrate that

Black and Hispanic homeowners are more likely to experience distressed sales and subsequently realize lower housing returns. Our study extends this research by investigating how monetary policy shocks influence racial gaps in housing returns and homeownership.

Furthermore, our study also adds to the extensive literature on the relationship between monetary policy and the housing market. Notable papers in this area include Fratantoni and Schuh (2003), Iacoviello (2005), Taylor (2007), Iacoviello and Neri (2010), Bernanke (2010), Beraja et al. (2019), Eichenbaum et al. (2022), Aastveit and Anundsen (2022), Gorea et al. (2022) etc. Additionally, recent research such as Guren (2018), Garriga and Hedlund (2020), Kaplan et al. (2020), Guren et al. (2021), Chodorow-Reich et al. (2023) provides new insights on the dynamics of the housing market.

Finally, researchers have recently ventured into incorporating racial inequality into traditional Heterogeneous Agents New Keynesian (HANK) models (e.g., Nakajima (2023)). However, a limitation of this model is its abstraction from housing dynamics. Our empirical findings suggest responses of housing prices and homeownership to monetary policy vary by racial groups and constitute an important source of heterogeneity. Consequently, these findings hold potential value as inputs for forthcoming HANK models that embrace both racial inequality and housing dynamics.

The subsequent sections of this paper are organized as follows. Section 1 provides an overview of the data used in our analysis. In Section 2, we present the main empirical findings, focusing on the effects of monetary policy shocks on race-specific entries and exits of homeownership and housing returns. We then investigate the potential transmission mechanism. In Section 3, we further explore the effects within specific income groups, by positive and negative monetary policy surprises and an alternative estimation approach. Finally, Section 4 concludes. Additional details are provided in the Appendix.

1 Data

We focus on three racial groups in our analysis: Non-Hispanic Black, Non-Hispanic White, and Hispanic (of any race), hereafter referred to as Black, White, and Hispanic, respectively. It is worth noting that, similar to Kermani and Wong (2021), our primary analysis does not include American Indians, Alaska Natives, Asians, Native Hawaiians, and other Pacific Islanders due to data limitations.[4] In this section, we provide an overview of our methodology for calculating entry

[4]Specifically, we do not have a sufficient number of repeat sales in our sample to construct house price indices for these racial groups at the city level.

and exit into homeownership and constructing house price indices (HPIs) for the three racial groups across the U.S. metropolitan areas.

1.1 CoreLogic-HMDA data

Our analysis uses housing market data sourced from CoreLogic, which provides linked information on housing and mortgage transactions collected from public tax and deed records. For housing transactions, we have access to the exact date, price, and location. For mortgage transactions, we observe key information such as the origination date, loan type (conventional, FHA, or VA), loan amount, lender name, and mortgage interest rate for a subset of loans.[5] We exclude transactions in CoreLogic where a house is purchased without a mortgage, by a corporation, or by individuals with the same last name as the seller.

Since CoreLogic does not provide race and income information of homebuyers, we address this limitation by matching the CoreLogic datasets with the HMDA filing data. HMDA captures the near-universe of mortgage originations. Updated annually, the HMDA data include information on the year of the application, the amount of the loan, the lender's decision, the securitization status of the loan, and the applicant's attributes such as income, race, ethnicity, gender, and location (state, county, and census tract). If a co-applicant is present, their race and ethnicity are also documented. The data also provide useful information on the lender, such as the name of the institution, its type, and its regulating agency. HMDA data became available in the early 1990s.

The CoreLogic-HMDA linking procedure follows a similar approach employed in previous studies (e.g., Bayer et al. (2016)). For each mortgage transaction in the CoreLogic dataset, we search for matching mortgage applications in the HMDA data based on the exact origination year, census tract, loan type, and loan amount. We further refine the matches based on the textual similarity of lender names, retaining only high-quality matches. Our overall matching rate is 54%, which is in line with the matching rate in Bayer et al. (2016).

We derive our racial and ethnic variables from HMDA and apply the following coding methodology. Hispanic households can be of any racial background. When both the applicant and, when applicable, the co-applicant identify as White and non-Hispanic, the household falls into the non-Hispanic White category. Similarly, if both the applicant and, when applicable, the co-applicant identify as Black and non-Hispanic, they are categorized as non-Hispanic Black. If both the ap-

[5] Conventional mortgages are not backed by a federal agency; FHA loans are backed by the Federal Housing Administration; VA loans are backed by the U.S. Department of Veterans Affairs.

plicant and co-applicant (if any) identify as Hispanic, they are placed in the Hispanic category. Since 2004, both applicants and co-applicants have had the option to report multiple races. For households classified as White or Black, we consider only those who report a single race. However, households under the Hispanic category in our sample can identify with multiple races.[6] The Appendix provides further details of the HMDA data, the matching procedure, and the racial and ethnic variables coding methodology.

One possible concern with our approach is whether our matching method generates a selection bias. To address this concern, we conduct an analysis of the matching rate along three dimensions: transaction price of houses, neighborhood White population share, and neighborhood median income. The results are presented in Table 1. In panel (a), we examine the matching rate between CoreLogic and HMDA data based on the transaction price of houses. Housing transactions in CoreLogic are divided into three groups by transaction price within a city-quarter, and we calculate the proportion of transactions within each group that are matched to HMDA. The analysis shows that there are no substantial differences in the matching rate between the three groups. Similarly, in panel (b), we investigate the matching rate based on the neighborhood-level White population share within a city. Housing transactions in CoreLogic are divided into three groups based on the non-Hispanic White population share of the census block group where the house is located within a city. Again, we find no significant differences in the matching rate between the three groups. Finally, in panel (c), we assess the matching rate based on the neighborhood-level median household income within a city. Housing transactions in CoreLogic are divided into three groups by median household income of the census block group where the house is located within a city. The analysis demonstrates that there are no substantial differences in the matching rate between the three groups. Overall, these results indicate that our matching method does not generate significant selection bias along these dimensions.

We then restrict the matched data to a sample that consists only of completed ownership spells (i.e., purchase and sale) where purchases took place between 1993 and 2017 and sales were com-

[6]The homeowners who are not in the non-Hispanic Black, non-Hispanic White or Hispanic categories are, for example, interracial homeowners, individuals who identify with multiple races, non-Hispanic Asians, non-Hispanic Pacific Islanders, and instances where only the applicant or co-applicant is Hispanic.

Table 1: Matching Rate Analysis

(a) House Price	# of Transactions	# of Matches	Matching Rate
Low	20700732	10727003	0.52
Middle	20890648	11474231	0.55
High	20961178	11379198	0.54
(b) Neighborhood White Share	# of Transactions	# of Matches	Matching Rate
Low	20641040	10768551	0.52
Middle	20784490	11268578	0.54
High	21017432	11517090	0.55
(c) Neighborhood Median Income	# of Transactions	# of Matches	Matching Rate
Low	20681980	10873438	0.53
Middle	20720888	11156979	0.54
High	20484524	11229846	0.55

Notes: This table presents the matching rate between CoreLogic and HMDA data along three dimensions. Panel (a) groups housing transactions by transaction price within a city-quarter. Panel (b) groups transactions by non-Hispanic White population share at the census block group level within a city. Panel (c) groups transactions by median household income within a city. We then calculate the proportion of transactions within each group that are matched to HMDA. Non-Hispanic White population share and median household income data come from the five-year summary file of the 2017 American Community Survey.

pleted before 2022.[7] [8] We exclude cases where a house is purchased by a corporation or an individual with the same last name as the seller, cases where a house is rebuilt prior to the purchase and cases where a house is sold within six months of purchase. Our final repeat sale sample from the CoreLogic-HMDA data comprises over 13 million completed ownership spells.

Table 2 provides a summary of the matched repeat sales data. Among the nearly 13 million repeat sales, the median purchase year is 2005, and the median sale year is 2012. The sales price on average amounts to $305,000, with the median being $230,000. In terms of homeownership demographics, roughly 65% identify as non-Hispanic White, 5.4% as non-Hispanic Black, 9.7% as Hispanic, and the remaining 20% fall into other racial and ethnic classifications. The median loan-to-value ratio is 60%, and the majority (60%) of the loans are conventional 30-year mortgages. We have data on 3.4 million mortgage rates, both the average and median of which are 6.1 percentage points.

Race-specific entries and exits We use the matched CoreLogic-HMDA repeat sales data to calculate race-specific entries and exits of homeownership at the city-quarter level. We compute both raw counts and dollar volumes to capture the intensity of homeownership transitions within each racial group. To assess differential financial costs faced by minorities, we calculate the average interest rates of 30-year conventional mortgages for each racial group. Furthermore, we compute at the MSA-quarter-race level the average mortgage rate, the share of FHA mortgages and the average loan-to-value ratio to be included as control variables in our analysis. Our study covers 140 Metropolitan Statistical Areas (MSAs), ensuring a broad geographical coverage.

Table 3 provides a summary of the variables mentioned above by race. For non-Hispanic Whites, the average home entries in each MSA in each quarter is 582, considerably higher than their non-Hispanic Black and Hispanic counterparts, which are 54.8 and 102.2, respectively. The

[7] We chose to start the sample in 1993 because HMDA data gathered before 1993 utilize the 1980 census tract number. HMDA data from 1993-2002 use the 1990 census tract, 2003-2012 use the 2000 census tract, and 2012-2017 use the 2010 census tract. We use the census block relationship files from the census website https://www.census.gov/geographies/reference-files/2010/geo/relationship-files.html to crosswalk the census tracts from 1990, 2000 and 2010. Using data before 1993 would result in significant data loss.

[8] Purchases made after 2017 have been excluded from the sample due to changes in the reporting methods of the HMDA. Specifically, prior to 2018, loan amounts were rounded to the nearest thousand dollars in HMDA data. However, as a result of the 2015 HMDA rule, loan amounts are now publicly disclosed in the post-2018 HMDA data at the midpoint of the $10,000 interval that encompasses the reported value. For instance, a loan amount of $198,600 would have been rounded to $199,000 in HMDA data before 2018, but in HMDA data from 2018 onwards it would be rounded to $195,000. This inconsistency hinders the feasibility and coherence of matching mortgages between CoreLogic and HMDA for constructing a sample starting from 1993 and encompassing 2018 and subsequent years.

Table 2: Summary Statistics of Matched CoreLogic-HMDA Repeated Sales Data

	count	mean	sd	p10	p50	p90
Purchase Year	12,821,389	2005.4	5.7	1998	2005	2014
Sale Year	12,821,389	2011.6	6.0	2003	2012	2019
Purchase Price (Thousands)	12,821,389	264.3	2922.1	90.0	199.3	486.5
Sale Price (Thousands)	12,821,389	304.7	4107.7	88.6	230.0	560.0
Ownership Spell (Years)	12,821,389	6.2	4.4	1.7	5.0	12.5
Annualized Return (%)	12,564,963	2.4	11.8	-9.8	2.7	13.9
White	12,821,389	0.649	0.5	0.0	1.0	1.0
Black	12,821,389	0.054	0.2	0.0	0.0	0.0
Hispanic	12,821,389	0.097	0.3	0.0	0.0	0.0
Income (Thousands)	12,406,011	99.8	159.8	35.0	73.0	173.0
FHA	12,821,389	0.2	0.4	0.0	0.0	1.0
ARM	6,344,654	0.5	0.5	0.0	0.0	1.0
Loan-to-Value (%)	12,565,013	78.1	23.9	29.6	80.0	99.7
30-Year Conventional Loan (%)	12,821,389	0.6	0.5	0.0	1.0	1.0
Mortgage Rate (%)	3,436,696	6.1	1.6	4.1	6.1	8.1

Notes: Sample consists of completed ownership spells (i.e., purchase and sale) where purchases occurred between 1993 and 2017. Purchase and Sale Years represent the years in which the purchase and sale transactions occur for a given ownership spell. Purchase and Sale Prices indicate the transaction prices associated with the purchase and sale, respectively. Ownership Spell measures the length of time between the purchase and sale dates. Annualized Return represents the unlevered annualized return for each ownership spell. White/Black/Hispanic are binary indicators denoting the respective racial groups. Income represents the total gross annual income used by the lender to make the credit decision. FHA and ARM are binary indicators for FHA-insured and adjustable-rate mortgages, respectively. Loan-to-Value represents the ratio of the mortgage amount at the time of origination to the purchase price. 30-year Conventional Loan is a binary indicator for 30-year mortgages that are not backed by a government agency. Mortgage Rate refers to the interest rate associated with the 30-year Conventional Loan.

non-Hispanic White group also observes 529 average exits, again reflecting higher counts than the other groups. Its average FHA mortgage share stands at 19.7%, which is significantly lower than the non-Hispanic Black's 33.7% and Hispanic's 34.5%. The non-Hispanic Whites have an average LTV of 82% and a mortgage rate of 5.2%, both being the lowest among the three groups. The non-Hispanic Black group, despite having fewer entries and exits, manifests a pronounced dependence on FHA mortgages at 33.7%. Their average LTV stands slightly higher at 88%, indicating potential higher borrowing relative to their property values. Their mortgage rate of 6.8% is also the highest among the groups.

In addition to constructing race-specific entries and exits, we also produce these variables at a more detailed level, utilizing either both race and neighborhood White population share or both race and income as criteria. In the former scenario, we classify homeowners into three distinct categories based on the non-Hispanic White population share within their census block group, thereby differentiating neighborhoods with low, moderate, and high concentrations of non-Hispanic White residents. In the latter scenario, we categorize mortgage applicants into three equally sized income groups (low, middle and high) for each MSA and application quarter. In both instances, we calculate entries and exits for a total of nine groups. Further details regarding the summary statistics of entries and exits at these more granular levels are available upon request.

Race-specific house price index and housing returns We construct quarterly MSA-level repeat sale House Price Index series using the linked CoreLogic-HMDA data for different races. To do so, we extend the canonical log-linear model of house price change by allowing the average appreciation in housing value to differ by homeowner race. Specifically, we estimate the following model separately for each MSA l using our repeat sale sample:

$$\log p_{i,l,t'} - \log p_{i,l,t} = \sum_{r \in \{White, Black, Hispanic\}} (b^r_{l,t'} - b^r_{l,t}) \mathbf{1}(\text{Homeowner Race}_{i,t,t'} = r) + \varepsilon_{i,l,t,t'}.$$

In the equation above, t' and t are the sale and purchase quarter, respectively; $p_{i,l,t'}$ and $p_{i,l,t}$ are the sale and purchase price of house i, respectively; $\mathbf{1}(\text{Homeowner Race}_{i,t,t'}$ is an indicator that equals 1 if the homeowner of house i between t and t' is of race r; $\varepsilon_{i,l,t,t'}$ is an idiosyncratic shock with mean zero. $b^r_{l,\cdot}$ are coefficients to be estimated, with $b^r_{l,t}$ representing log HPI of race r in MSA l and quarter t. Notice that $b^r_{l,t'} - b^r_{l,t}$ is the average appreciation in housing value for race r. If the average appreciation in housing value is common across racial groups, the estimated log HPI series ($b^r_{l,t}$) should be the same across r. Conversely, if the estimated log HPI series differ by racial

Table 3: Summary Statistics of Key Variables at the MSA-Quarter-Race Level

(a) non-Hispanic White	count	mean	sd	p10	p50	p90
Entry	10,831	582.1	756.6	78.0	327.0	1358.0
Exit	12,425	528.9	692.1	43.0	287.0	1344.0
Entry Dollar Volume	10,831	155683.5	235253.1	15414.1	73674.6	385558.0
Exit Dollar Volume	12,425	167630.6	291602.2	6592.0	64300.0	461153.1
FHA Share (%)	10,831	19.7	14.4	2.4	17.8	40.3
Average LTV (%)	10,828	82.0	8.1	69.4	83.9	90.3
Average Mortgage Rate (%)	9,457	5.2	1.7	3.2	5.2	7.5
(b) non-Hispanic Black	count	mean	sd	p10	p50	p90
Entry	10,429	54.8	157.9	2.0	16.0	126.0
Exit	11,636	52.6	121.8	2.0	16.0	131.0
Entry Dollar Volume	10,429	10886.6	34746.2	373.0	2947.7	21744.0
Exit Dollar Volume	11,636	10197.4	24814.3	270.9	2518.0	25123.4
FHA Share (%)	10,429	33.7	28.1	0.0	30.0	72.2
Average LTV (%)	10,417	88.0	11.3	70.6	91.7	98.4
Average Mortgage Rate (%)	4,963	6.8	2.0	3.8	7.1	9.1
(c) Hispanic	count	mean	sd	p10	p50	p90
Entry	10,687	102.2	296.0	3.0	22.0	240.0
Exit	11,645	95.0	240.4	3.0	20.0	243.0
Entry Dollar Volume	10,687	25431.3	104732.1	489.5	3614.9	49256.9
Exit Dollar Volume	11,645	22978.8	67275.3	318.0	3140.3	57311.4
FHA Share (%)	10,687	34.5	26.2	0.0	33.3	69.7
Average LTV (%)	10,683	86.9	10.6	70.4	90.0	96.9
Average Mortgage Rate (%)	5,486	6.3	1.9	3.5	6.6	8.7

Notes: Entry and Exit represent the raw counts of home purchases and sales at the MSA-quarter-race level. Entry and Exit Dollar Volume refers to the aggregated prices of home purchases and sales at the MSA-quarter-race level, measured in thousands of dollars. Average Mortgage Rate represents the average interest rate of 30-year conventional mortgages for each MSA-quarter-race combination. FHA and ARM Share denote the share of mortgages that are FHA-insured and adjustable-rate mortgages, respectively, at the MSA-quarter-race level. Average LTV is the average loan-to-value ratio computed at the MSA-quarter-race level.

groups, we know that different racial groups experience unequal returns of homeownership. We estimate the coefficients $b^r_{l,\cdot}$ using linear regression on MSAs with at least 200 complete ownership spells for each race that we study.[9] We adopt an interval weighting procedure that uses as weights the reciprocal of the standard deviation of the prediction error by quantiles of the length of the ownership spell. We then construct (nominal) HPI series and housing returns from estimated $b^r_{l,\cdot}$ for different races.[10]

Similar to the approach taken with entries and exits of homeownership, we also generate more detailed HPIs by incorporating additional criteria, specifically considering both race and neighborhood White population share or both race and income. Further details regarding the summary statistics of HPIs at these more granular levels are available upon request.

To check if our CoreLogic-HMDA repeat sale sample is reasonably representative, for each MSA we estimate an all-race HPI by pooling all repeat sales together regardless of race, calculate the all-race housing returns at different horizons and compute the correlation of these returns and the housing return implied by the FHFA All Transaction Index.[11] Table 4 reports the summary statistics of these MSA-level correlations at 4, 8 and 20 quarter horizons. We can see that our index tends to correlate closely with the FHFA All Transaction Index over the long term, but short-term differences can be significant. This is not unique to our index: different indices provided by FHFA also have a smaller short-run correlation than the long-run correlation.[12] The full list of the 140 MSAs as well as the correlations between our all-race HPI and FHFA All Transaction Index by MSA can be found in the Appendix.

Finally, we also estimate race-specific HPIs at the national level, shown in Figure 1. Table 5 provides summary statistics of the national HPIs for White, Black, and Hispanic groups. The first two columns document the mean and variance of quarterly housing returns for different racial groups. It is evident that White homeowners enjoyed a higher and less variable return in housing. The last three columns document the correlations of quarterly housing return and output gap with 4, 8 and 20 quarters lead. We find that exceptionally high housing returns usually predate a positive output gap, and the relationship is similar across racial groups.

[9] $b^r_{l,t}$ is normalized to 0 in the base year for all races.

[10] Housing returns in this paper refer to average appreciations in housing value, calculated as log differences of HPIs at different points in time.

[11] FHFA All Transaction Index data come from https://www.fhfa.gov/DataTools/Downloads/Pages/House-Price-Index-Datasets.aspx#qat.

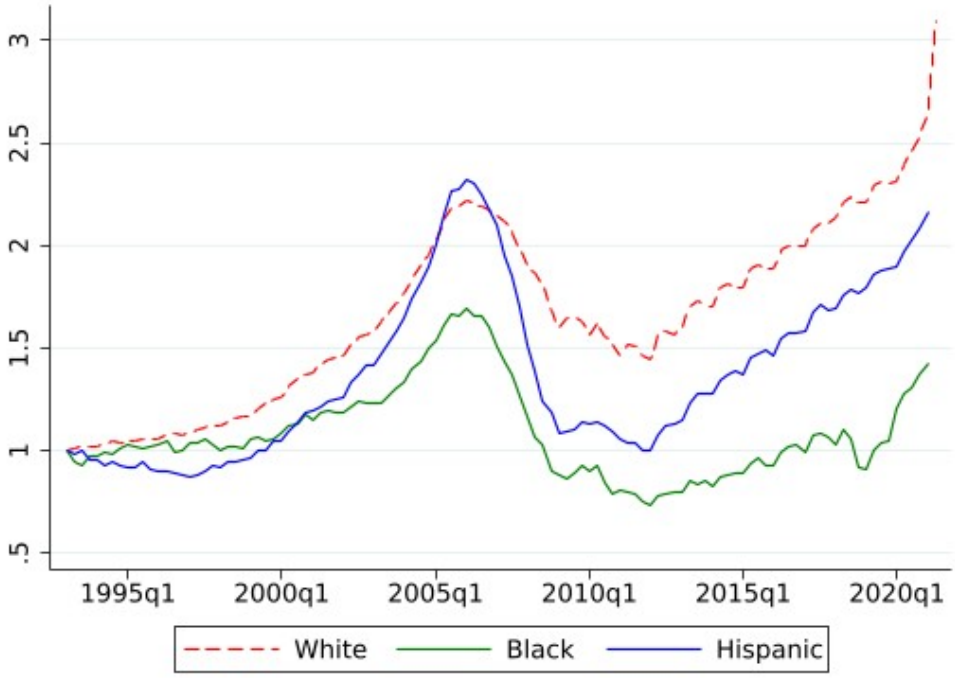
[12] See details at https://www.fhfa.gov/Media/PublicAffairs/Pages/House-Price-Index-Frequently-Asked-Questions.aspx.

Table 4: Housing Return Correlations between CoreLogic-HMDA All-Race and FHFA Indices

	count	mean	sd	p10	p50	p90
Return correlation: 4 quarters	140	0.61	0.29	0.20	0.68	0.93
Return correlation: 8 quarters	140	0.70	0.28	0.29	0.81	0.96
Return correlation: 20 quarters	140	0.76	0.31	0.35	0.89	0.97

Notes: For each of the 140 MSAs, we compute housing returns at 4, 8 and 20 quarter horizons using two indices: the CoreLogic-HMDA All-Race HPI and the Federal Housing Finance Agency (FHFA) All Transaction Index. In this table, we present the count, mean, standard deviation and the 10th, 50th and 90th quantiles of the correlations between the returns.

Figure 1: Race-Specific HPIs at the National Level



Notes: This figure plots the time series of point estimates of race-specific nominal HPIs at the national level. All indices are normalized to 1 in 1993 Q1.

Table 5: Summary Statistics of the National HPIs for White, Black, and Hispanic Groups

	mean	Var	corr with Δy:		
			lead 4	lead 8	lead 20
White	1.00	7.96	0.23	0.30	0.04
Black	0.32	18.08	0.08	0.30	0.08
Hispanic	0.69	12.86	0.26	0.36	0.05

Notes: This table presents the mean and variance of quarterly returns implied by national race-specific HPIs and the correlation between quarterly returns and the output gaps at 4, 8 and 20 quarters ahead. The quarterly returns are calculated as log differences of HPIs between two consecutive quarters, in percentage. The output gap is computed as 100*(GDP - potential GDP)/potential GDP, where the quarterly GDP and potential GDP are obtained from Federal Reserve Economic Data (tickers: GDPC1 and GDPPOT).

1.2 Other regional data

Racial composition To account for racial composition, we use county-year level population data by race and Hispanic origin from the Survey of Epidemiology and End Results (SEER) database and aggregate it to city-year level.[13]. For aggregation, we use the 2018 county-to-MSA crosswalk provided by the U.S. Census Bureau's website,[14], which is the same as those employed in the most recent FHFA HPI report.

Lender concentration To capture the level of lender competitiveness, we adopt the approach of Scharfstein and Sunderam (2013) and construct city-level lender competitiveness measures. These measures are based on the share of mortgages held by the top four lenders in each area and are obtained from HMDA data at the city-year level. Additionally, we compute the Herfindahl–Hirschman Index as an alternative measure of lender concentration.

Labor market We use two primary data sources to capture labor market conditions. First, we collect quarterly city-level unemployment rates from the U.S. Bureau of Labor Statistics' Local Area Unemployment Statistics (LAUS) program. Second, we obtain quarterly city-level employment statistics by race from the U.S. Census Bureau's Quarterly Workforce Indicators (QWI) program. QWI is constructed from the Longitudinal Employer Household Dynamics data and provides insights into the labor market dynamics of different racial groups within each city. The vari-

[13] SEER data are downloaded from https://seer.cancer.gov/popdata/.

[14] https://www.census.gov/geographies/reference-files/time-series/demo/metro-micro/historical-delineation-files.html.

ables we use are the full-quarter employment (stable), end-of-quarter hiring rate, and beginning-of-quarter separation rate.

Income and earnings To examine income and earnings levels, we draw upon two main data sources. The annual nominal per capita income at the city level is obtained from the U.S. Bureau of Economic Analysis. Additionally, for each racial group, we obtain average earnings data from the QWI program, allowing us to analyze differences in earnings across racial categories.

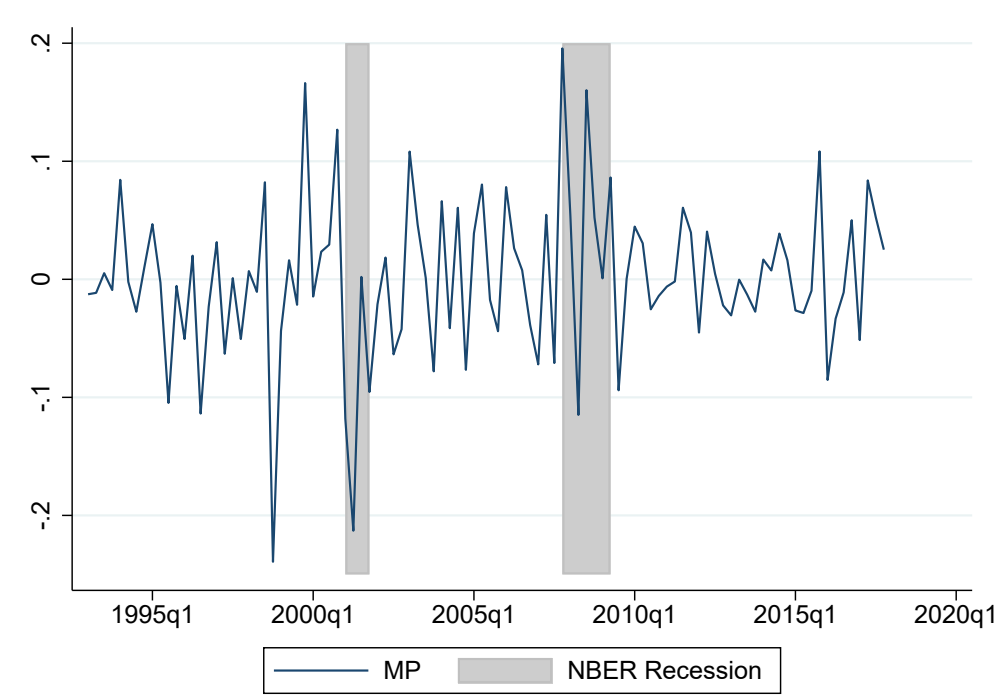
1.3 Monetary policy shocks

We use the monetary policy shock series provided by Bauer and Swanson (2023). The author constructs these shocks by analyzing the changes in various asset prices surrounding each Federal Open Market Committee (FOMC) announcement. Specifically, they consider the changes in the current month's federal funds rate (MP1), three-month ahead federal funds futures (FF4), and two-, three-, and four-quarter-ahead Eurodollar futures. The shocks are then orthogonalized with respect to pre-announcement macroeconomic and financial data.

To standardize the shock series, we employ a normalization procedure where a one-unit increase in the monetary policy shock corresponds to a 100 basis point change in the intraday fluctuations of three-quarter-ahead Eurodollar future. Positive values of the shock indicate a contractionary monetary policy stance. For further details on the impact of the shocks on various financial market instruments, please refer to the Appendix.

To convert the monetary policy shocks to a quarterly frequency, we aggregate all meeting-frequency shocks that occur within each quarter. The resulting quarterly shock series are visualized in Figure 2. Furthermore, to ensure the robustness of our result, we also repeat our analysis using alternative measures of monetary policy shocks. The details of these alternative measures and the related analysis are outlined in the Appendix.

Figure 2: Monetary Policy Shock at Quarterly Frequency



Notes: This figure plots the quarterly series of the monetary policy shocks. The shocks are first computed at meeting frequency where a one-unit increase in the shock corresponds to a 100 basis point change in the three-quarter-ahead Eurodollar future. To obtain quarterly frequency, we sum the meeting frequency shocks for that quarter. Positive values correspond to contractionary monetary policy shocks.

2 Main Findings

We investigate the causal dynamic effect of monetary policy shocks on entry and exit of homeownership in subsection 2.1 and explore potential mechanisms in subsection 2.2. We then investigate the effect on housing returns in subsection 2.3 and discuss the role of housing segregation in subsection 2.4. Finally, we briefly summarize the various robustness checks we have conducted in subsection 2.5.

2.1 Entry and exit

First, we focus on the effects of monetary policy on the entries and exits of homeownership. We employ the local projections method of Jordà (2005). Our empirical specification is as follows:

$$\text{Outcome}_{l,r,t+h} = \beta_r^{(h)} \text{MP}_t + \text{controls} + \text{error}_{l,r,t}^{(h)}, \quad h = 0, 1, 2, \ldots \tag{1}$$

In Equation (1), the $\text{Outcome}_{l,r,t+h}$ represents the log of the total entries or exits for the specific racial group r in city l during quarter $t+h$. The controls include four lagged values of the following variables: the first difference of Outcome for each racial group, city-level racial compositions, the log of the employment of each racial group, nominal per capita income and lender competitiveness and city fixed effects. The error term $\text{error}_{l,r,t}^{(h)}$ captures unobserved factors and random variation. The inclusion of the first difference of the log entries or log exits addresses potential serial correlations in unobserved factors that impact housing demand. Incorporating the city-level racial compositions as control variables is crucial to account for the influence of inflows and outflows of minorities on housing demand within a city. Controlling the level of employment and nominal per capita income is relevant because past employment and income levels have direct effects on housing demand. Lender competitiveness can also affect housing demand through its impact on the degree of interest rate pass-through. Furthermore, city fixed effects are included in the model to control for unobserved heterogeneity across cities and capture the city-specific characteristics that may influence housing demand. The incorporation of fixed effects ensures that the analysis focuses on the within-city variations resulting from changes in monetary policy.

As explained in Jordà (2005), the identification assumption for the response of the dependent variable at time $t+h$ is that the shock variables are independent (conditional on other controls). Under this assumption, the local projection identifies the dynamic response of the dependent vari-

able to the monetary policy surprises. In the Appendix we also explore the local projections with the instrumental variable (LP-IV) approach. Our results are qualitatively robust.

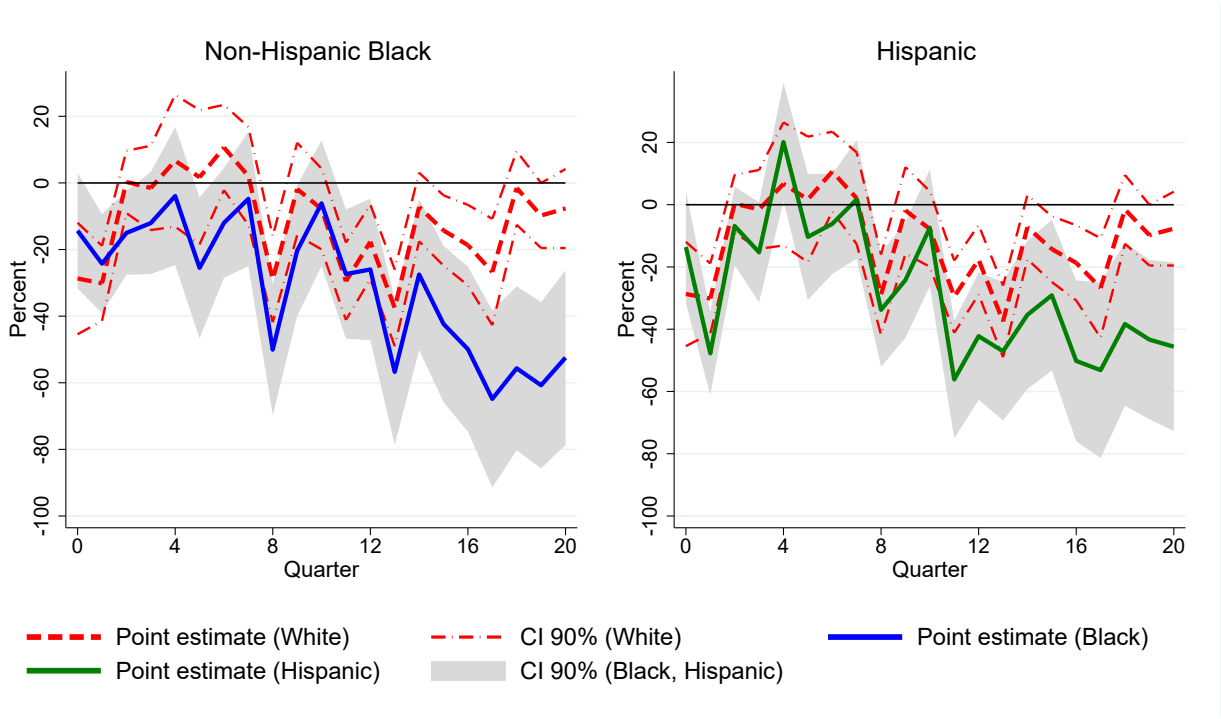
Our coefficient of interest is $\beta_r^{(h)}$, which measures the percentage change in home entries or exits for a specific race/ethnicity group r after h quarters of a unit contractionary monetary policy shock. By employing this specification, we aim to examine the impact of monetary policy shocks on the dynamics of homeownership entries and exits for different racial and ethnic groups. Since we have gaps in the observational data for entries and exits, we use their values at horizon h instead of cumulative entries and exits up to h quarters.

Figure 3 presents the regression results for entries into homeownership. The left panel depicts the responses of non-Hispanic Black individuals using a solid blue line, while the right panel illustrates Hispanic responses with a solid green line. Additionally, on both panels, the responses of non-Hispanic White homeowners are represented using a red dashed line. Our analysis reveals that contractionary shocks have a negative effect on housing entries across all races. However, a notable gap between minority and White households becomes apparent after 13 quarters. Specifically, White entries of homeownership decrease by 19%, whereas both Black and Hispanic entries of homeowners experience a substantial drop of approximately 50%. Our findings reveal significant heterogeneity: a one-unit monetary tightening shock leads to an additional 31% lower entry into homeownership for minorities in 16 quarters, compared to that of White homeowners.

In Figure 4, we present the regression results regarding the exits of homeownership. The analysis reveals that there is a decrease in exits following contractionary shocks. For White homeowners, there is a 1% drop in exits after 4 quarters, which further escalates to a 30% drop after 12 quarters. Importantly, the impact of contractionary shocks on the exits of homeownership is similar across different racial groups.

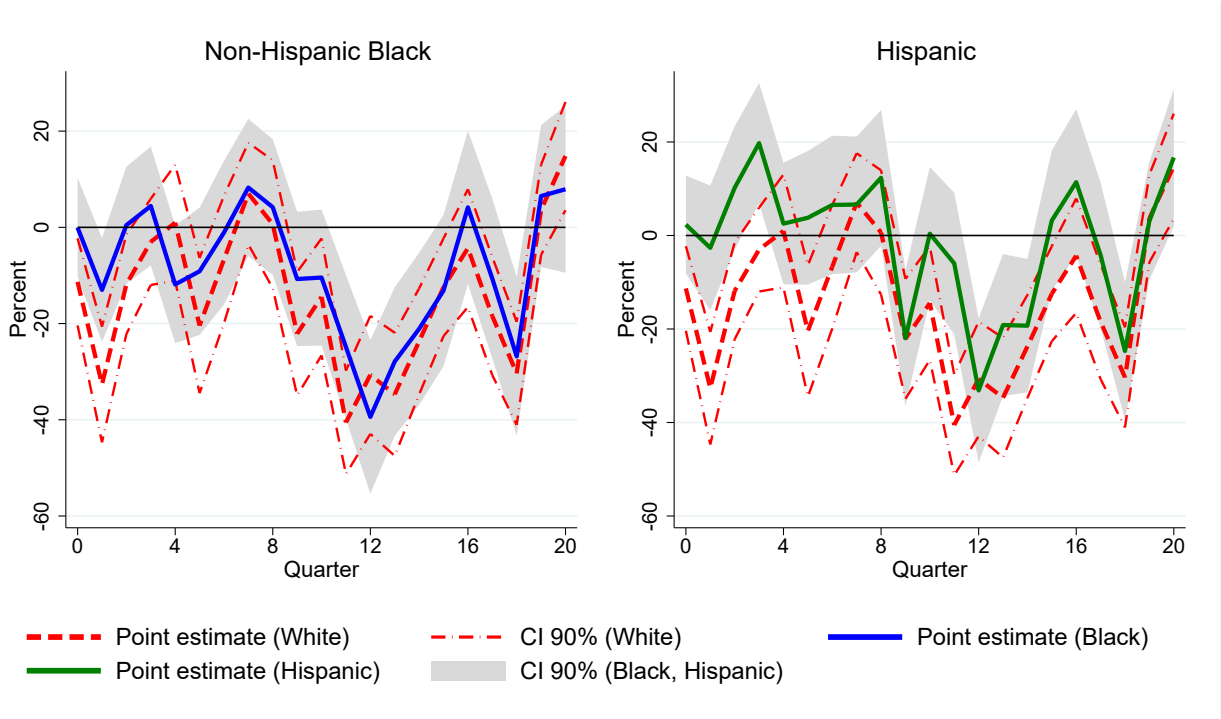
The results obtained thus far suggest that contractionary monetary shocks lead to relatively lower housing demand from minority households. These findings provoke a deeper inquiry: what underlying factors contribute to the pronounced disparity in homeownership entries between White and minority households after monetary policy shocks? To better understand these underlying factors, in the next subsection we explore potential transmission mechanisms of monetary policy to the housing market.

Figure 3: The Responses of Entry to Monetary Shock, by Race



Notes: The figure presents the responses of the log total entry when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1). The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

Figure 4: The Responses of Exit to Monetary Shock, by Race



Notes: The figure presents the responses of the log total exit when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1). The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

2.2 Potential mechanisms

Specifically, we examine two important factors that affect housing demand: employment/earnings and financing costs. By investigating these channels, we aim to gain insight into the mechanisms through which monetary policy impacts the housing market and how these effects may vary among different racial groups.

Changes in mortgage interest rates represent a direct and significant transmission mechanism through which monetary policy influences the housing market. Lower mortgage interest rates reduce the cost of borrowing for homebuyers, making mortgages more affordable. This can incentivize individuals to purchase homes, thereby stimulating housing demand. If the pass-through of the policy rate to mortgage interest rates is stronger for minority households compared with White households, it could explain why minorities tend to respond more strongly to monetary policy shocks.

To test if there are differential pass-throughs of monetary policy by race, we use the CoreLogic-HMDA merged data to obtain average mortgage rates at home purchases by city, quarter and race. We then employ local projections to examine the responses of race-specific average mortgage rates to monetary policy shocks. The estimation process involves estimating specifications similar to Equation (1), but with the outcome variable replaced by average mortgage rates. The average mortgage rate data used in our study has fewer observations compared to other variables, so in this regression we only control two lags for the mortgage rate: the log of housing price for three racial groups and the log employment for three racial groups. Other control variables are the same as before: city fixed effects and four lagged values of the city-level racial compositions, nominal per capita income, and lender competitiveness.

Figure 5 displays the responses of average mortgage rates for the three racial groups. Notably, our analysis reveals minimal differences in the pass-through of monetary policy by race. It is important to acknowledge that our data limitation could explain the lack of significant racial differences in the observed pass-through effects. Further investigation using alternative data sources, such as rate lock data, may provide more comprehensive insights into the potential racial disparities in monetary policy pass-through to mortgage rates.

Another important channel through which monetary policy affects the housing market is via the labor market. Individuals need a stable job to apply for mortgages (Munnell et al., 1996). Typically, gaining mortgage approval necessitates a work history spanning at least two years. If a person is currently unemployed or has a job duration short of two years, their mortgage applications

are usually subject to more scrutiny.[15] Contractionary monetary shocks can lead to declines in aggregate demand and reductions in job vacancies. This, in turn, may result in unemployment or shorter job duration for individuals, which can discourage people from pursuing home ownership. If the labor market outcomes of minority workers demonstrate a stronger response to monetary policy shocks compared with White workers, these outcomes could contribute to a larger impact on housing demand and subsequently on housing market outcomes for minority households.[16]

To examine the transmission of monetary policy through the labor market, we use the Quarterly Workforce Indicators (QWI) data to construct MSA-level employment and average earnings data by race. We then employ local projections to analyze the responses to monetary policy shocks.

Figure 6 presents the impact of a one-unit contractionary monetary policy shock on log of total employment for different racial groups after h quarters. The results reveal that after 8 quarters, employment for White individuals experiences a drop of 1.9% following the contractionary monetary policy shock. In comparison, the drops for Black and Hispanic employment are notably larger, at 3.2% and 3.9%, respectively. After 12 quarters, employment for White workers decreases by 3.4%, while the drops for Black and Hispanic workers are 7% and 6.2%, respectively. These findings suggest that the negative impact of contractionary monetary policy on employment is more pronounced for Black and Hispanic workers compared to their White counterparts. After 16 quarters, the gap is about 4% for both Black and Hispanic workers compared with White workers. In the Appendix, we further show that the main driving force of the employment dynamic heterogeneity is the hiring process rather than the separation process.

It is important to underscore that racial disparities in labor market reactions become apparent approximately 11 quarters following a monetary shock. This timing precedes the emergence of racial disparities in housing market results, which manifest around 13 quarters after a monetary shock. The fact that racial disparities in the labor market predate those in the housing market is indicative of a possible causality link: given that steady employment is vital for mortgage approval, the labor market disparities can subsequently prevent more minorities from entering the housing market.

Figure 7 focuses on the effects of a one-unit contractionary monetary policy shock on log of average earnings for different racial groups after h quarters. In contrast to the employment results, we observe minimal disparity among the average earnings responses of minority and White

[15] See also https://mfmbankers.com/job-changes-and-other-factors-that-affect-the-home-buying-process/.

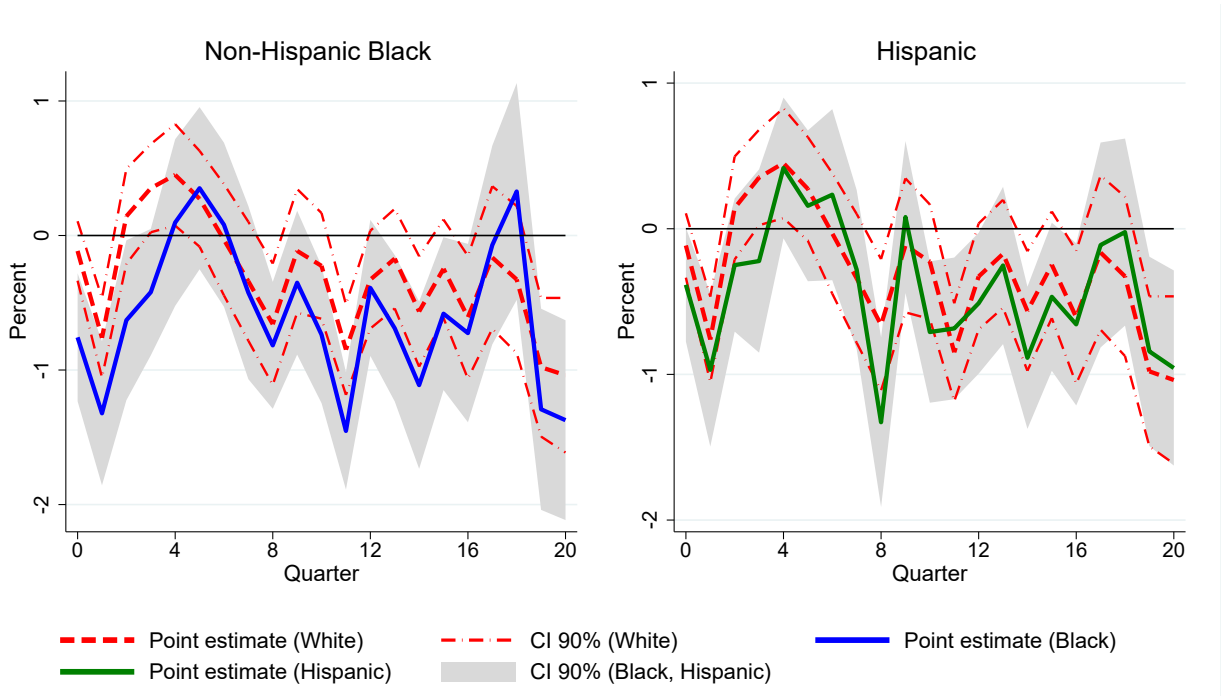
[16] Research conducted by Bergman et al. (2022) has shown that certain populations, such as Blacks, high school dropouts, and women, tend to be more responsive to monetary policy.

workers.

Overall, our analysis suggests that the heterogeneous responses in employment among different racial groups, rather than differences in interest rate pass-through, may account for the greater sensitivity of minority households' housing returns and entries of homeownership to monetary policy tightening. This implies that the labor market can be an important channel in shaping the housing market dynamics for minority groups in response to monetary policy changes.

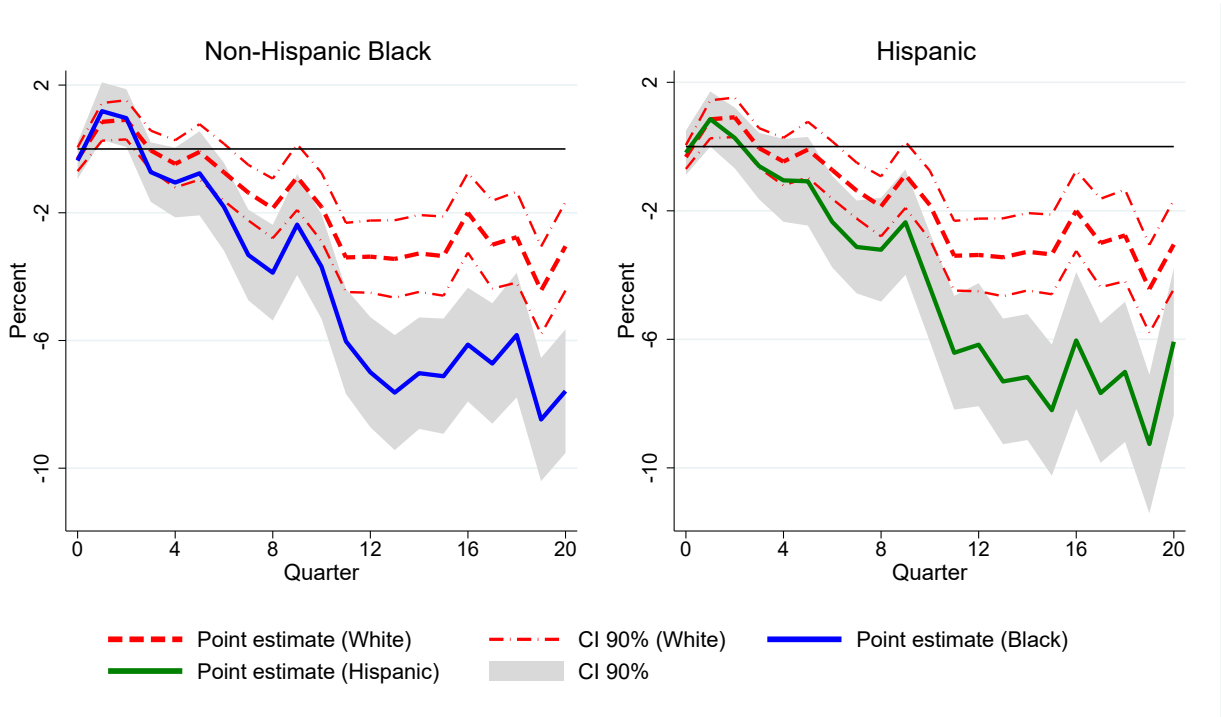
However, it is important to acknowledge that there may be additional factors contributing to the observed heterogeneity. For example, racial differences in the propensity to refinance mortgages, levels of financial literacy and non-interest financing costs could also influence housing market responses to monetary policy among different racial groups. Considering these factors would provide a more comprehensive understanding of the dynamics within the housing market and help further explain the observed racial heterogeneity in responses to monetary policy.

Figure 5: The Responses of Average Mortgage Rate to Monetary Shocks, by Race



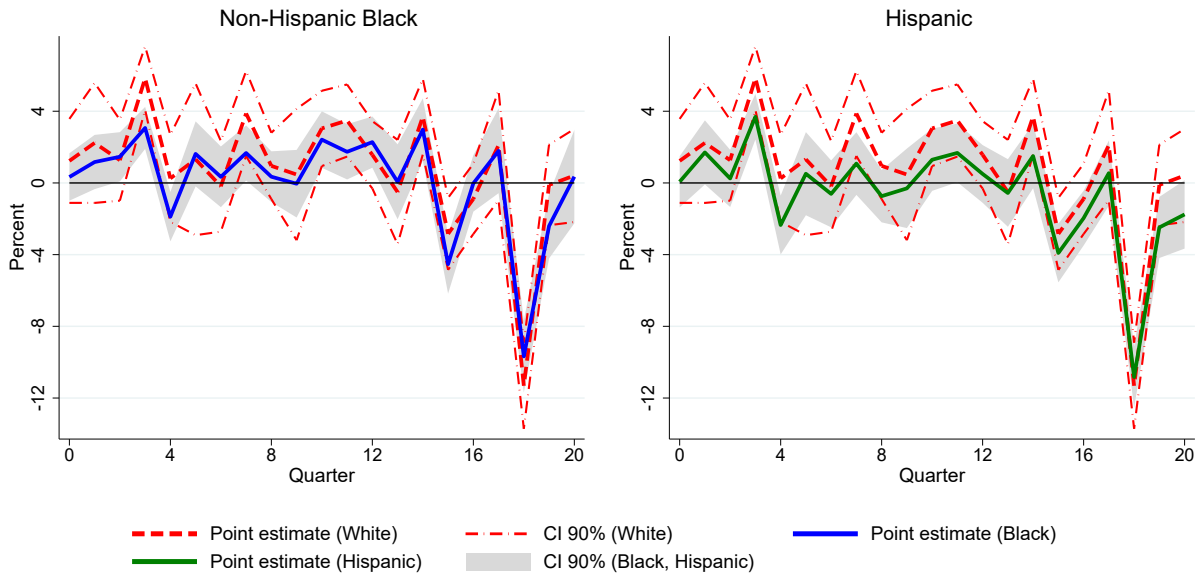
Notes: The figure presents the responses of the average mortgage rate at purchase when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1). The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

Figure 6: The Responses of Employment to Monetary Shocks, by Race



Notes: The figure presents the responses of the change in log employment when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (2). The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

Figure 7: The Responses of Earnings to Monetary Shocks, by Race



Notes: The figure presents the responses of the log average earnings when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1). The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

2.3 Housing returns

After observing a decline in housing demand from minority households following monetary tightening, in this section we examine if a decrease in demand is linked to a drop in housing returns. The empirical specification for each race r is as follows:

$$\log(\text{HPI}_{l,r,t+h}) - \log(\text{HPI}_{l,r,t-1}) = \beta_r^{(h)} \text{MP}_t + \text{controls} + \text{error}_{l,r,t}^{(h)}, \quad h = 0, 1, 2, \ldots \tag{2}$$

In Equation (2), $\log(\text{HPI}_{l,r,t+h}) - \log(\text{HPI}_{l,r,t-1})$ represents the cumulative change in the log of the HPI for racial group r in city l from period $t-1$ to $t+h$. The term MP_t denotes the monetary policy surprise at quarter t. The control variables controls include four lagged values of the following variables: the first difference of $\log(\text{HPI})$ for each racial group, city-level racial compositions, the log of the employment of each racial group, nominal per capita income and lender competitiveness

(measured by the share of mortgages by the top four lenders). Furthermore, city fixed effects are included in the model to control for unobserved heterogeneity across cities and capture the city-specific characteristics that may influence housing prices. The incorporation of fixed effects ensures that the analysis focuses on the within-city variations resulting from changes in monetary policy. $\text{error}_{l,r,t}^{(h)}$ is the error term. We use the total population in each MSA as weights. Finally, standard errors are clustered at the city by year level to account for potential correlations within the same city and year.

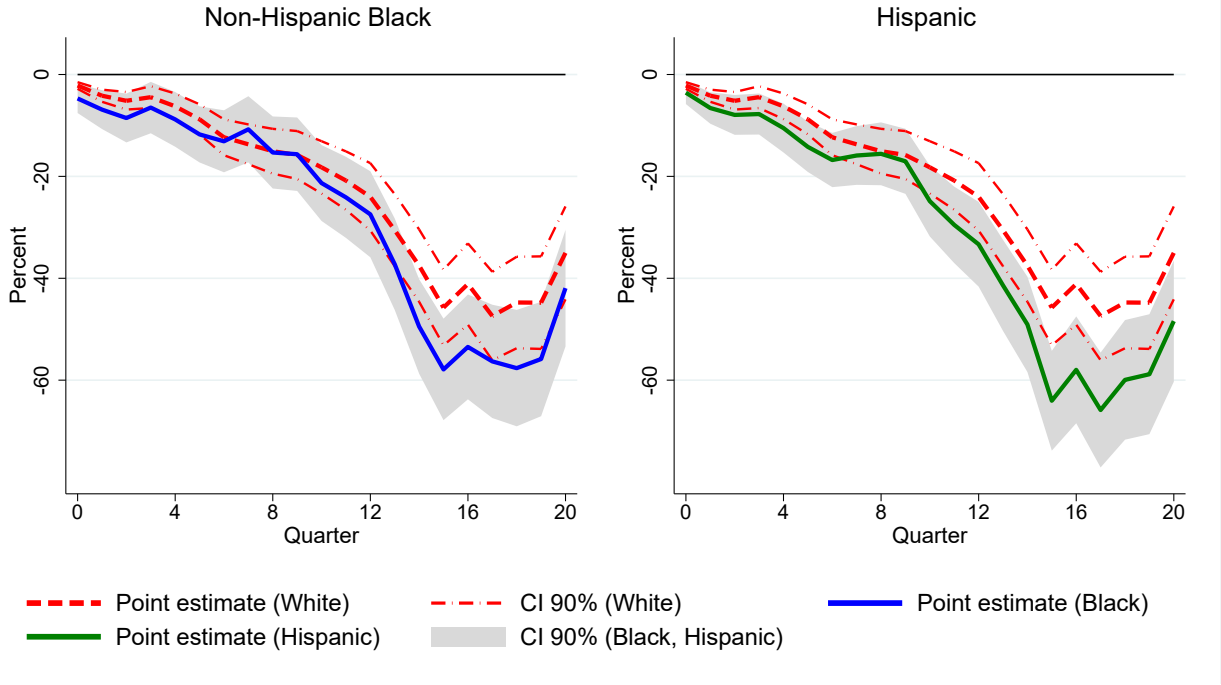
In Figure 8 we depict $\beta_r^{(h)}$, representing the cumulative effect of a one-unit contractionary monetary policy shock on housing returns for different racial groups after h quarters. The graph illustrates that contractionary monetary policy shocks have a negative impact on housing prices across all racial groups. However, there are significant variations among racial groups. After 4 quarters, housing returns for White homeowners decrease by 6.2%. In comparison, the drops for Black and Hispanic homeowners are notably larger at 8.8% and 10.5%, respectively. The largest discrepancies occur at 16 quarters, with housing returns for White homeowners falling by 41%. In contrast, the drops for Black and Hispanic homeowners are considerably greater, at 58% and 53%, respectively. We perform a separate test for the difference between the two estimates, and it is statistically significant at the 10% level. Our findings reveal significant heterogeneity: a one-unit monetary tightening shock leads to an additional 15% lower housing return for minority households within 16 quarters, compared to that of White households.

To ensure the robustness of our results, we also conducted an additional analysis using real house price indices. To achieve this, we divided the city-level HPI by the national Consumer Price Index (CPI) to adjust for inflation, representing housing prices in real terms. Despite this adjustment, the results from this alternative approach remained qualitatively and quantitatively similar to our main findings. This consistency provides additional support for the reliability of our conclusions. The results can be found in the Appendix.

To provide context for our findings, we compare our estimated effects to those of earlier studies. Using 17 countries from post-Second World War to 2013, Williams (2016) found there is an 8% decrease in real house prices over a two-year period following a one-percentage-point exogenous increase in the short-term interest rate. In our study, using data from 1993 to 2017, we estimate that two years after a one-unit monetary policy shock, White households experience a decrease in cumulative real housing return of 13%, while Black and Hispanic households experience a decrease in real housing return of 16% and 18%, respectively. If we restrict the data to end in 2013, then the magnitude ranges from 1.9% to 4.3%. This suggests that our full sample estimated effects are a bit

higher than what is reported in the previous literature, which is probably due to the sample period. The results with a shorter sample period can be found in the Appendix.

Figure 8: The Responses of Housing Return to Monetary Shock, by Race



Notes: The figure presents the responses of the cumulative change in the log housing price index when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (2). The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

2.4 Effects of residential segregation

In an ideal market without barriers, a decreased housing demand from minority groups should consistently affect the housing returns of both minority and White demographics. Yet, our previous findings indicate a more pronounced effect on minority populations compared with Whites. What could account for this observable racial discrepancy in housing returns after a monetary shock? One plausible explanation might be the impact of racial segregation ingrained in the U.S. housing landscape. This section explores how racial disparities in housing outcome following a monetary shock vary across neighborhoods characterized by different racial compositions.

We start by classifying homeowners into three categories based on the non-Hispanic White population share within their census block group, thereby distinguishing neighborhoods with low, moderate and high concentrations of non-Hispanic White residents. Subsequently, we establish repeated housing price indices, along with entries and exits of homeownership, for each of the nine possible combinations of racial groups and neighborhood White population shares. We then repeat the analysis outlined in 2.1 and 2.3 for these distinct groupings.

Figure 9 illustrates the dynamics of housing entries by race and neighborhood White population share, following a one-unit contractionary monetary policy shock. The figure employs a two-by-three arrangement, with columns representing low, moderate and high levels of neighborhood White population shares. The upper panel's three subfigures depict the responses of non-Hispanic Black households, while the lower panel's subfigures show the responses of Hispanic households. Each of these subfigures includes the baseline responses of White households for comparison. Following a unit contractionary monetary policy shock, notable racial variations emerge in entries of homeownership within the same type of neighborhoods. In neighborhoods characterized by a large White population share, the entries of White homeowners decline by 22% after 16 quarters, while the entries of Black and Hispanic homeowners decrease by 40.2% and 37.2%, respectively. In neighborhoods with a small White population share, the entries of White homeowners decrease by 30.9% after 16 quarters. In contrast, the entries of Black and Hispanic homeowners decrease by 53.4% and 37.2%, respectively. These findings demonstrate that a contractionary monetary shock reduces housing demand from minority households relative to White households in all types of neighborhoods.

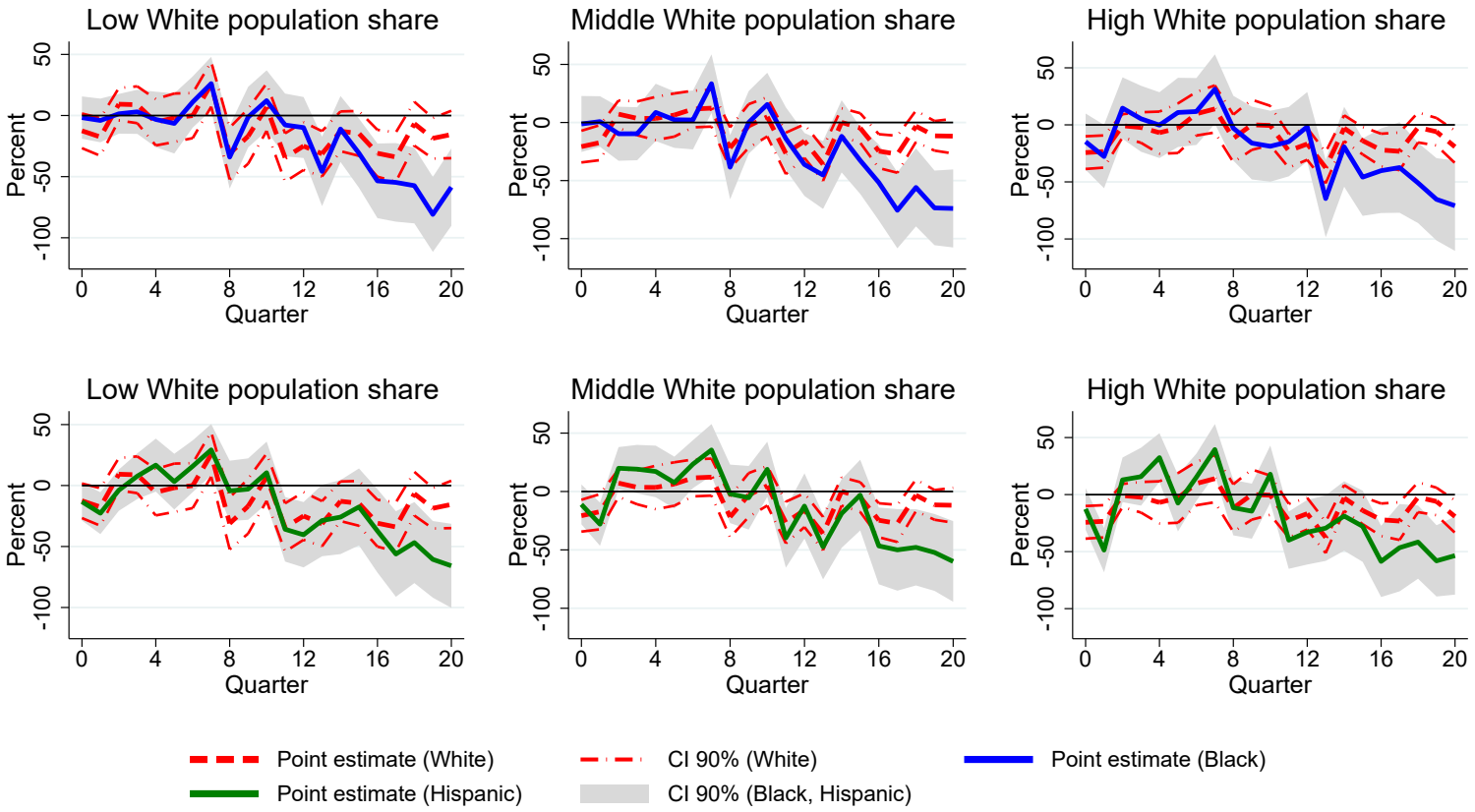
Figure 10 shows exits in response to monetary policy shocks. Unlike entries, we do not find significant differences in the response of exits between minority and White households living in similar neighborhoods.

Figure 11 presents the housing return dynamics based on race and neighborhood White population share, subsequent to a one-unit contractionary monetary policy shock. Unlike entries, there are no discernible differences in the housing return responses between minority and White households within similar neighborhoods. Instead, substantial divergence emerges across neighborhoods with varying racial compositions. Specifically, for White households residing in neighborhoods with the lowest White population share, the housing return experiences a decline of 58.6% after 16 quarters. In contrast, White households living in neighborhoods with middle and high White population shares witness decreases of 50.4% and 43.7%, respectively. These findings lead us to the conclusion that the excess sensitivity of minority housing returns to monetary policy is primarily

driven by the excess sensitivity of housing returns within minority neighborhoods. This is logical because even though a contractionary monetary shock reduces housing demand from minority households relative to White households across all types of neighborhoods, areas relying more on minority demand are more severely impacted than those less dependent on minority demand.

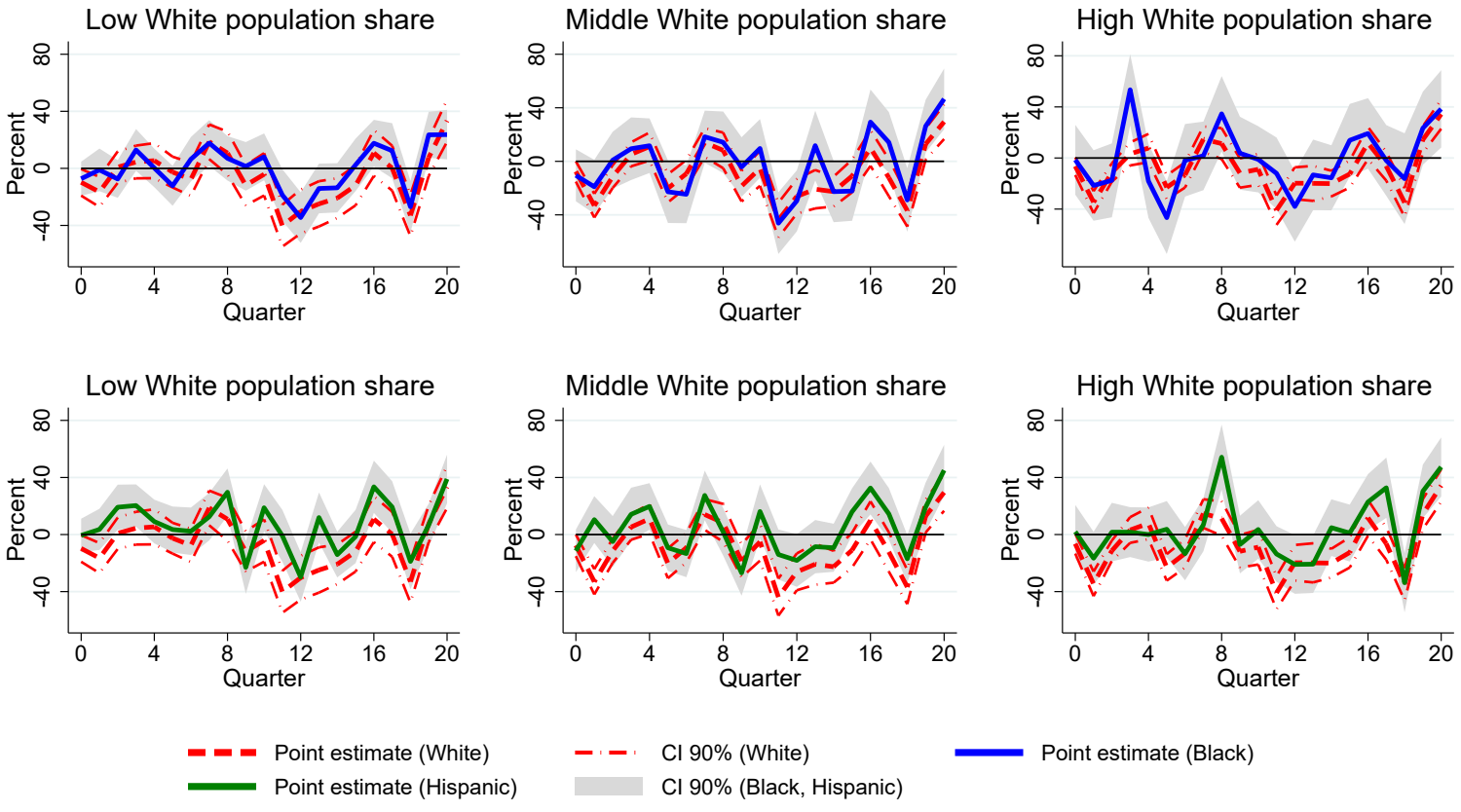
These findings indicate that the racial differences in the response of housing returns to monetary policy can be attributed to residential segregation by race. If the response heterogeneity is unaffected by residential segregation, uniform responses would be anticipated within each racial group across different neighborhood types. However, our analysis underscores a distinct pattern. The housing return response to monetary policy within a specific racial group is contingent upon the neighborhood's White population share. Specifically, housing returns for minorities in predominantly White neighborhoods exhibit less sensitivity to monetary policy compared with those in predominantly minority neighborhoods.

Figure 9: The Responses of Entry to Monetary Shock, by Race and Neighborhood White Population Share



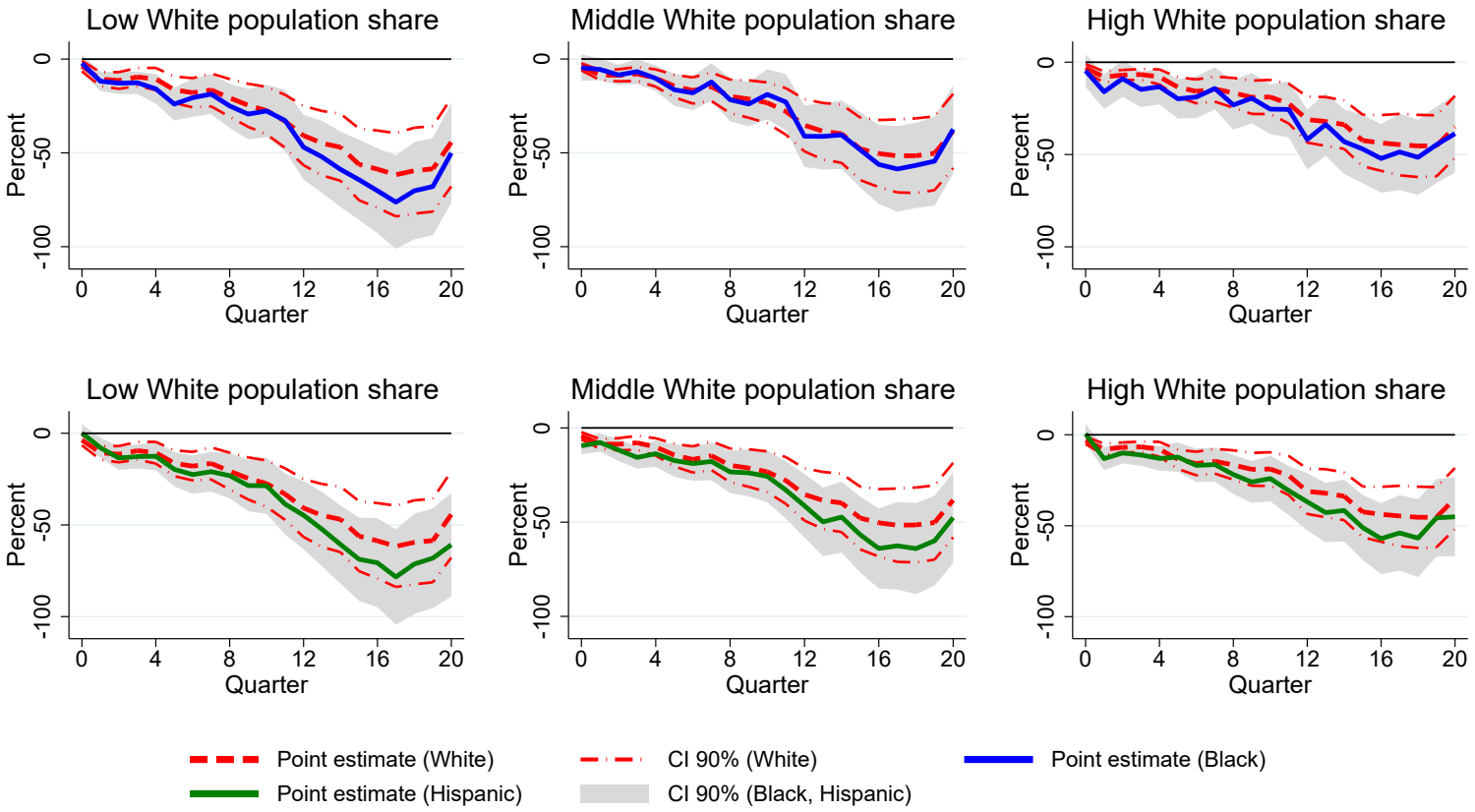
Notes: The figure displays the responses of log total entry to a one-unit increase in the monetary policy shock. The upper panel shows the responses for non-Hispanic Black households residing in areas characterized by low, middle and high non-Hispanic White population shares, respectively. The lower panel highlights the responses for Hispanic households living in similar areas. Additionally, each subplot incorporates the responses for White households residing within the same areas, illustrated by dashed lines. The responses are estimated using Equation 2, and the standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

Figure 10: The Responses of Exit to Monetary Shock, by Race and Neighborhood White Population Share



Notes: The figure displays the responses of log total exit to a one-unit increase in the monetary policy shock. The upper panel shows the responses for non-Hispanic Black households residing in areas characterized by low, middle and high non-Hispanic White population shares, respectively. The lower panel highlights the responses for Hispanic households living in similar areas. Additionally, each subplot incorporates the responses for White households residing within the same areas, illustrated by dashed lines. The responses are estimated using Equation 2, and the standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

Figure 11: The Responses of Housing Return to Monetary Shock, by Race and Neighborhood White Population Share



Notes: The figure displays the cumulative housing return responses to a one-unit increase in the monetary policy shock. The upper panel shows the responses for non-Hispanic Black households residing in areas characterized by low, middle and high non-Hispanic White population shares, respectively. The lower panel highlights the responses for Hispanic households living in similar areas. Additionally, each subplot incorporates the responses for White households residing within the same areas, illustrated by dashed lines. The responses are estimated using Equation 2, and the standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

2.5 Robustness check

We perform several separate robustness checks on the results presented in Section 2. Our results remain robust when we control for the four lags of the first four differences of log employment for racial groups instead of controlling for city-level unemployment rates, when we use the log average earnings by race instead of nominal income per capita, when we use HHI as an alternative measure of concentration, and when we include current quarter FHA share and ARM share for three racial groups. Furthermore, qualitatively similar results are obtained when we control for one lag of monetary policy shocks. We also explore alternative measures of monetary policy, and the results are consistent and provided in the Appendix. Lastly, our findings are robust to whether we use the total city population as weights or not. All the results are available upon request.

3 Further Discussion

3.1 Effects of income

It could be contended that the perceived racial disparity in responses to monetary policy is primarily a result of varying incomes among racial groups. In this section, we address this concern by examining differences in the impact of monetary policy based on race within a particular income bracket. We begin by categorizing homeowners into three income groups (low, middle and high). This classification is based on the quantiles of mortgage applicants' income for each city and quarter. Subsequently, we construct repeated housing price indices, as well as entries and exits of homeownership, for each of the nine combinations of race and income groups. Then, we repeat the analysis detailed in Section 2 for these nine groups.

In Figure 12, we present the results on entries for the nine income and racial groups. The figure is structured in a two-by-three format, with the columns representing the low-, middle- and high-income groups. The three subfigures in the upper panel plot the responses of non-Hispanic Black households, while those in the lower panel display the responses of Hispanic households. Within each of these subfigures, the responses of White households are also plotted as baselines for comparison.

Following a one-unit contractionary monetary policy shock, significant racial heterogeneity is observed in the entries of homeowners within the same income group. Among low-income households, the entries of White homeowners decrease by 15% after 16 quarters, while the entries

of Black and Hispanic homeowners experience a decline of 45%. Similarly, among high-income households, the entries of White homeowners decrease by 22% after 16 quarters. In comparison, the entries of Black and Hispanic homeowners decrease by 55% and 69%, respectively.

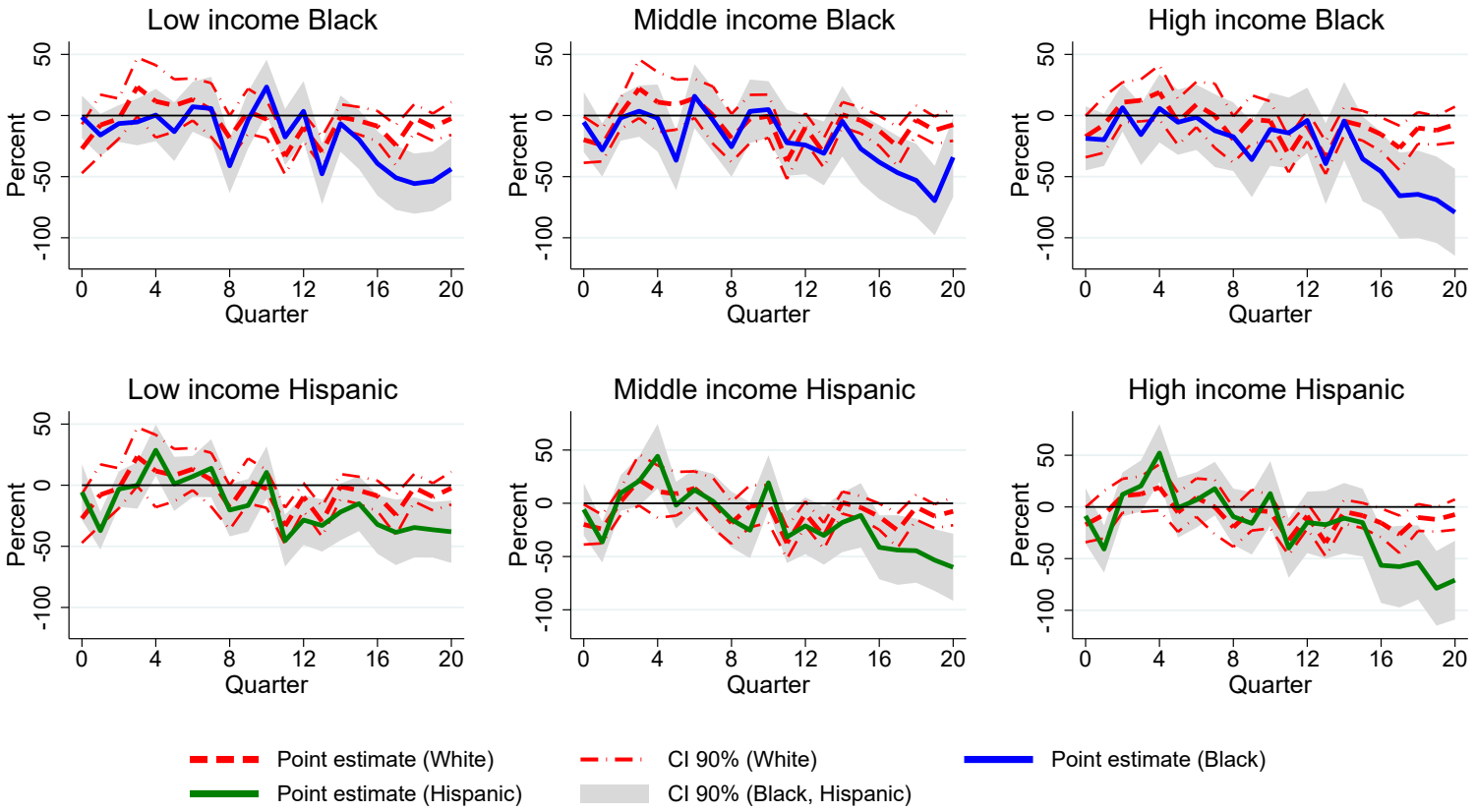
Figure 13 displays the responses of housing market exits to monetary policy shocks for the nine income and racial groups. The figure is again organized in a two-by-three format, with the columns dedicated to the low-income group, middle-income group and high-income group, respectively. In the initial quarters, we observe that White households tend to exit the market more than minority households, and these differences are statistically significant. However, as time progresses, the gaps diminish, and notably the majority of these estimates do not show statistically significant differences from each other. Therefore, we cannot conclude that exits of homeownership differ by race for a given income group in response to monetary policy.

In Figure 14, we present the housing return dynamics by race and income groups following a one-unit contractionary monetary policy shock. Following a one-unit contractionary monetary policy shock, housing returns drop across all nine groups. However, significant racial heterogeneity is observed within the same income group. Specifically, among high-income households, the housing return for White homeowners decreases by 8.5% after 4 quarters. In comparison, Black and Hispanic homeowners experience decreases of 14% and 8%, respectively. The most substantial differences emerge at 16 quarters, where the housing return for White homeowners falls by 43%, compared with approximately 60% for both Black and Hispanic homeowners.

These findings indicate that the impact of monetary policy on housing returns varies by race, even within the same income group. If the heterogeneity in response were solely driven by income, we would expect to observe identical responses within each income group across different races. However, our analysis reveals a different pattern. Across all income groups, the point estimates for White households tend to be smaller in absolute value than those for minority households, with occasional statistical significance.

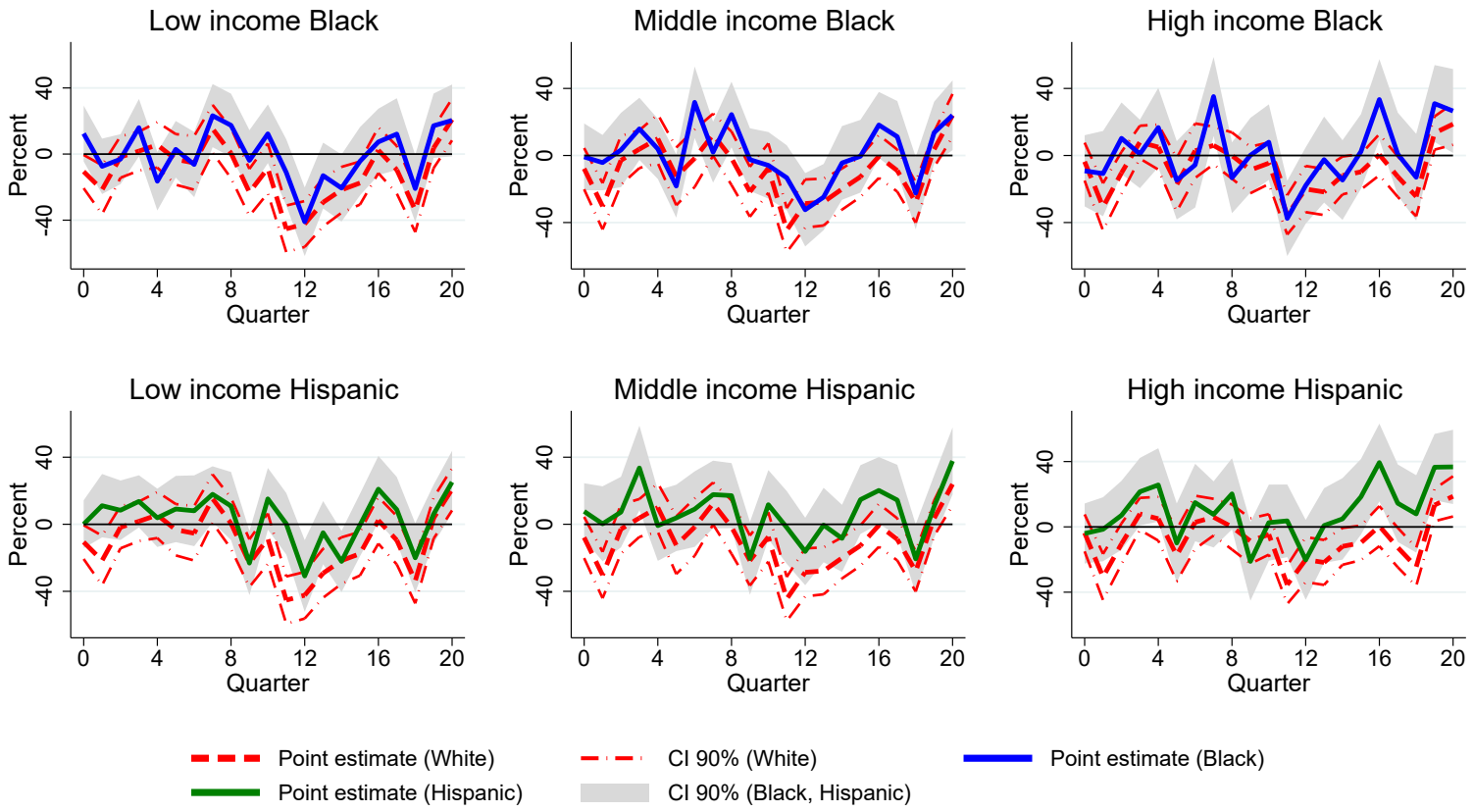
In summary, our analysis suggests that the effects of monetary policy on housing returns and entries display notable racial heterogeneity within a specific income group. However, we do not observe significant variations in housing exits among different race and income groups.

Figure 12: The Responses of Entry to Monetary Shock, by Race and Income



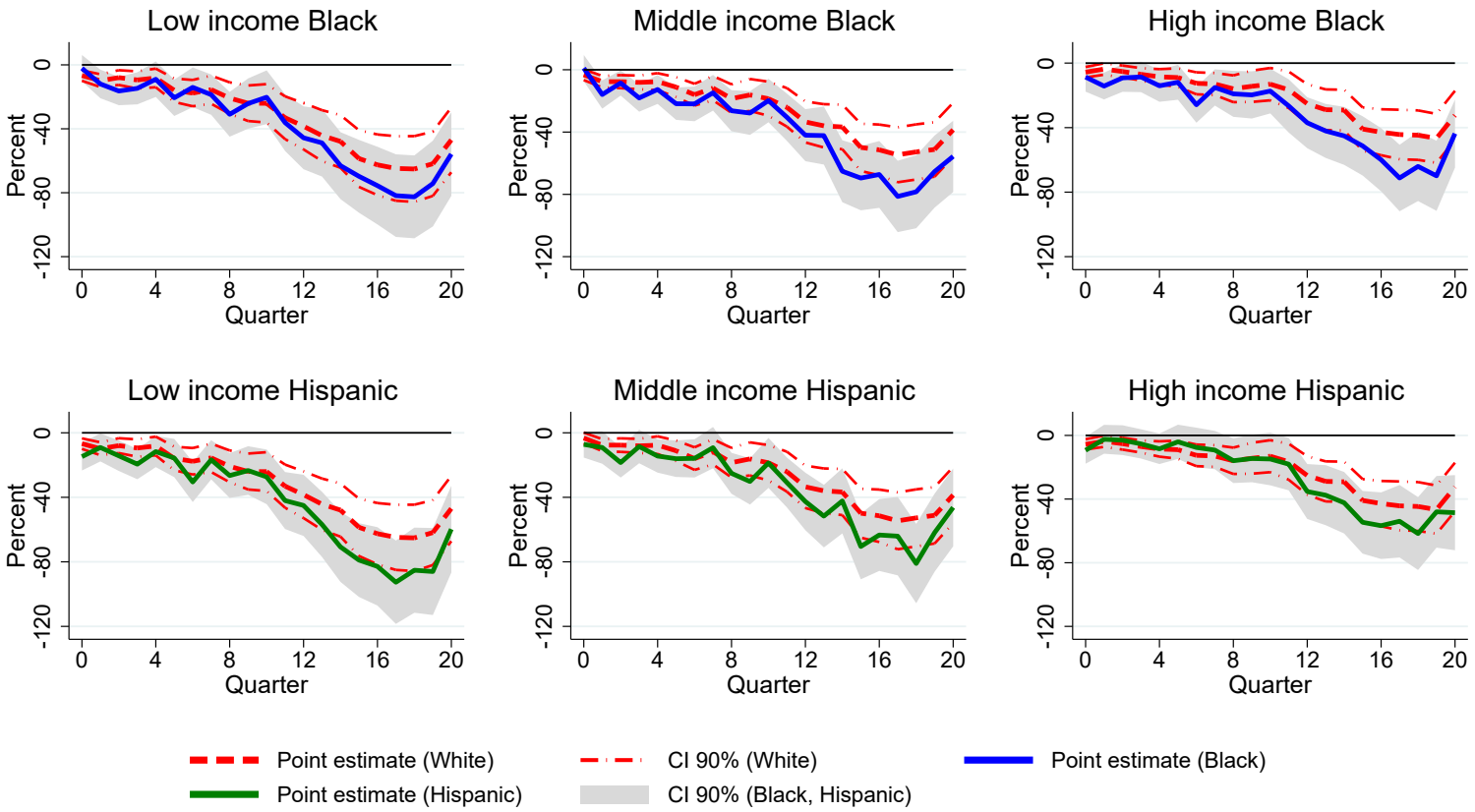
Notes: The figure displays the responses of log total entry to a one-unit increase in the monetary policy shock. The upper panel represents the responses for low-income, middle-income and high-income non-Hispanic Black households, respectively, while the lower panel illustrates the responses for low-income, middle-income and high-income Hispanic households, respectively. Additionally, each subplot includes the responses for White households, represented by the dashed line. The responses are estimated using Equation 1, and the standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

Figure 13: The Responses of Exit to Monetary Shock, by Race and Income



Notes: The figure displays the responses of log total exit to a one-unit increase in the monetary policy shock. The upper panel represents the responses for low-income, middle-income and high-income non-Hispanic Black households, respectively, while the lower panel illustrates the responses for low-income, middle-income and high-income Hispanic households, respectively. Additionally, each subplot includes the responses for White households, represented by the dashed line. The responses are estimated using Equation 1, and the standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

Figure 14: The Responses of Housing Return to Monetary Shock, by Race and Income



Notes: The figure displays the cumulative housing return responses to a one-unit increase in the monetary policy shock. The upper panel represents the responses for low-income, middle-income and high-income non-Hispanic Black households, respectively, while the lower panel illustrates the responses for low-income, middle-income and high-income Hispanic households, respectively. Additionally, each subplot includes the responses for White households, represented by the dashed line. The responses are estimated using Equation 2, and the standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

3.2 Asymmetric effects of monetary policy

In this section, we explore the possibility of asymmetric effects resulting from positive or negative monetary policy shocks. To examine this, we split the monetary policy shock series into its positive and negative components and estimate the following regression model:

$$\begin{aligned}\text{Outcome}_{l,r,t+h} = \beta_r^{\text{pos},(h)} \max(\text{MP}_t, 0) + \beta_r^{\text{neg}(h)} \min(\text{MP}_t, 0) \\ + \text{controls} + \text{error}_{l,r,t}^{(h)}, \quad h = 0, 1, 2, \ldots \end{aligned} \tag{3}$$

Here $\beta_r^{\text{pos},(h)}$ quantifies the h-quarter impact of a one-unit increase in positive monetary surprise (contractionary shock). Similarly, $-\beta_r^{\text{neg},(h)}$ measures the h-quarter impact of a one-unit decrease in negative monetary surprise (expansionary shock). By separating the effects of positive and negative surprises, we can separately evaluate the impacts of each component and assess which component primarily drives the observed heterogeneous response by race.

Our main outcome variables are the log of total entries (exits) and housing returns. Figure 15 displays the responses of entries into homeownership to a positive (upper panel) and a negative (lower panel) monetary policy shock. In response to contractionary monetary policy surprises, Black and Hispanic households experience greater drops in entry compared to White households. However, in the case of a negative monetary policy surprise, the differences across the three racial groups are relatively minor.

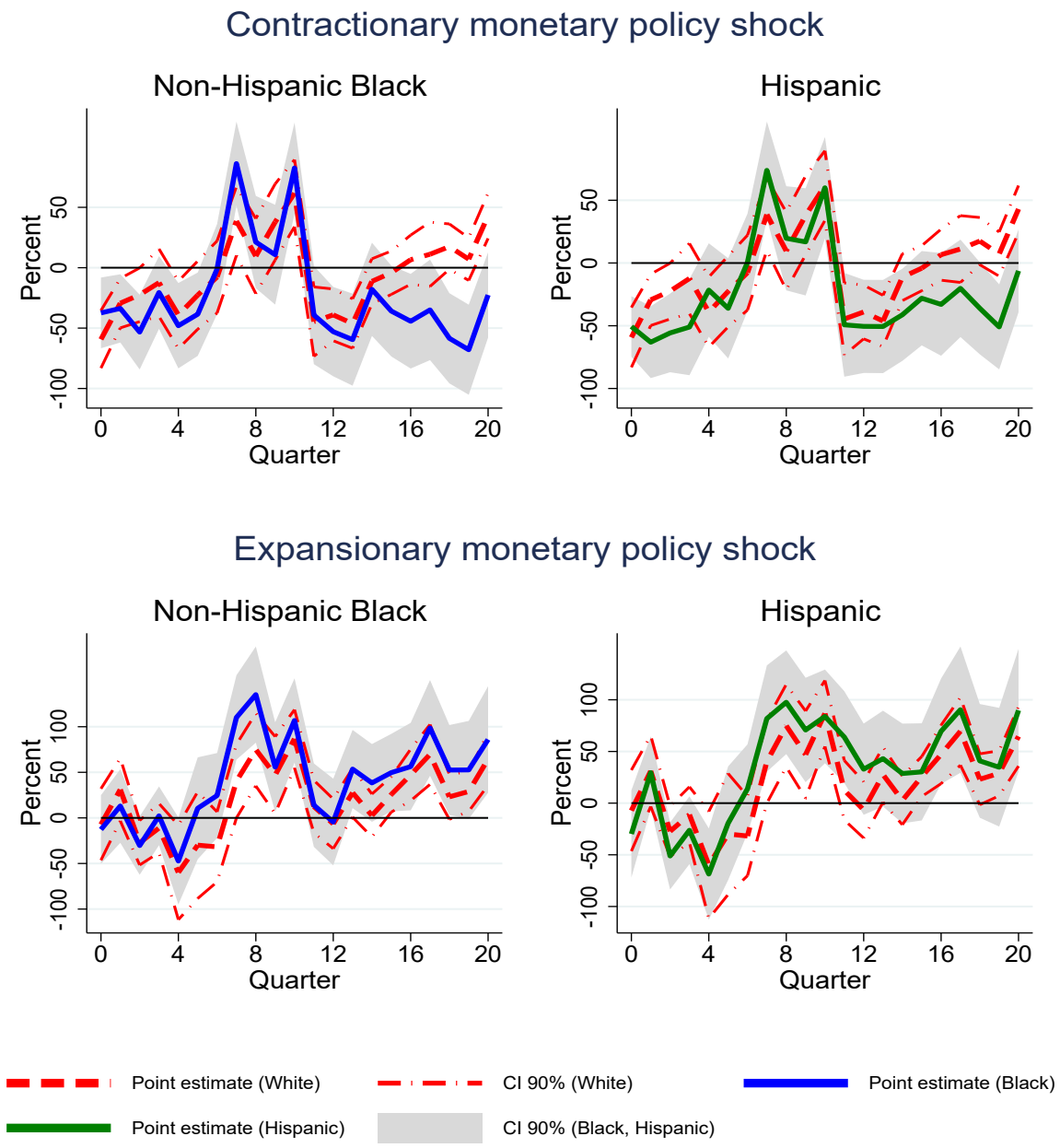
Similarly, Figure 16 displays the responses of exits to a positive (upper panel) and a negative (lower panel) monetary policy shock. Except for the initial few quarters in the upper panel, the behavior of exits remains comparable across all racial groups.

Figure 17 illustrates how housing returns respond to the positive component (upper panel) and the negative component (lower panel) of monetary policy shock. On one hand, we note that in response to contractionary monetary shocks, both Black and Hispanic homeowners experience larger decreases in housing returns compared with White homeowners. This suggests that positive monetary surprises have a stronger impact on housing returns for minority groups. On the other hand, in response to expansionary monetary shocks, the housing returns respond in a similar way across all three racial groups. This indicates that the effects of negative monetary surprises on housing returns do not differ significantly across racial groups.

Based on our analysis, it can be concluded that the response of minority and White hous-

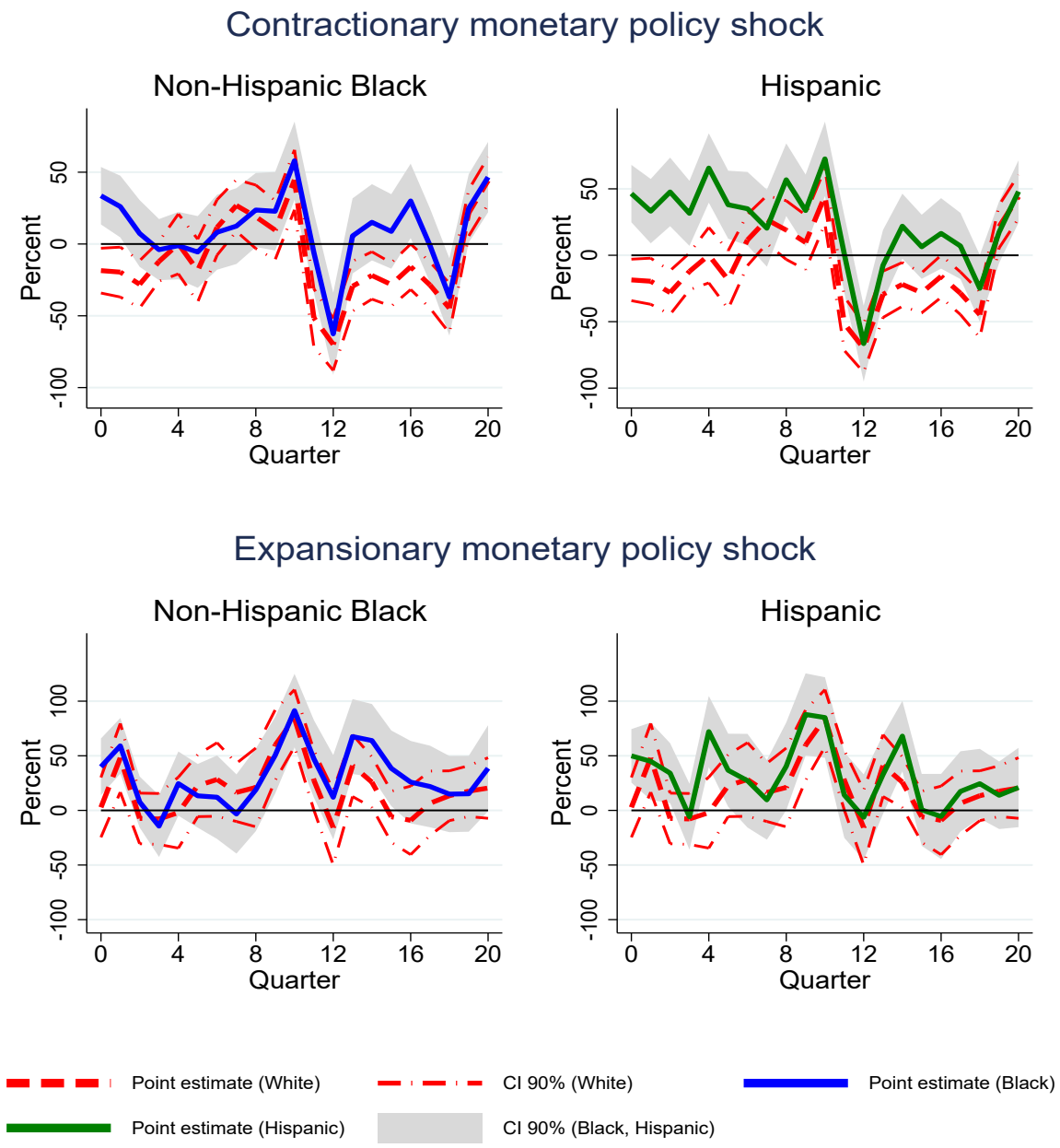
ing returns and homeownership to negative monetary policy surprises is generally similar. However, when it comes to positive monetary policy shocks, there is a greater impact on minority groups. This suggests that while monetary easing does not specifically benefit minorities in the housing market, monetary tightening disproportionally hurts them disproportionately more than White households.

Figure 15: The Responses of Entry to Positive and Negative Monetary Shocks, by Race



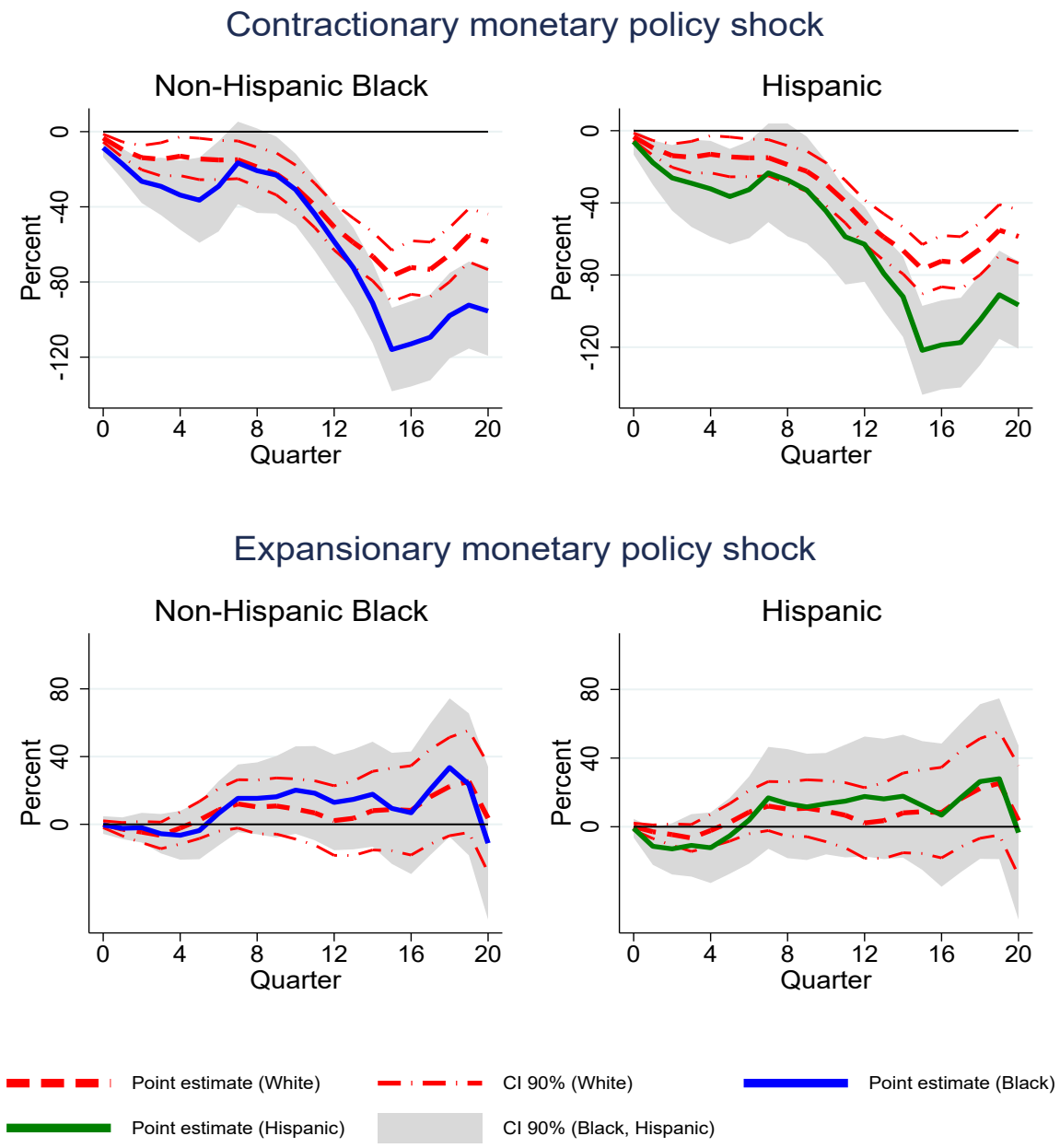
Notes: The figure presents the responses of log total entry to both a contractionary monetary policy shock (upper panel) and a one-unit expansionary monetary policy shock (lower panel), separately for non-Hispanic Black (left) and Hispanic (right) households. In each subplot, the dashed line represents the responses for White households. Responses are estimated using Equation (3). Standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

Figure 16: The Responses of Exit to Positive and Negative Monetary Shocks, by Race



Notes: The figure presents the responses of log total exit to both a one-unit contractionary monetary policy shock (upper panel) and a one-unit expansionary monetary policy shock (lower panel), separately for non-Hispanic Black (left) and Hispanic (right) households. In each subplot, the dashed line represents the responses for White households. Responses are estimated using Equation (3). Standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

Figure 17: The Responses of Housing Return to Positive and Negative Monetary Shocks, by Race



Notes: The figure presents the responses of cumulative housing return to both a one-unit contractionary monetary shock (upper panel) and a one-unit expansionary monetary shock (lower panel), separately for non-Hispanic Black (left) and Hispanic (right) households. In each subplot, the dashed line represents the responses for White households. Responses are estimated using Equation (3). Standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

4 Conclusion

In summary, our study offers new insights into the relationship between monetary policy and racial inequality in housing returns and homeownership. We observe that minority households demonstrate heightened sensitivity in their responses to monetary policy shocks compared with non-Hispanic White households. We also find that the racial differences in the response of housing returns to monetary policy can be attributed to residential segregation by race. While our research focuses on the housing sector, the implications of these findings may extend beyond housing. Previous studies, such as Iacoviello and Neri (2010), have shown that spillover effects from the housing market to consumption are non-negligible and have become increasingly relevant over time. Therefore, addressing racial disparities in housing outcomes could potentially have broader implications for overall racial inequality in consumption.

Additionally, our analysis underscores the importance of employment channels in explaining the excess responsiveness of minority housing outcomes to monetary tightening. The stronger impact of monetary policy on minority employment, compared with White employment, is an important factor contributing to the observed excess responsiveness. While we highlight the employment channel in this study, it is essential to acknowledge that other channels may be at play. Factors such as racial differences in the propensity to refinance mortgages, levels of financial literacy, and non-interest financing costs warrant further exploration and consideration in future research.

In recent times, there has been growing recognition among central bankers and critics regarding the distributional implications of monetary policy. Our study adds to this discourse by shedding light on the unintended consequences of monetary policy on racial inequality within the housing market. By understanding these differential effects, policymakers can adopt targeted strategies to reduce the impact of monetary policy on racial inequality in housing, particularly during monetary tightening cycles when disparities in housing outcomes for minority households may be exacerbated. Such efforts can develop a more equitable and inclusive approach to public policies.

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MONETARY POLICY AND RACIAL INEQUALITY IN THE HOUSING MARKET: A STUDY OF 140 US METROPOLITAN AREAS*

— *Supplemental Appendix* —

— *For Online Publication* —

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*The views expressed herein are those of the authors and not necessarily those of the Bank of Canada.

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Contents

A Details of the HMDA Data

The HMDA data capture the near-universe of mortgage originations. The data are available on an annual frequency. Each loan application has a number of key pieces of information: year of the application, the lender's decision, the securitization status of the loan, the gender of the applicant, the race and ethnicity of each applicant (and co-applicant, if any), the loan amount, income, state, county and the census tract where the home is located. The data also provide useful information on the lender, such as the name of the institution, its type, and its regulating agency. HMDA data became available in the early 1990s.

An important issue for our study concerns maintaining consistent coding of race and ethnicity variables for the applicant and co-applicant across the entire sample period. Before 2004, the applicant could only report one race, chosen from "American Indian or Alaska Native," "Asian or Pacific Islander," "Black," "Hispanic," "White" and "Other." If a co-applicant exists, then the same rule applied to the co-applicant. In 2004, in line with changes instituted in the 2000 U.S. census, HMDA changed the manner in which the race and ethnicity of borrowers were recorded. Instead of treating Hispanic as a race, HMDA moved to classifying race and Hispanic ethnicity separately, therefore allowing people of any race to claim Hispanic ancestry. In addition, both the applicant and co-applicant can report up to five races.

To ensure uniformity of the race/ethnicity variables across the entire sample period, we recode the post-2004 race/ethnicity variables to be consistent with their coding prior to 2004. We apply the following coding methodology. An applicant (and co-applicant, if any) reporting Hispanic ancestry is assigned to the Hispanic category. Before 2004, an applicant reporting Black or White are recorded as non-Hispanic Black and non-Hispanic White. Starting from 2004, if the applicant and the co-applicant, when pertinent, both classify themselves as White in the race category and non-Hispanic in the ethnicity category, they are categorized under the non-Hispanic White group. In contrast, if both the primary applicant and, if applicable, the co-applicant state they are Black and non-Hispanic, they fall into the non-Hispanic Black bracket. From the 2004 HMDA onward, both main and co-applicants can denote multiple racial identities. In our data, households labeled as White or Black are only those that identify one racial identity. In contrast, those in our Hispanic segment can associate with multiple racial identities. The homeowners who are not in the non-Hispanic Black, non-Hispanic White or Hispanic categories are, for example, mixed-race homeowners—individuals with multiple racial identifications, non-Hispanic Asians, non-Hispanic Pacific Islanders, and scenarios where only the primary or co-applicant claims

Hispanic origin.

For each mortgage transaction in the CoreLogic dataset, we search for matching mortgage applications in the HMDA data based on the exact origination year, census tract, loan type, and loan amount. We then fine-tune these matches by comparing the textual likeness of lender names, keeping only those that are of high precision.

We use the census tract number as a primary variable for matching. Census tracts are further divided into Block Groups. In the CoreLogic data, we can identify the 2010 census block group number. HMDA data from 1993–2002 is based on the 1990 census tract, 2003–2012 on the 2000 census tract, and 2012–2017 on the 2010 census tract. To bridge the data, we employ the census block relationship files from the census website.[1] This allows us to link the 2010 census blocks with the 1990 and 2000 census tracts. With this groundwork, we then match the CoreLogic data with the HMDA records.

[1] https://www.census.gov/geographies/reference-files/2010/geo/relationship-files.html.

B List of MSAs and the Housing Return Correlations

Table B.1 provides a list of the 140 Metropolitan Statistical Areas (MSAs) examined in this study. The first column lists the names of the MSAs, while the second column contains their corresponding codes. To ensure the representative nature of our CoreLogic–HMDA repeated sale sample, we assess each MSA by estimating an all-race HPI that pools all repeated sales irrespective of race. In columns three to five we show the correlations between the all-race housing returns and the housing return implied by the FHFA All Transaction Index at 4-, 8- and 20-quarter horizons, respectively. We find that our index generally exhibits a high correlation with the FHFA All Transaction Index over the long term, although disparities may emerge in the short term.

Table B.1. MSA

		Correlations		
MSA name	MSA code	4-qtr	8-qtr	20-qtr
Detroit-Dearborn-Livonia, MI	19804	0.89	0.96	0.99
Merced, CA	32900	0.95	0.97	0.99
Stockton, CA	44700	0.96	0.98	0.99
Modesto, CA	33700	0.96	0.98	0.99
Vallejo, CA	46700	0.96	0.97	0.98
Baltimore-Columbia-Towson, MD	12580	0.94	0.97	0.98
Reno, NV	39900	0.95	0.97	0.98
Denver-Aurora-Lakewood, CO	19740	0.90	0.96	0.98
Jacksonville, NC	27340	0.75	0.89	0.98
Warren-Troy-Farmington Hills, MI	47664	0.87	0.94	0.98
Las Vegas-Henderson-Paradise, NV	29820	0.94	0.96	0.98
Colorado Springs, CO	17820	0.91	0.96	0.98
Grand Rapids-Kentwood, MI	24340	0.82	0.91	0.97
Elgin, IL	20994	0.85	0.93	0.97
Oxnard-Thousand Oaks-Ventura, CA	37100	0.92	0.96	0.97
Bakersfield, CA	12540	0.92	0.94	0.97
Olympia-Lacey-Tumwater, WA	36500	0.93	0.96	0.97
Sacramento-Roseville-Folsom, CA	40900	0.95	0.96	0.97
Fresno, CA	23420	0.93	0.96	0.97
Riverside-San Bernardino-Ontario, CA	40140	0.94	0.96	0.97

Santa Rosa-Petaluma, CA	42220	0.92	0.95	0.97
Salinas, CA	41500	0.95	0.96	0.97
Clarksville, TN-KY	17300	0.80	0.88	0.97
Seattle-Bellevue-Kent, WA	42644	0.93	0.96	0.97
Tucson, AZ	46060	0.91	0.94	0.97
Yuba City, CA	49700	0.94	0.96	0.97
Omaha-Council Bluffs, NE-IA	36540	0.80	0.90	0.97
Oklahoma City, OK	36420	0.77	0.89	0.97
Portland-Vancouver-Hillsboro, OR-WA	38900	0.92	0.95	0.97
Anaheim-Santa Ana-Irvine, CA	11244	0.92	0.95	0.97
San Diego-Chula Vista-Carlsbad, CA	41740	0.94	0.96	0.97
Tacoma-Lakewood, WA	45104	0.91	0.94	0.97
Savannah, GA	42340	0.81	0.89	0.96
Frederick-Gaithersburg-Rockville, MD	23224	0.93	0.95	0.96
Virginia Beach-Norfolk-Newport News, VA-NC	47260	0.82	0.87	0.96
Phoenix-Mesa-Chandler, AZ	38060	0.93	0.94	0.96
Richmond, VA	40060	0.91	0.95	0.96
Oakland-Berkeley-Livermore, CA	36084	0.92	0.94	0.96
Los Angeles-Long Beach-Glendale, CA	31084	0.93	0.95	0.95
San Francisco-San Mateo-Redwood City, CA	41884	0.87	0.92	0.95
Des Moines-West Des Moines, IA	19780	0.62	0.80	0.95
Fayetteville, NC	22180	0.68	0.87	0.95
Lansing-East Lansing, MI	29620	0.68	0.87	0.95
Killeen-Temple, TX	28660	0.65	0.89	0.95
Nashville-Davidson–Murfreesboro–Franklin, TN	34980	0.85	0.90	0.95
Gainesville, GA	23580	0.74	0.85	0.95
Chicago-Naperville-Evanston, IL	16984	0.88	0.93	0.95
Fayetteville-Springdale-Rogers, AR	22220	0.81	0.88	0.95
San Jose-Sunnyvale-Santa Clara, CA	41940	0.85	0.90	0.94
Ogden-Clearfield, UT	36260	0.89	0.93	0.94
Visalia, CA	47300	0.91	0.93	0.94
Toledo, OH	45780	0.77	0.89	0.94
Raleigh-Cary, NC	39580	0.79	0.88	0.94
Milwaukee-Waukesha, WI	33340	0.78	0.89	0.93
Montgomery County-Bucks County-Chester County, PA	33874	0.74	0.87	0.92

Durham-Chapel Hill, NC	20500	0.49	0.71	0.92
Buffalo-Cheektowaga, NY	15380	0.63	0.82	0.92
Atlanta-Sandy Springs-Alpharetta, GA	12060	0.77	0.85	0.92
El Paso, TX	21340	0.73	0.86	0.92
Charlotte-Concord-Gastonia, NC-SC	16740	0.78	0.83	0.91
Albuquerque, NM	10740	0.85	0.90	0.91
Nassau County-Suffolk County, NY	35004	0.56	0.76	0.90
Augusta-Richmond County, GA-SC	12260	0.74	0.81	0.90
Tulsa, OK	46140	0.63	0.77	0.90
Greensboro-High Point, NC	24660	0.72	0.82	0.90
Cleveland-Elyria, OH	17460	0.73	0.83	0.90
Waco, TX	47380	0.48	0.73	0.90
Myrtle Beach-Conway-North Myrtle Beach, SC-NC	34820	0.81	0.84	0.90
Dallas-Plano-Irving, TX	19124	0.71	0.80	0.90
Fort Worth-Arlington-Grapevine, TX	23104	0.66	0.79	0.89
Austin-Round Rock-Georgetown, TX	12420	0.75	0.85	0.89
Knoxville, TN	28940	0.67	0.74	0.89
Columbus, OH	18140	0.75	0.84	0.89
Winston-Salem, NC	49180	0.73	0.81	0.88
Rochester, NY	40380	0.66	0.80	0.88
Fort Wayne, IN	23060	0.57	0.71	0.88
St. Louis, MO-IL	41180	0.74	0.84	0.88
Akron, OH	10420	0.67	0.79	0.88
Little Rock-North Little Rock-Conway, AR	30780	0.74	0.85	0.88
Bremerton-Silverdale-Port Orchard, WA	14740	0.92	0.94	0.88
Memphis, TN-MS-AR	32820	0.61	0.67	0.86
Sebastian-Vero Beach, FL	42680	0.33	0.66	0.84
Tallahassee, FL	45220	0.28	0.48	0.84
Kansas City, MO-KS	28140	0.71	0.78	0.83
Wichita, KS	48620	0.63	0.70	0.82
Anchorage, AK	11260	0.80	0.90	0.82
Houston-The Woodlands-Sugar Land, TX	26420	0.59	0.72	0.82
Pensacola-Ferry Pass-Brent, FL	37860	0.33	0.59	0.82
Burlington, NC	15500	0.36	0.61	0.82
Dayton-Kettering, OH	19430	0.46	0.71	0.81

Allentown-Bethlehem-Easton, PA-NJ	10900	0.67	0.77	0.81
Tampa-St. Petersburg-Clearwater, FL	45300	0.40	0.61	0.81
Deltona-Daytona Beach-Ormond Beach, FL	19660	0.34	0.55	0.81
Urban Honolulu, HI	46520	0.61	0.77	0.80
Huntsville, AL	26620	0.44	0.56	0.80
San Antonio-New Braunfels, TX	41700	0.63	0.72	0.79
Palm Bay-Melbourne-Titusville, FL	37340	0.30	0.53	0.79
Fort Lauderdale-Pompano Beach-Sunrise, FL	22744	0.28	0.51	0.78
West Palm Beach-Boca Raton-Boynton Beach, FL	48424	0.38	0.59	0.78
Gainesville, FL	23540	0.38	0.57	0.78
Port St. Lucie, FL	38940	0.29	0.51	0.77
Gary, IN	23844	0.53	0.61	0.77
Orlando-Kissimmee-Sanford, FL	36740	0.30	0.51	0.76
Lakeland-Winter Haven, FL	29460	0.29	0.49	0.76
Lancaster, PA	29540	0.48	0.69	0.75
Charleston-North Charleston, SC	16700	0.64	0.70	0.75
North Port-Sarasota-Bradenton, FL	35840	0.31	0.49	0.74
Punta Gorda, FL	39460	0.24	0.51	0.74
Crestview-Fort Walton Beach-Destin, FL	18880	0.36	0.54	0.73
Poughkeepsie-Newburgh-Middletown, NY	39100	0.52	0.68	0.71
Cape Coral-Fort Myers, FL	15980	0.41	0.59	0.71
Beaumont-Port Arthur, TX	13140	0.36	0.49	0.67
East Stroudsburg, PA	20700	0.46	0.62	0.65
Ocala, FL	36100	0.19	0.36	0.65
New York-Jersey City-White Plains, NY-NJ	35614	0.36	0.45	0.64
Naples-Marco Island, FL	34940	0.42	0.53	0.59
New Brunswick-Lakewood, NJ	35154	0.17	0.29	0.55
Reading, PA	39740	0.24	0.31	0.47
Birmingham-Hoover, AL	13820	0.20	0.34	0.46
Philadelphia, PA	37964	0.19	0.36	0.46
Jacksonville, FL	27260	0.27	0.30	0.44
Hilton Head Island-Bluffton, SC	25940	0.45	0.53	0.44
Atlantic City-Hammonton, NJ	12100	0.21	0.27	0.40
Indianapolis-Carmel-Anderson, IN	26900	0.11	0.25	0.39
Washington-Arlington-Alexandria, DC-VA-MD-WV	47894	0.22	0.16	0.38

Columbia, SC	17900	0.28	0.36	0.38
Tyler, TX	46340	0.41	0.57	0.33
Greenville-Anderson, SC	24860	0.16	0.27	0.32
Cambridge-Newton-Framingham, MA	15764	0.11	0.16	0.18
Newark, NJ-PA	35084	-0.08	-0.05	0.17
Boston, MA	14454	0.07	0.10	0.10
Minneapolis-St. Paul-Bloomington, MN-WI	33460	0.06	0.08	0.07
New Orleans-Metairie, LA	35380	0.27	0.34	-0.04
Harrisburg-Carlisle, PA	25420	0.31	0.35	-0.08
Pittsburgh, PA	38300	0.23	0.46	-0.12
Trenton-Princeton, NJ	45940	-0.04	-0.14	-0.17
Camden, NJ	15804	-0.06	-0.16	-0.19
Wilmington, DE-MD-NJ	48864	-0.23	-0.29	-0.22
Vineland-Bridgeton, NJ	47220	0.05	0.17	-0.25
Springfield, MA	44140	0.26	0.21	-0.59

Notes: The table presents details about the 140 MSAs investigated in this study. The first column shows the names of the MSAs, and the second column contains their corresponding codes. Columns three to five show the correlations between our all-race housing returns and the housing return inferred from the FHFA All Transaction Index at 4-, 8-, and 20-quarter horizons, respectively.

C Features of the Monetary Policy Shocks

The impact of the Bauer and Swanson (2023)'s monetary shock on the intraday changes of multiple financial market instruments on FOMC days are shown in Table C.2. The sample period is from 1989 to 2019.

	(1) ED4	(2) Two-year Treasury Yield	(3) Five-year Treasury Yield	(4) Ten-year Treasury Yield	(5) SP500
MP	0.994***	0.740***	0.643***	0.412***	-5.570***
	(0.048)	(0.045)	(0.047)	(0.042)	(0.838)
Constant	-0.010***	-0.008***	-0.005***	-0.002	0.041
	(0.002)	(0.002)	(0.002)	(0.002)	(0.029)
Observations	322	258	307	322	322
R-squared	0.750	0.689	0.550	0.363	0.249

Table C.2. Effects of Bauer and Swanson (2023)'s Monetary Policy Surprises on the Financial Market

D Robustness

D.1 Complete set of controls

We focus on four primary variables: the log of employment, log of entries, log of total exits, and the first difference of the log housing price. We conduct four separate regression analyses using each of these core variables for each racial group at the time horizon t+h as the dependent variable (with the exception of the cumulative change in housing price, which is used instead of the first difference at horizon t+h). For each regression set, we include control variables that account for four lagged values of the following metrics: the four primary variables for each racial group, city-level racial proportions (that is, Black population ratio and Hispanic population ratio), nominal per capita income, lender competitiveness, and city-specific fixed effects. In all, the models consist of 4 * (4 * 3 + 2 + 1) = 64 control variables, in addition to the fixed city effects. This forms our estimation incorporating the complete set of controls.

The outcomes of these analyses are displayed in Figure D.1 for the log of total entries, Figure D.2 for the log of exits, Figure D.3 for cumulative housing returns, and Figure D.4 for the log of employment. The majority of our findings remain consistent. A notable observation is the diminished level of cumulative housing returns for each racial group compared with the main results presented earlier. However, the differences in these returns based on race, which are central to this study, remain consistent.

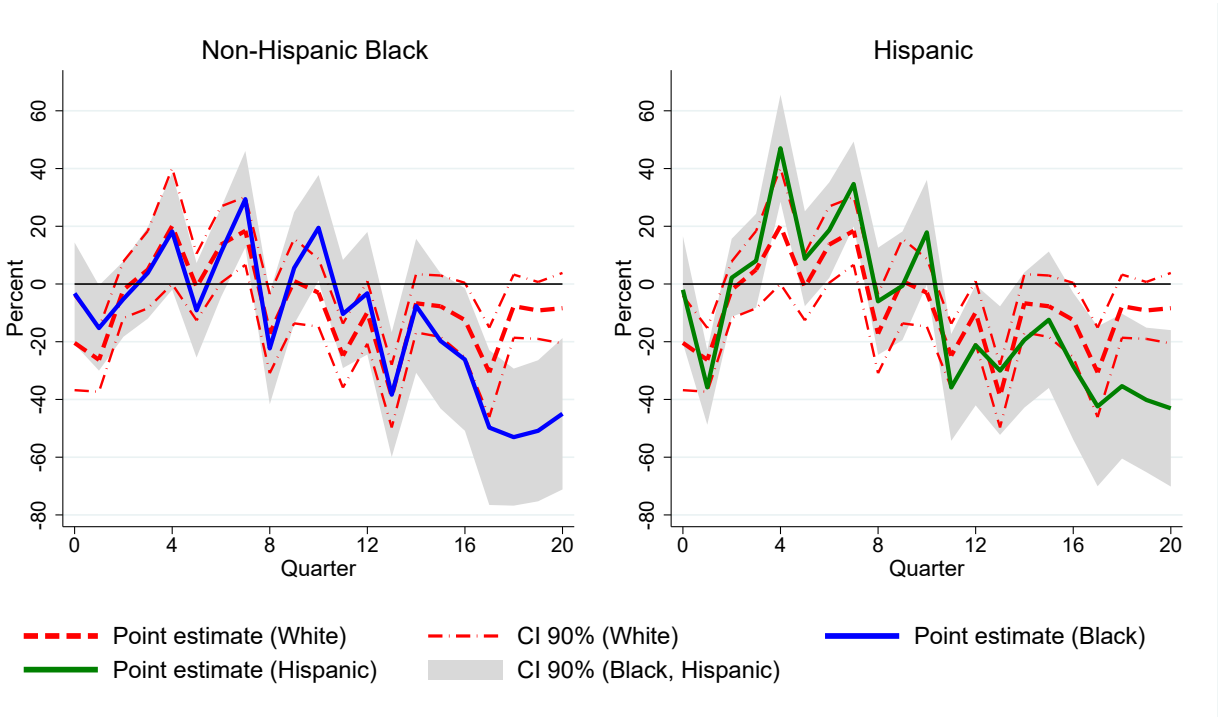

Figure D.1. The Responses of Entry to Monetary Shock, by Race

Notes: The figure presents the responses of the log total entry when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1) in the main text with full set of controls. The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

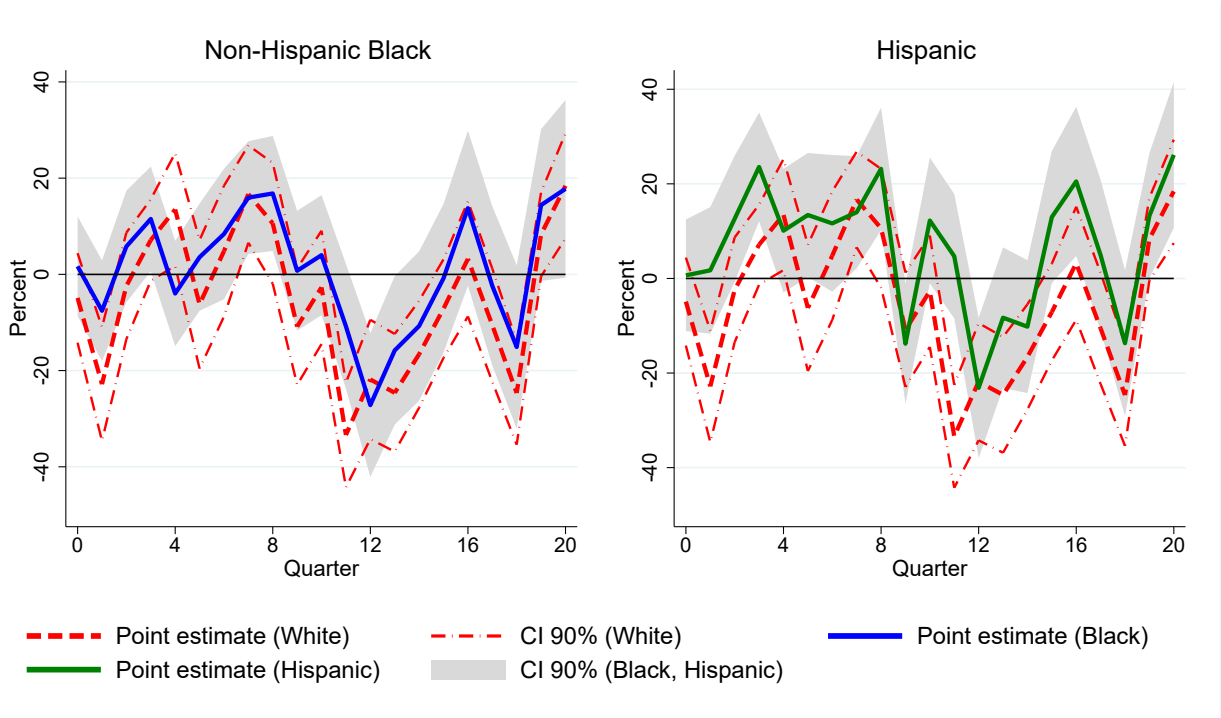

Figure D.2. The Responses of Exit to Monetary Shock, by Race

Notes: The figure presents the responses of the log total exit when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1) in the main text with full set of controls. The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

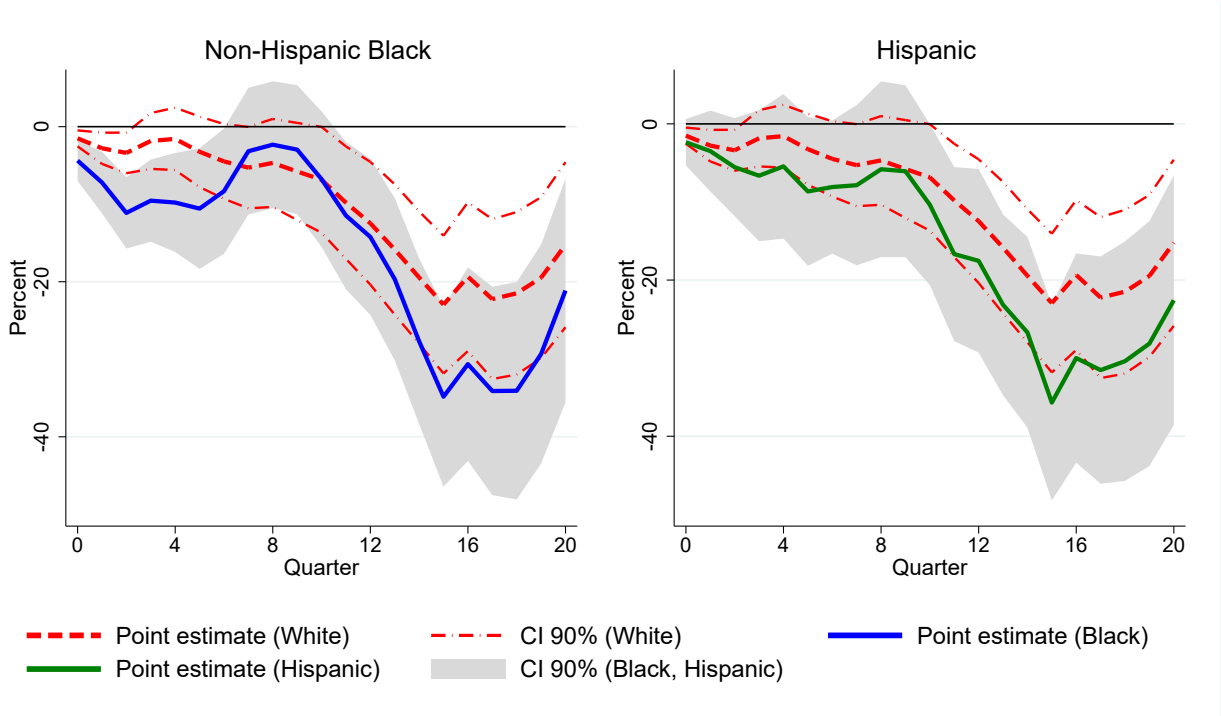

Figure D.3. The Responses of Housing Return to Monetary Shock, by Race

Notes: The figure presents the responses of the cumulative change in the log housing price index when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (2) in the main text with full set of controls. The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

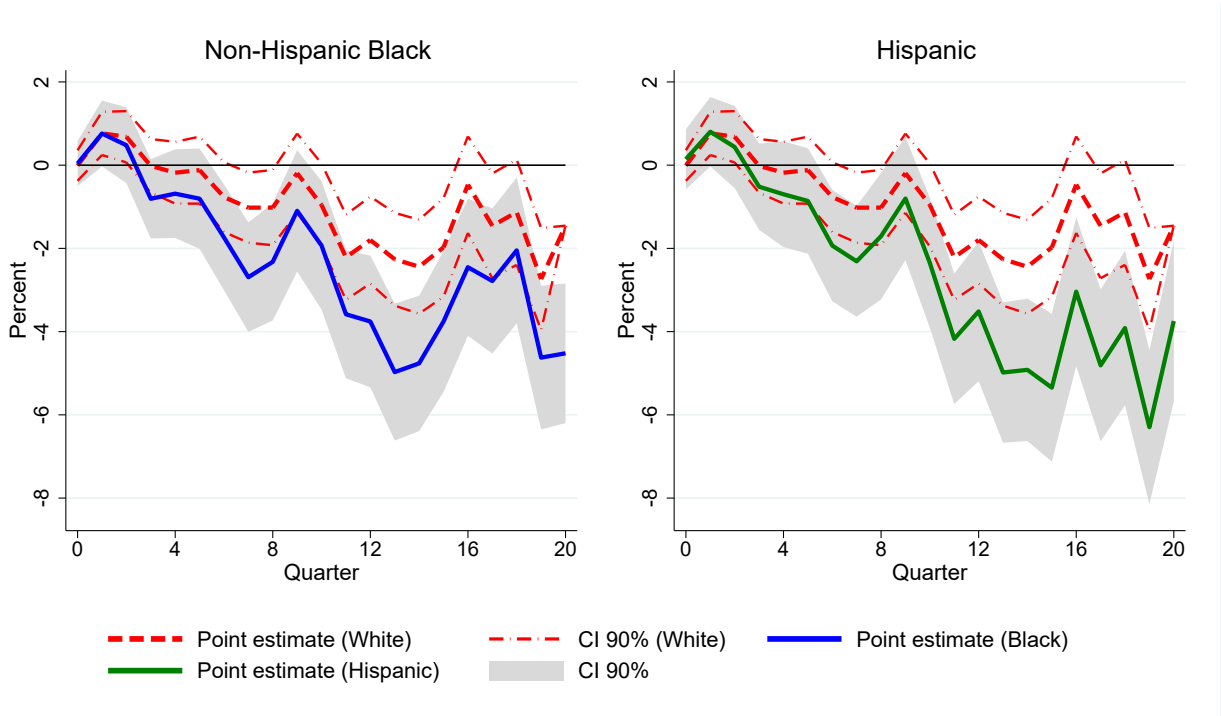

Figure D.4. The Responses of Employment to Monetary Shocks, by Race

Notes: The figure presents the responses of the change in log employment when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1) in the main text with full set of controls. The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

D.2 Alternative monetary policy shocks and robustness

In this section, we construct alternative monetary policy shock series using the change in a number of asset prices in a 30-minute window bracketing each FOMC announcement from July 1991 through December 2018. The data we use are changes in the current month's federal funds rate (MP1, adjusted by the date of the month); three-month ahead federal funds futures (FF4); Eurodollar futures 2-, 3- and 4-quarters-ahead; two-year Treasury yields; five-year Treasury yields; and ten-year Treasury yields around FOMC announcements. The first five instruments are the ones used in Gürkaynak et al. (2005) and Nakamura and Steinsson (2018). The mid- and long-term Treasury yields are included to capture the effects of unconventional monetary policies.

The first principal component of the asset price responses is extracted. Similar to Bauer and Swanson (2023), we normalize the shock series such that one unit of the monetary policy shock increases the intraday change in 3-quarter-ahead Eurodollar futures by 100 basis points. Positive values correspond to contractionary monetary policy shocks. The impact of the shock on the intraday changes of multiple financial market instruments on FOMC days are shown in Table D.3.

	(1) ED4	(2) Two-year Treasury Yield	(3) Five-year Treasury Yield	(4) Ten-year Treasury Yield	(5) SP500
Alternative MP	1.000***	0.791***	0.700***	0.491***	-4.388***
	(0.045)	(0.024)	(0.048)	(0.070)	(0.697)
Constant	-0.011***	-0.007***	-0.004**	-0.002	0.005
	(0.002)	(0.001)	(0.002)	(0.002)	(0.032)
Observations	240	240	240	240	239
R-squared	0.865	0.922	0.767	0.476	0.263

Table D.3. Effects of Alternative Monetary Policy Surprises on the Financial Market

To obtain monetary policy shocks at monthly frequencies, we assign each shock to the month in which the corresponding Fed announcement occurs. If there are two announcement days in a month, then we sum the shocks. If there are no meetings in a month, then we record the shock as zero for that month. To obtain quarterly frequency, we sum the monthly shocks for that quarter. The quarterly shock series are plotted in Figure D.5.

We then repeat the same exercise as in Section 2. In particular, we employ the following specification:

$$\log(\text{HPI}_{l,r,t+h}) - \log(\text{HPI}_{l,r,t-1}) = \beta_r^{(h)}\text{MP}_t + \text{controls}_{l,r,t} + \text{error}_{l,r,t}^{(h)}, \quad h = 0, 1, 2, \ldots$$

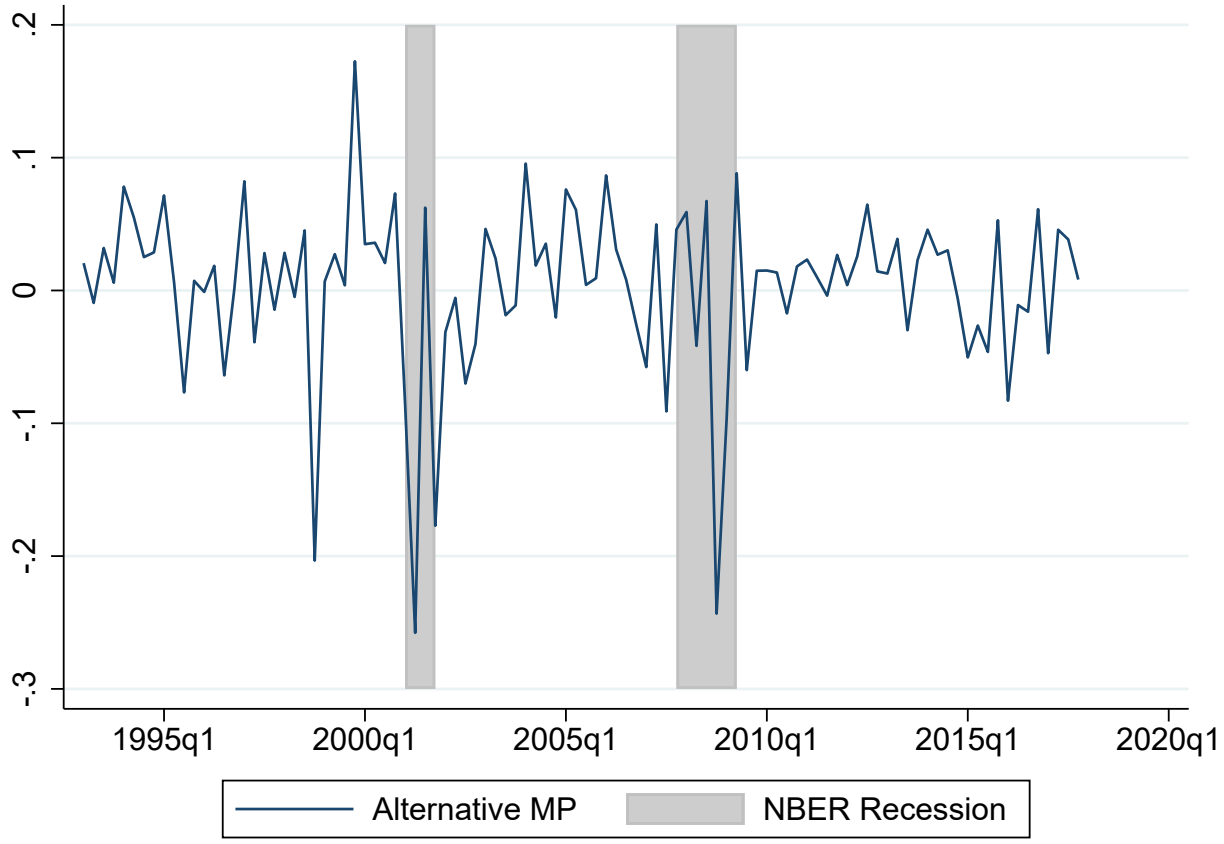

Figure D.5. Alternative Monetary Policy Shock at Quarterly Frequency

Note: This figure plots the quarterly series of the alternative monetary policy shocks.

where $\log(\text{HPI}_{l,r,t+h}) - \log(\text{HPI}_{l,r,t-1})$ represents the cumulative change in the log of the HPI for racial group r in city l from period $t-1$ to $t+h$. The term MP_t denotes the monetary policy surprise at quarter t. The control variables $\text{controls}_{l,r,t}$ include four lagged values of the following variables: the first difference of log(HPI) for each racial group, city-level racial compositions, the log of the employment of each racial group, nominal per capita income and lender competitiveness as well as the city-level fixed effects. We follow Eichenbaum et al. (2022) and include the average forecast of the SPF for the following variables: the two-year ahead real GDP growth, the two-year ahead civilian unemployment rate, and the one- and two-year-ahead CPI inflation rate. We didn't add this control to the specification in the main text because Bauer and Swanson (2023) already purged their monetary policy shocks by macro news.

As shown in Figure D.8, using the alternative monetary policy measure we still find that minority homeowners' cumulative housing return responds more than that of White

homeowners.

We repeat the exercises for log total entries and log total exits. We use the following specifications:

$$\log(\text{Outcome}_{l,r,t+h}) = \beta_r^{(h)}\text{MP}_t + \text{controls}_{l,r,t} + \text{error}_{l,r,t}^{(h)}, \quad h = 0, 1, 2, \ldots$$

where the $\log(\text{Outcome}_{l,r,t+h})$ represents the log of the total entries or exits for the specific racial group r in city l during quarter $t+h$. Our coefficient of interest is $\beta_r^{(h)}$, which measures the percentage change in home entries or exits for a specific race/ethnicity group r after h quarters of a unit contractionary monetary policy shock.

The estimates are plotted in Figure D.6 and Figure D.7. Again, we have similar findings as in the main text, though the magnitude is larger.

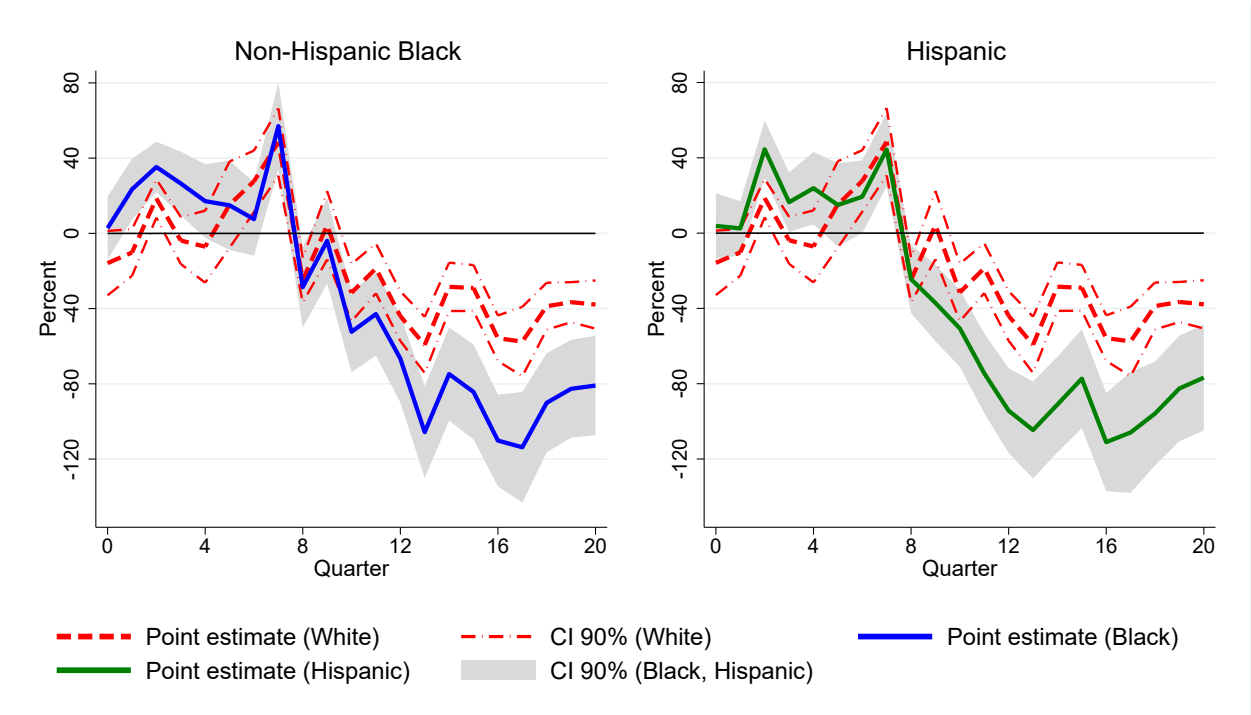

Figure D.6. The Responses of Entry to Monetary Shock, by Race

Notes: The figure presents the responses of the log total entry when the alternative monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1) in the main text. The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

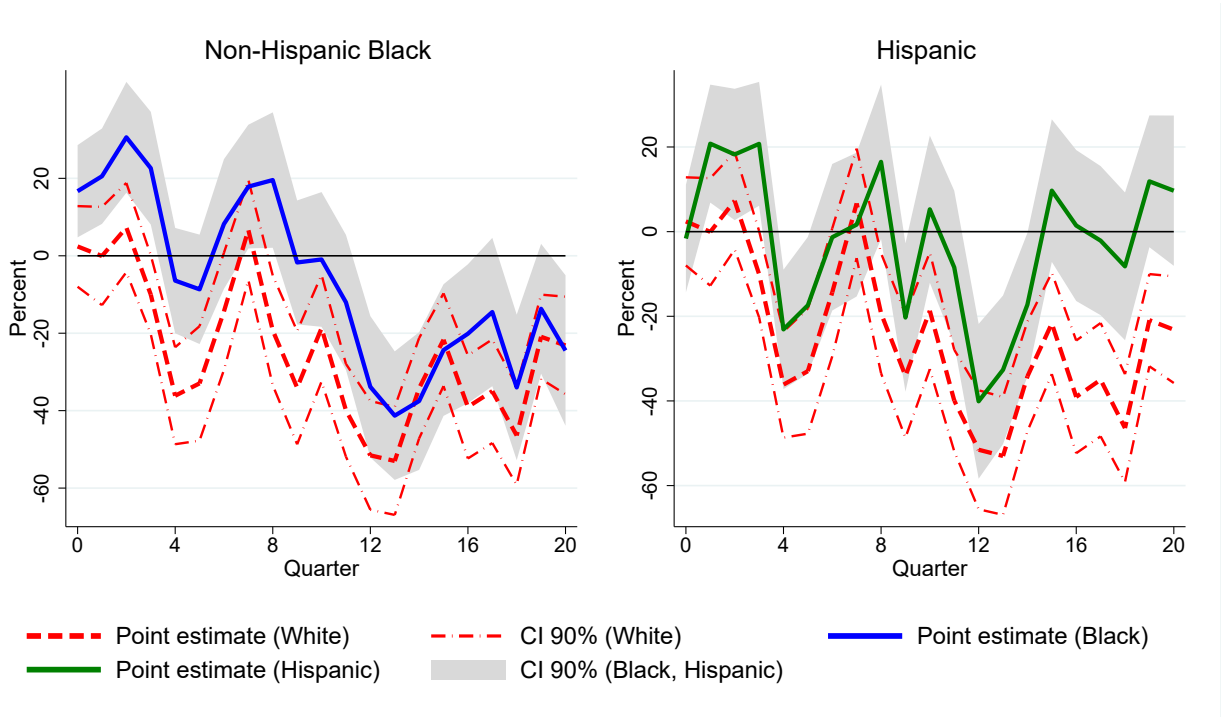

Figure D.7. The Responses of Exit to Monetary Shock, by Race

Notes: The figure presents the responses of the log total exit when the alternative monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1) in the main text. The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

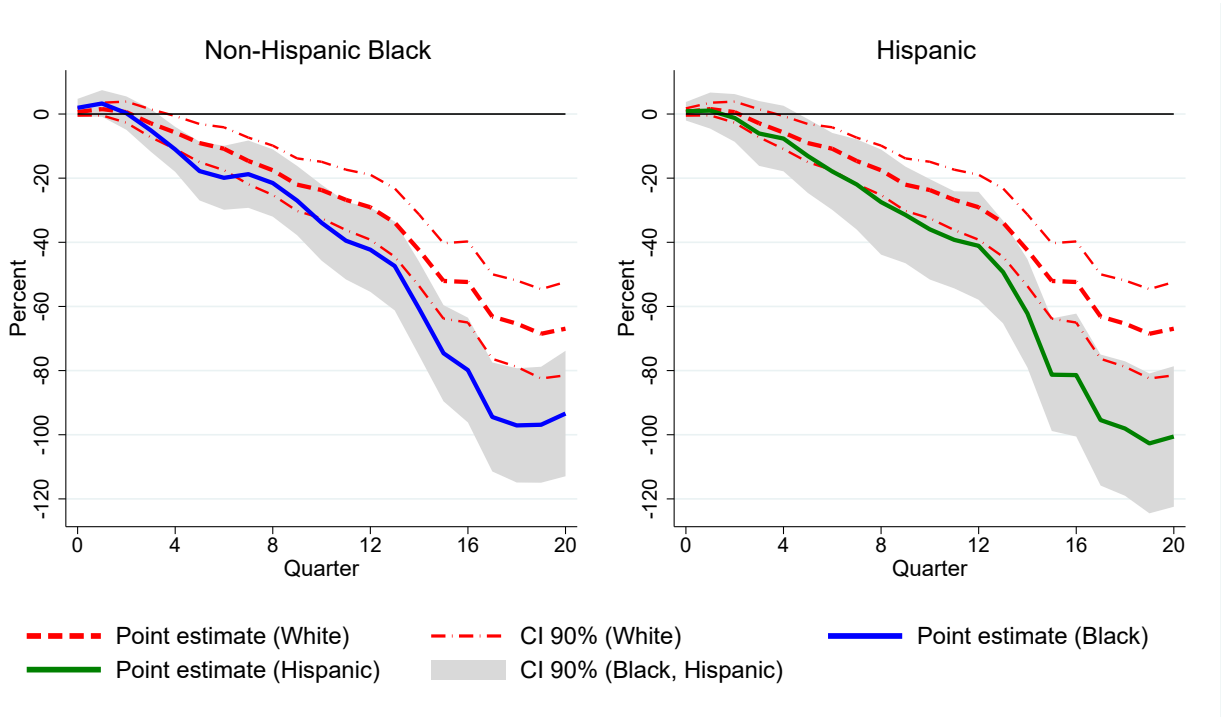

Figure D.8. The Responses of Housing Return to Monetary Contraction, by Race

Notes: The figure presents the responses of the cumulative change in the log housing price index when the alternative monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (2) in the main text. The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

E Real Housing Price Index

In this section, we divide the city-level nominal HPI by the national Consumer Price Index (CPI) to adjust for inflation, representing housing prices in real terms. We then employ the local projections method to examine the impact of monetary policy shocks on real housing price indices for different racial groups. The results are shown in Figure E.1 for the full sample and in Figure E.2 for the sample up to December 2013.

Based on our estimation using the full sample data, we find that two years after a one-unit monetary policy tightening, White households experience a 13% decrease in cumulative real housing return. In comparison, Black and Hispanic households experience a greater decline in real housing return, with decreases of 16% and 18%, respectively.

When we restrict the data to end in 2013, the results show that two years after a one-unit monetary policy tightening, White households experience a smaller decrease in cumulative real housing return, around 3.8%. Meanwhile, Black and Hispanic households still experience declines in real housing return relative to White households, at 4.3% and 1.9%, respectively. Sixteen quarters after a one-unit monetary policy tightening, White households experience a decline of approximately 28% in their cumulative real housing returns. In contrast, Black and Hispanic households continue to experience reductions, with percentages reaching 41% and 42%, respectively.

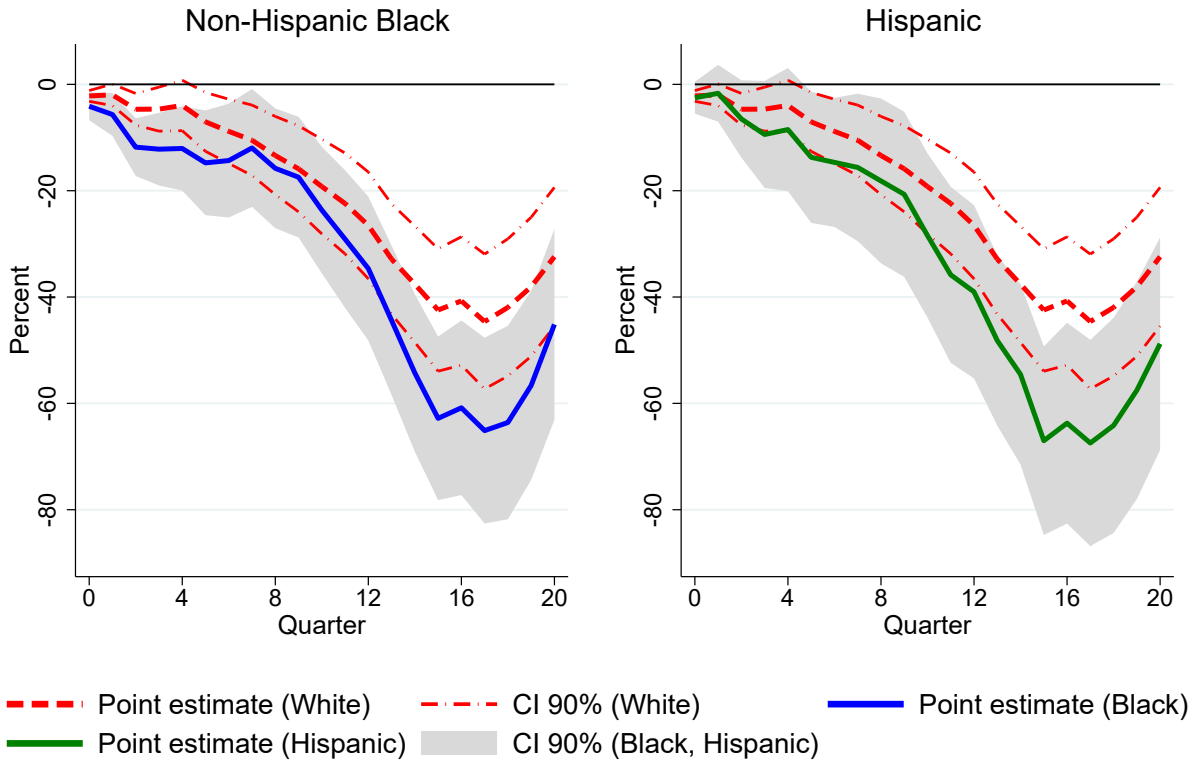

Figure E.1. The Responses of Real Housing Return to Monetary Contraction, Full Sample by Race

Notes: The figure presents the responses of the cumulative change in the log of the real housing price index when the monetary policy shock decreases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1) in the main text. The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners. The sample period is 1993–2017.

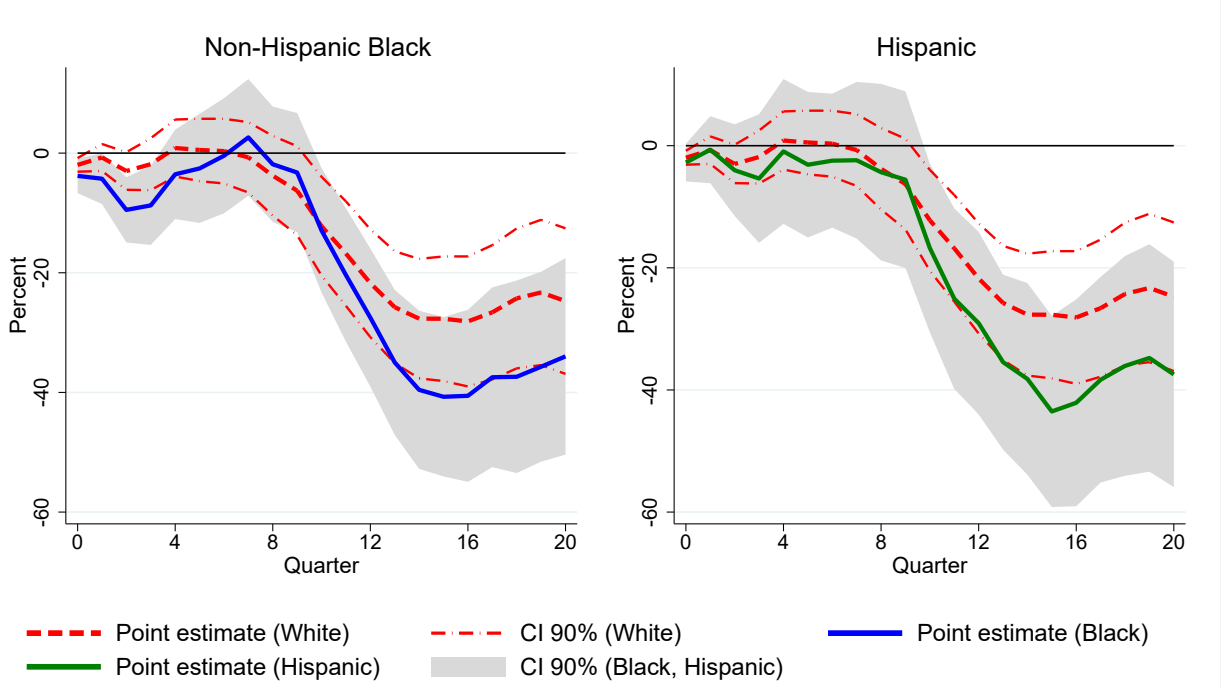

Figure E.2. The Responses of Real Housing Return to Monetary Contraction, 1993–2013, by Race

Notes: The figure presents the responses of the cumulative change in the log of the real housing price index when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1) in the main text. The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners. The sample period is 1993–2013.

F Hiring and Separation

We obtain the quarterly city-level end-of-quarter hiring rate and beginning-of-quarter separation rate by race from the U.S. Census Bureau's Quarterly Workforce Indicators (QWI) program. The hiring rate is defined as hires divided by average employment. The separation rate is defined as separations divided by average employment. We then re-estimate the specification of Equation (1) in the main text using the hiring rate and separation rate as the outcome variable, respectively.

The results are shown in Figure F.1 for hiring rate and F.2 for separation rate responses. The racial differences are mainly driven by the hiring rate.

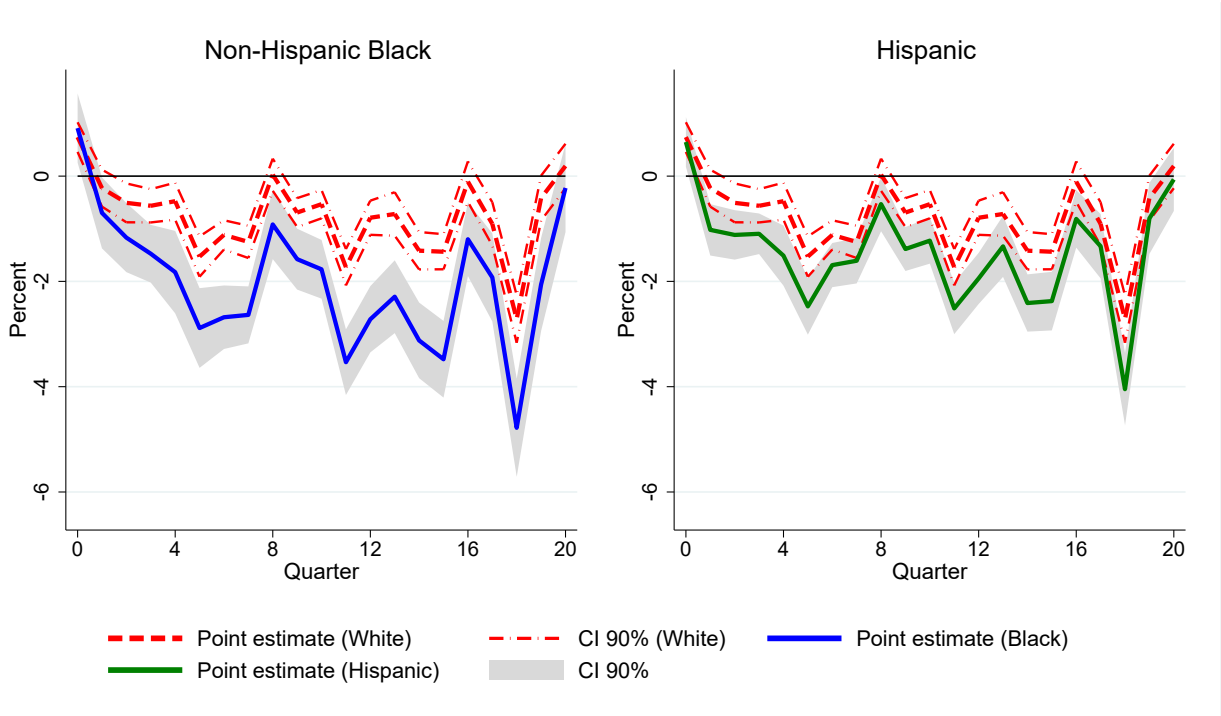

Figure F.1. The Responses of Hiring Rate to Monetary Shock, by Race

Notes: The figure presents the responses of the hiring rate when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (2) in the main text. The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners. The sample period is 1993–2017.

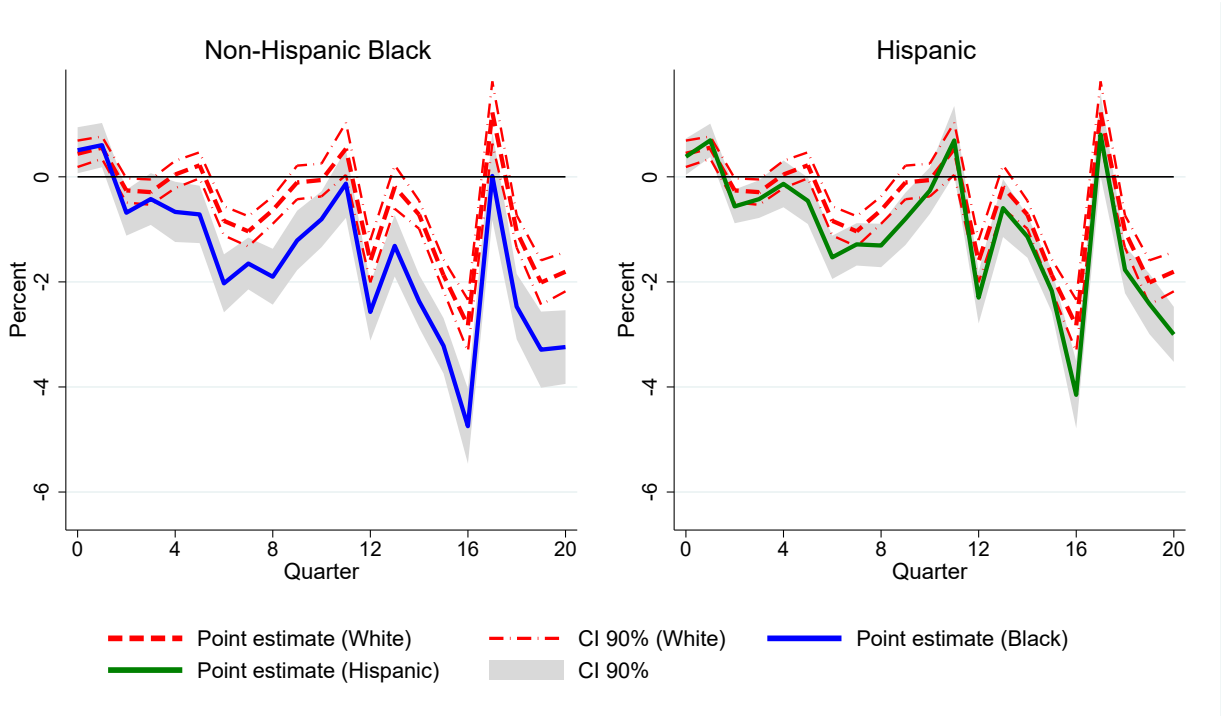

Figure F.2. The Responses of Separation Rate to Monetary Shock, by Race

Notes: The figure presents the responses of separation rate when the monetary policy shock increases by one unit for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (2) in the main text. The standard errors are clustered at the city by year level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners. The sample period is 1993–2017.

G Local Projections with Instrumental Variable (LP-IV)

In this section, we use an instrumental variable approach to re-evaluate our results. The difference between the LP-IV and the LP-OLS we presented in the main text is the underlying assumption. Under LP-OLS, the assumption is that the econometrician can observe the structural monetary policy shock. Under LP-IV, it is assumed that this structural shock cannot be observed, and the high-frequency monetary policy surprises are only one part of it or have measurement error. See Stock and Watson (2018) for details.

To implement this method, we follow the approach of Gertler and Karadi (2015) and use the quarterly one-year Treasury yield as a policy indicator. We then use the monetary policy shock as the instrument variable for the change in the policy indicator. The regression equation we estimate is as follows:

$$\begin{aligned}\log(\text{HPI}_{l,r,t+h}) - \log(\text{HPI}_{l,r,t-1}) = \beta_r^{(h)} \triangle \text{PolicyIndicator}_t + \text{controls} \\ + \text{error}_{l,r,t}^{(h)}, \quad h = 0, 1, 2, \ldots \end{aligned} \tag{1}$$

To ensure that the instrumental variable is exogenous, we include the same controls as in Equation 1 . The control variables controls include four lagged values of the following variables: the first difference of log(HPI) for each racial group, city-level racial compositions, the log of the employment of each racial group, nominal per capita income and lender competitiveness. We also include city fixed effects. The standard errors are clustered at the city level.

In Figure G.1 we depict $\beta_r^{(h)}$, representing the cumulative effect of a 100 basis point increase in the one-year rate on cumulative housing returns for different racial groups after h quarters. Once again, we observe that the housing return for minority households decreases more significantly compared with White households.[2] In Figures G.2 and G.3, we show that our results of entries and exits also hold qualitatively, though the gap is somewhat larger.

[2]The Cragg-Donald Wald F statistic for weak identification test is 71 at horizon 8 and 50 at horizon 16. Both are higher than the 10% Stock-Yogo weak ID test critical values.

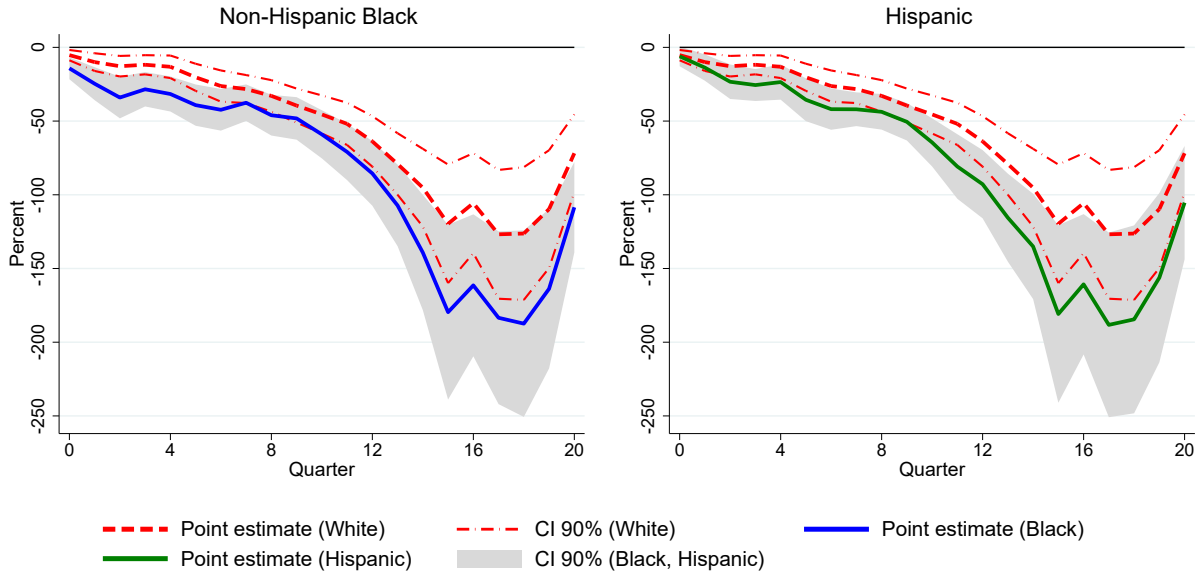

Figure G.1. The Responses of Housing Return to Monetary Shock, by Race, LP-IV Approach

Notes: The figure presents the responses of the cumulative change in the log housing price index when the one-year rate increases by 100 basis points for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1). The standard errors are clustered at the city level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

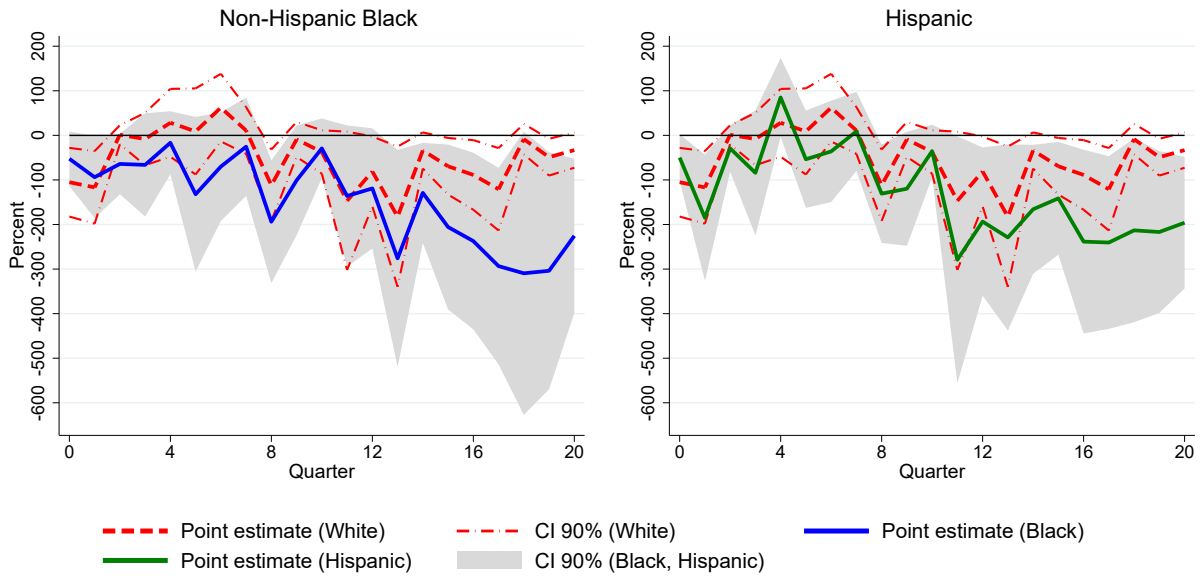

Figure G.2. The Responses of Entry to Monetary Shock, by Race, LP-IV Approach

Notes: The figure presents the responses of the log total entry when the one-year rate increases by 100 basis points for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1). The standard errors are clustered at the city level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

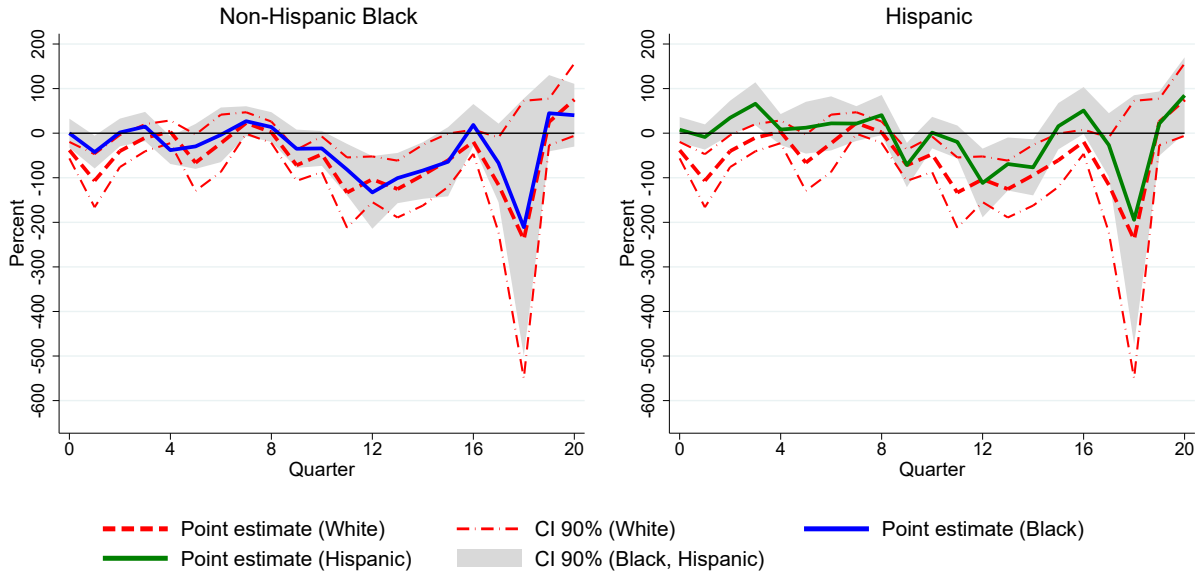

Figure G.3. The Responses of Exit to Monetary Shock, by Race, LP-IV Approach

Notes: The figure presents the responses of the log total exit when the one-year rate increases by 100 basis points for non-Hispanic Black (left) and Hispanic (right) racial groups, and compares them with the responses for non-Hispanic White homeowners. The responses are estimated using the specification in Equation (1). The standard errors are clustered at the city level. The 90% confidence intervals are represented using the shaded area for minority homeowners and dash-dot lines for White homeowners.

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