Online Appendix

"Interest rates and the spatial polarization of housing markets"

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A Superstar cities revisited

A.1 Rent growth

Gyourko, Mayer, and Sinai (2013) derive a set of propositions, that directly imply that superstar cities should have experienced stronger rent growth than the rest of the country. Proposition 1 states that superstar cities have higher rental values than the rest of the country. Proposition 3 states that an increase in aggregate income leads to stronger rental increases in the superstar cities than in the rest.[15] These two propositions are tested in Tables 2 and 3 of the paper, using log house value as the dependent variable. Here, we replicate the analysis focusing on the effects on house value growth and rent growth. Table 2 presents our regression output. There are two primary results. First, the coefficients for rent values are significant and positive, just as the coefficients for house values. Second, the coefficients for rent values are slightly less than half those of house values. This indicates that the effects on rents are much smaller than on prices, which raises the question of whether we can fully explain the strong divergence in prices with the divergence in rents.

Table 2: *Replicating Panel A from Tables 2 and 3 in Gyourko, Mayer, and Sinai (2013)*

	log house value	log rent value	log house value	log rent value
Superstar	0.605	0.291		
	(0.0729)	(0.0377)		
Superstar x Rich			0.394	0.172
			(0.0356)	(0.0193)
N	1116	1116	1116	1116
adj. R^2	0.414	0.308	0.856	0.861

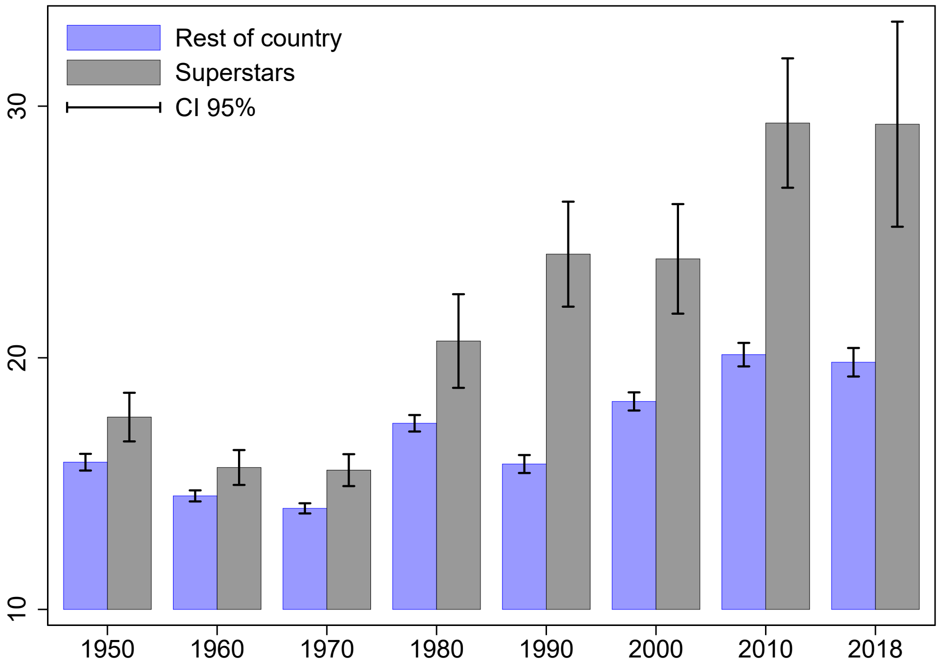
Note: This table replicates Panel A from Tables 2 and 3 in Gyourko, Mayer, and Sinai (2013). In addition to the regression on log house value, we perform the same regression on rent log value. Columns 1 and 2 present the results of a regression of the left hand-side variable on a superstar dummy and year fixed effects. Columns 3 and 4 present the OLS coefficients of a regression on an interaction effect of a superstar dummy and the log number of rich families in the U.S. and time and superstar fixed effects. Standard errors are in parentheses and are clustered at the MSA-level.

[15] Propositions 2 and 4 relate to income growth in the superstar cities.

A.2 Price-rent ratios

In this subsection, we present evidence that the divergence in price-rent ratios between superstar cities and the rest has strongly increased since the 1980s, extending the data set presented in Gyourko, Mayer, and Sinai (2013) to 2010 and 2018. We then use the definition of superstar cities to categorize the cities into superstars group and non-superstars groups, which we call the rest of the country. We estimate an equally weighted average of price–rent ratios for both groups by year. Figure 5 presents the results. The Figure shows that price–rent ratios have been increasing over time in superstar areas and in the rest of the country. However, in the superstar cities, price–rent ratios have increased much more, leading to a growing regional divergence in price–rent ratios.

Figure 5: *Price–rent ratios in the U.S., 1950-2018*



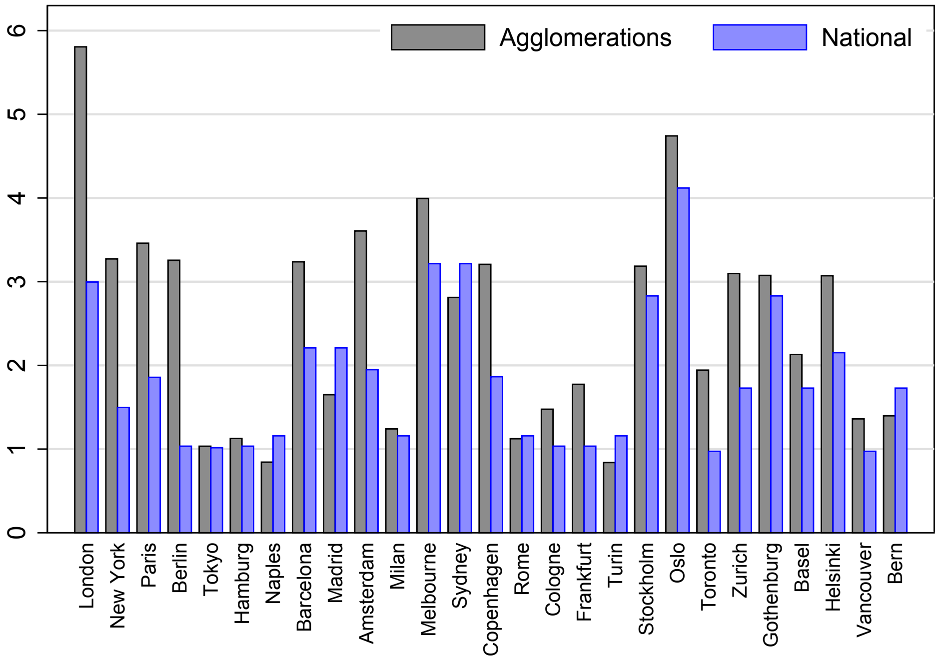
Note: We define superstar cities as cities that were at least once a superstar city between 1950 and 2000 according to the superstar definition in Gyourko, Mayer, and Sinai (2013). We extended the data from Gyourko, Mayer, and Sinai (2013) to 2010 and 2018. Each bar represents an unweighted average by year for the specific group. 95% confidence bands are shown in black.

The model developed by Gyourko, Mayer, and Sinai (2013) predicts that price–rent ratios are higher in superstar cities, but it does not account for the growing gap between superstars and non-superstars over time.

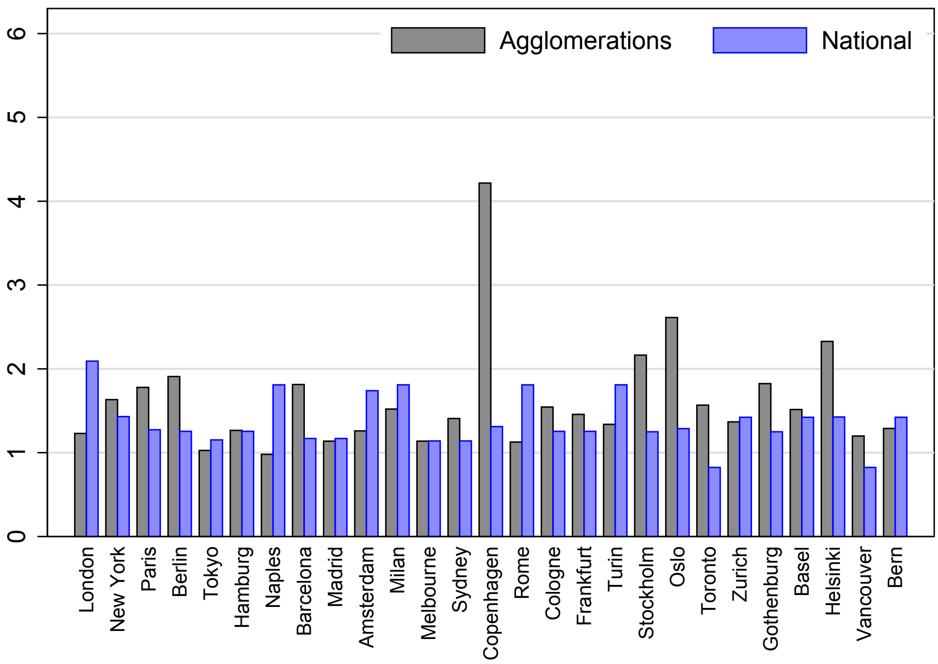
B Price and rent growth rates for 27 major agglomerations

Figure 6: *City-level growth rates for 27 major agglomerations compared to national averages*

(a) *Housing prices*



(b) *Rents*

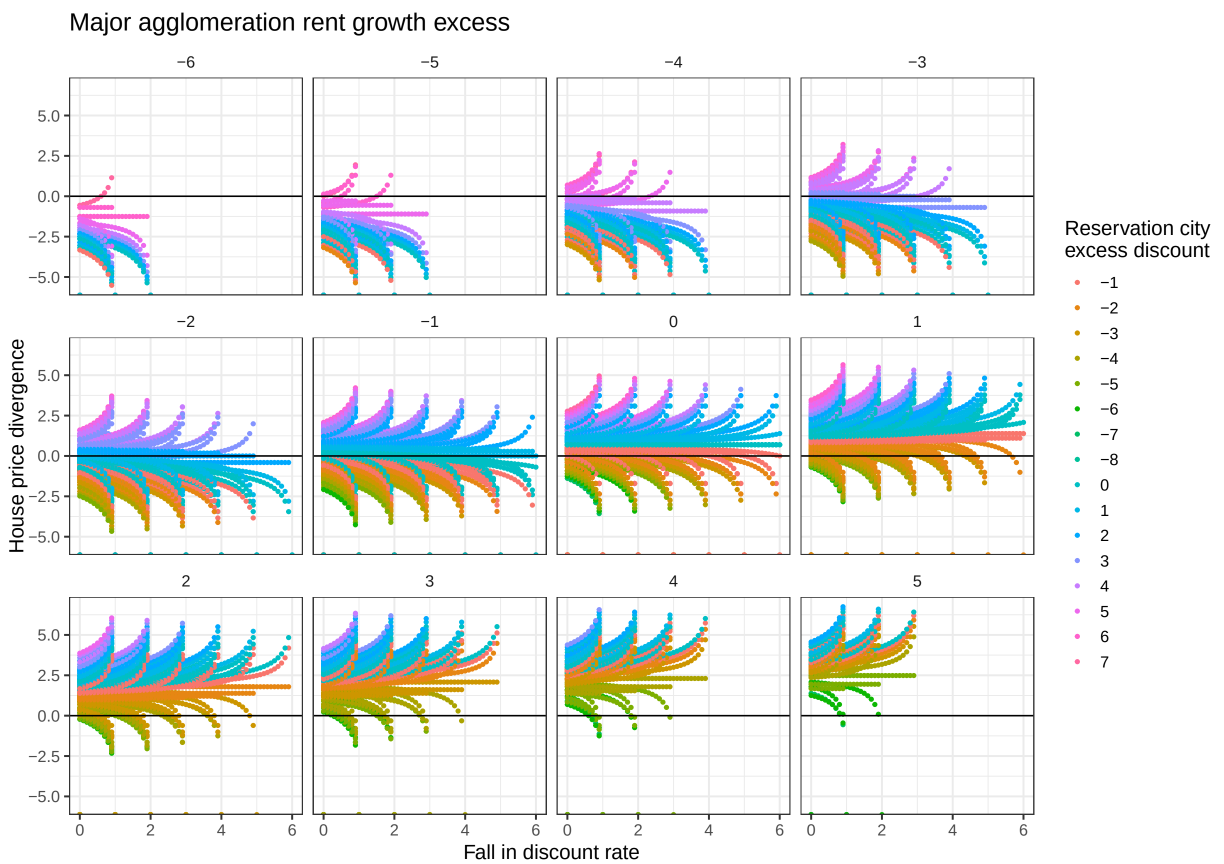


Note: Geometric mean of annual housing price (Panel (a)) and rent (Panel (b)) growth rates by city for 27 major agglomerations (black) and the respective national averages (blue).

C Model simulation of risk–free rate fall on housing price divergence

To examine the scope conditions under which a falling discount rate leads to increasing housing price divergence between the agglomeration and the reservation city, we simulate our asset-pricing model for a range of potential, and not always realistic, values. The result displays the housing price divergence (in log) as a function of falling discount rates (in %) and is broken down for all possible combinations of differences in rent and discount rate growth rates between the agglomeration and reservation city (7). The figure demonstrates that housing price divergence occurs under a majority of calibrations, as long as the agglomeration rent growth excess and the reservation city excess discount rate is sufficiently high.

Figure 7: *Simulation results by excess rent growth of agglomeration*



Note: Facets show the percentage points by which the agglomeration's rent growth exceeds that of the reservation city. Colors indicate the percentage points by which the reservation city's discount rate exceeds that of the agglomeration.

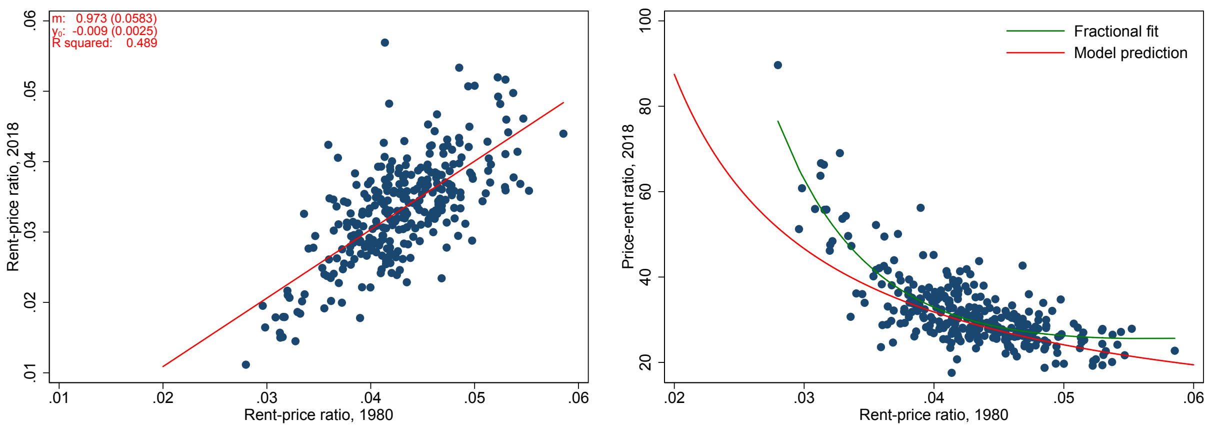
D Model evidence using U.S. MSA-level data

We also use the U.S. MSA-level data from Gyourko, Mayer, and Sinai (2013), which was extended to 2018 in Amaral et al. (2021), to test our mechanism empirically. We want to replicate Figure 3 in the main paper. Our mechanism predicts a one-to-one relation between rental yields in 1980 and in 2018, with a linear shift due to the fall in real discount rates (compare Figure 2 in the main paper). It also predicts a non-linear relation between rental yields in 1980 and price–rent ratios in 2018, with initially lower rental yield MSAs subsequently having disproportionately higher price–rent ratios (compare Figure 3 panel (b) in the main paper). As demonstrated below, these predictions hold to a great extent in the data.

Figure 8 panel (a) plots the rent–price ratios for all MSAs in 2018 relative to the rent–price ratios in 1980. It also shows a linear fit with the resulting regression coefficients. Rent–price ratios in 2018 can indeed be predicted by rent–price ratios in 1980 but have fallen uniformly by approximately 85 basis points. Of course, MSA-level rent–price ratios do not perfectly align with the regression line. This implies that rent–price ratios have also been affected by city–specific shocks. Not all variation in rent–price ratios can be explained by a fall in discount rates alone, however, the linear fit can explain approximately half of the variation in the data.

Figure 8: *Comparison model and U.S. MSA-level data*

(a) *Rent-price ratio 2018* **(b)** *Price-rent ratio 2018*



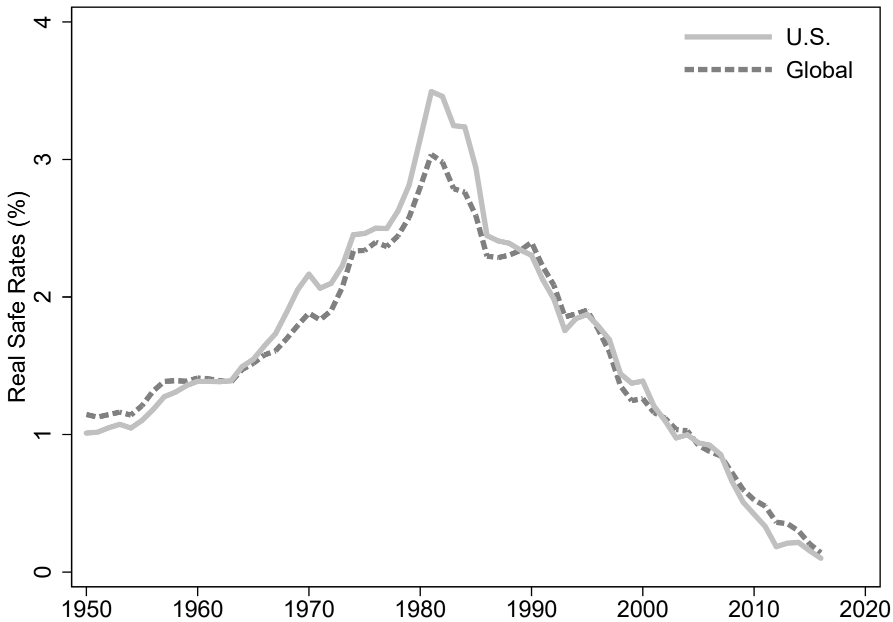
Note: Panel (a) shows the rent–price ratios in 2018 relative to the rent–price ratios in 1980 together with a linear fit and the resulting regression coefficients (standard errors in parentheses). Panel (b) shows the price–rent ratio in 2018 relative to the rent–price ratio in 1980 together with a fractional fit and the predictions of our model resulting from the linear fit in Panel (a). The data is taken from Gyourko, Mayer, and Sinai (2013) and extended by Amaral et al. (2021).

Panel (b) of Figure 8 plots price–rent ratios in 2018, also presenting a fractional fit to the data (green line). The red line depicts the price–rent ratios that the model would predict for 2018, given the rent–price ratio in 1980 and the uniform fall in rent–price ratios estimated in panel (a). Again, the model does not fit the data perfectly, however, it does agree with the overall picture of the data and predicts higher price–rent ratios for cities that already had low rent–price ratios in 1980. The fact that price–rent ratios in cities with the lowest rental yields initially are even higher than predicted by the model leaves some room for alternative explanations. One example would be increasingly more optimistic rent expectations (g) in major agglomerations relative to the rest of the country. Another would be a tightening of supply constraints in major agglomerations.

E Fall in real safe rates

Several papers have documented the long-run decline in real safe rates across OECD economies since the 1980s (Del Negro et al., 2019; Rachel and Summers, 2019; Blanchard and Katz, 1992). Using the estimates from Del Negro et al. (2019), we plot the time-series evolution of ex-ante real safe rates in the U.S. as well as averaged over 15 OECD economies in Figure 9. It is evident that real safe rates have been declining considerably both in the U.S. as well as across the world, since the 1980s.

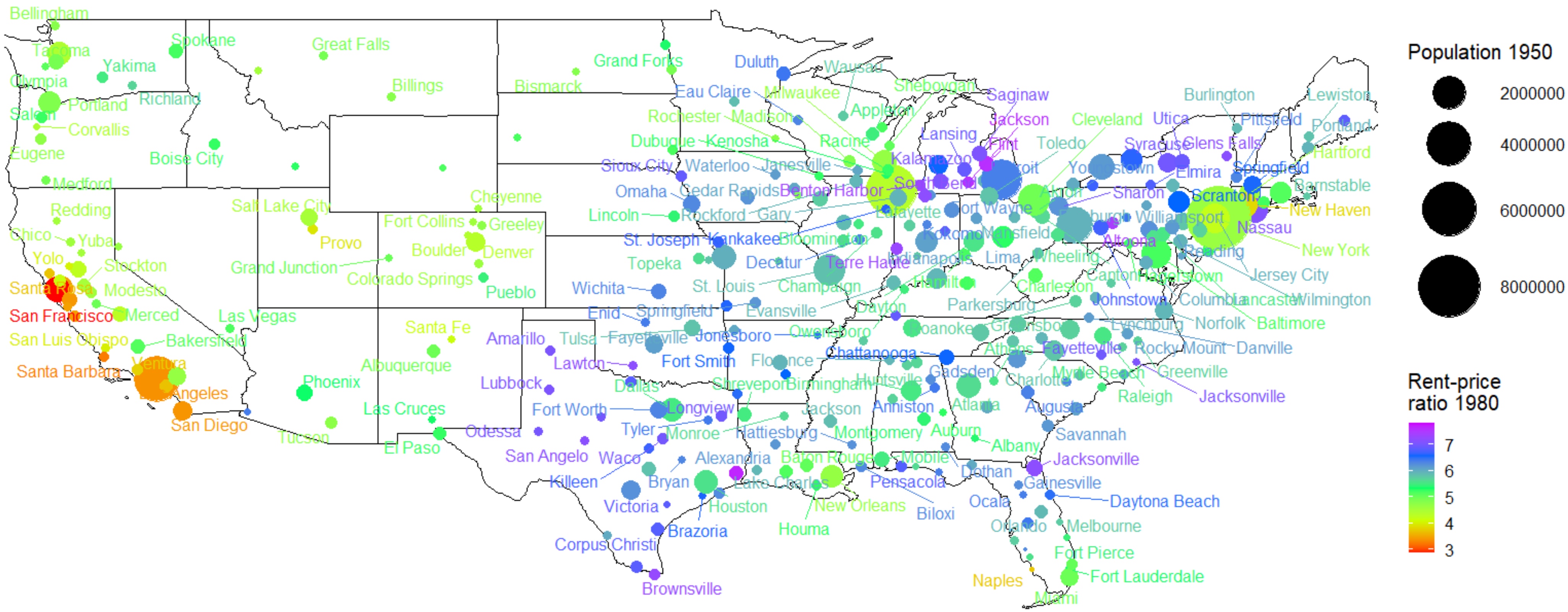
Figure 9: *Global and U.S. Real Safe Rates, 1950-2016*



Note: The Figure plots the posterior median of the trend in global and U.S. real safe rates. The estimates are taken from Del Negro et al. (2019).

Figure 10: *Rent–price ratios in the U.S. 1980*

F USA Rent-price ratios 1980



Note: Data for US MSAs are taken from Gyourko, Mayer, and Sinai (2013) extended for the period 2010 to 2018 with the American Community Survey.