# On-Line Appendix

Appendix A1: Distribution of State Economic Factor R^2 and Beta

Panel A shows the kernel density of the explained variation in 51 separate regressions of local economic conditions on a constant and national economic conditions as discussed in Section 4. Panel B shows the kernel density of the coefficients on national economic conditions in the aforementioned regression.
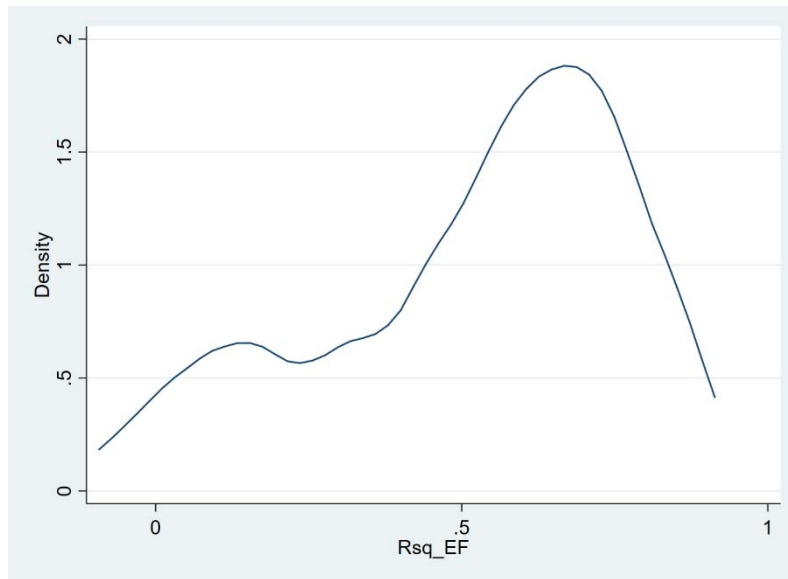

(a)
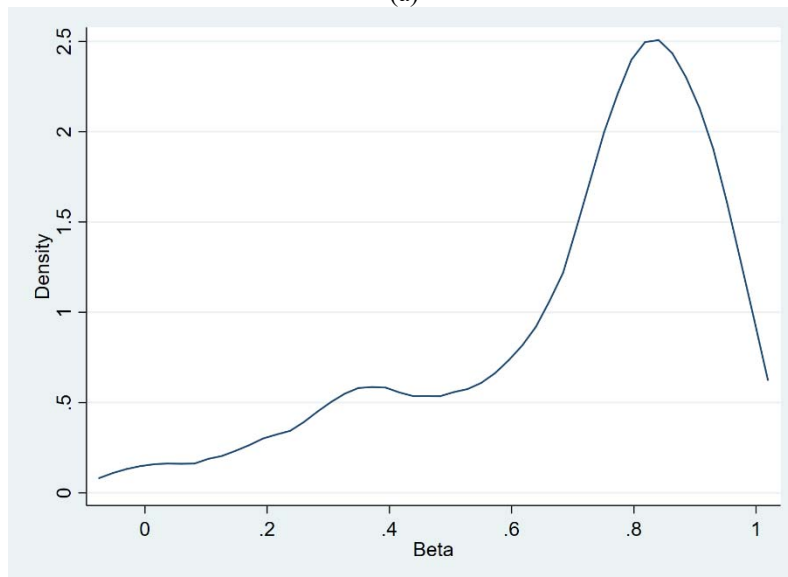
(b)

Appendix A2: Relationship between Equifax CLTV and CRISM CLTV

We note that the Equifax data we use does not have a direct measure of current CLTV of mortgage borrowers. We compute this variable in a region (county or zip code) by dividing the average combined mortgage debt level of borrowers with first mortgages on their credit files by the median house price in a region (from Zillow). The plot below verifies that our (Equifax-based) measure of average CLTV in a zip code is closely related to the CLTV measure from wieldy used Credit Risk Insight Servicing McDash (CRISM) data that covers approximately seventy percent of mortgage borrowers. It shows the relationship between zip CLTV in the CRISM data (x-axis) and the Equifax data (y-axis) during the depth of the crisis (in 2009). As we observe the estimated slope of this relationship is very close to unity. We note that our measure indicates slightly higher CLTV levels than CRISM data, likely in part due to underrepresentation of subprime borrowers in the CRISM data.


$y = 1.0192x + 7.549$
$R^2 = 0.5892$
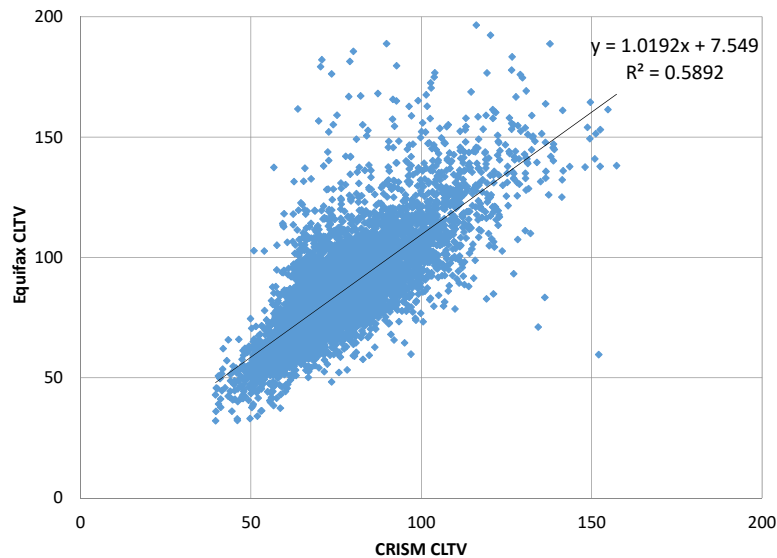
A3: Zip Code Heterogeneity: DTI, Credit Score (Vantage), and Foreclosures during the Great Recession
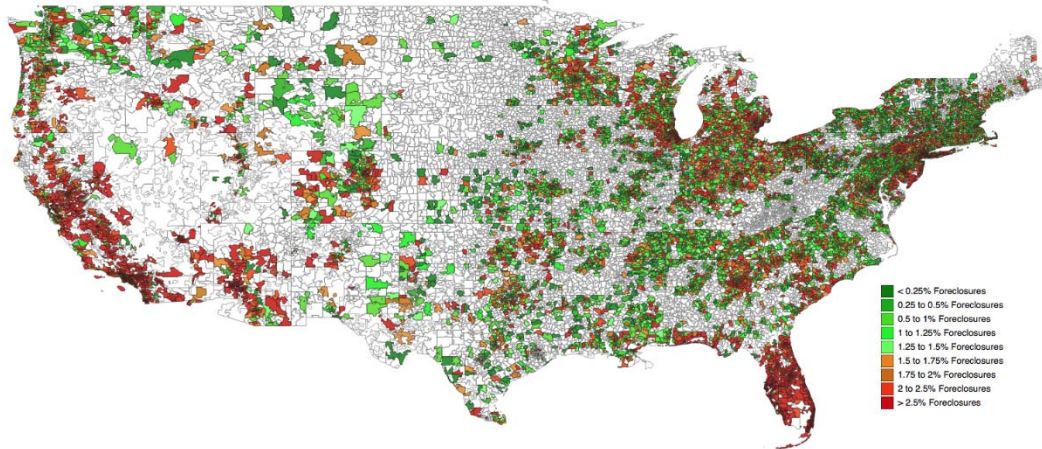
Panel A shows the spatial distribution of average annual zip code mortgage debt payment to income ratio (DTI) in 2010. Panel B shows average zip code vantage in 2010. Panel C shows the percentage of loans in foreclosure in zip code in 2010. Data comes from the Equifax representative panel of 10% of US population.
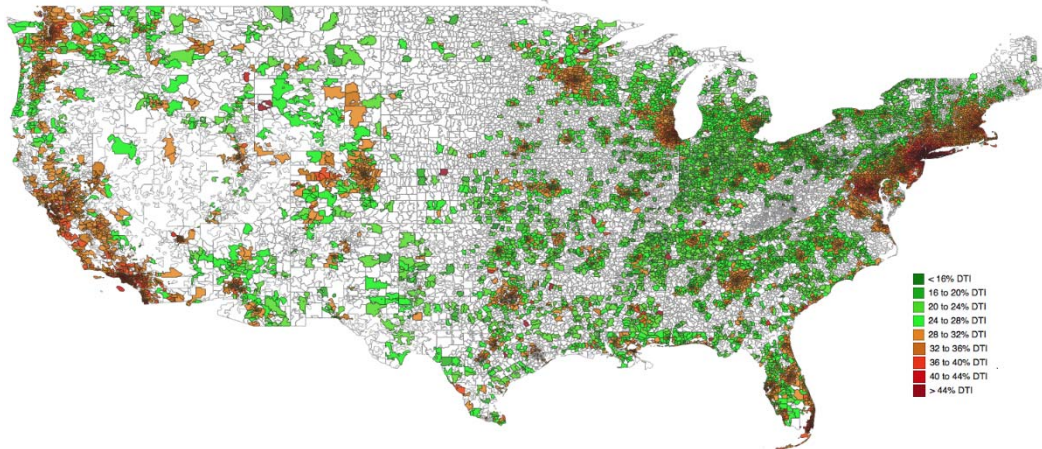
(a) DTI
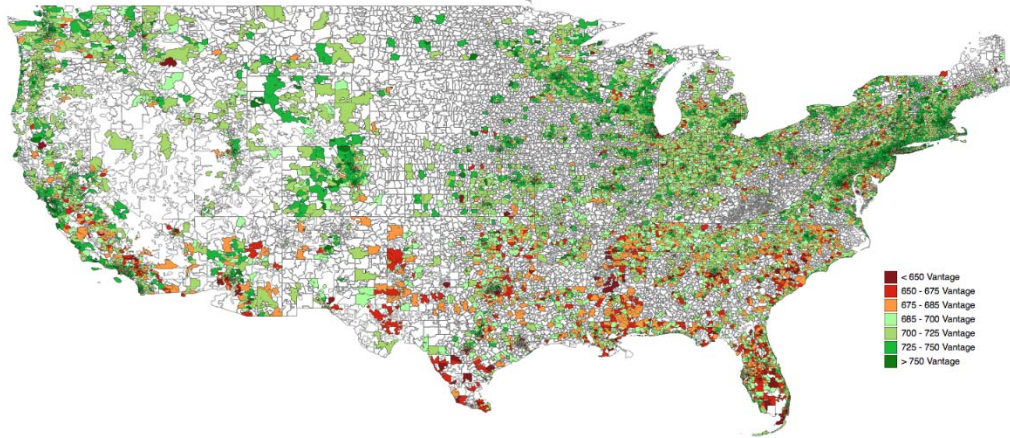
(b) Credit score

(c) Foreclosure rate

Appendix A4: Summary Statistics for the Analysis of the Importance of Local Economic Variables and the Upper Bound to R^2

This table shows the summary statistics of major housing variables at the zip-code level used in the analysis shown in Table 5. Panel A shows the statistics for levels while Panel B shows the corresponding statistics for the monthly growth rates. Combined loan to value, debt to income, delinquency rates, and foreclosures data are from Jul 2005-Dec 2017 (form Equifax); real house price data are from Jan 1997-Dec 2017 (from Zillow).

Panel A: Levels

Variable	Obs.	Mean	Std. Dev.
Real House Price	3,378,242	$235,118	$170,804
CLTV	2,001,211	81%	7%
DTI	2,135,081	29%	4%
Delinquency Rate	2,101,678	5%	4%
Foreclosure Rate	2,082,162	2%	2%

Panel B: Growth Rates

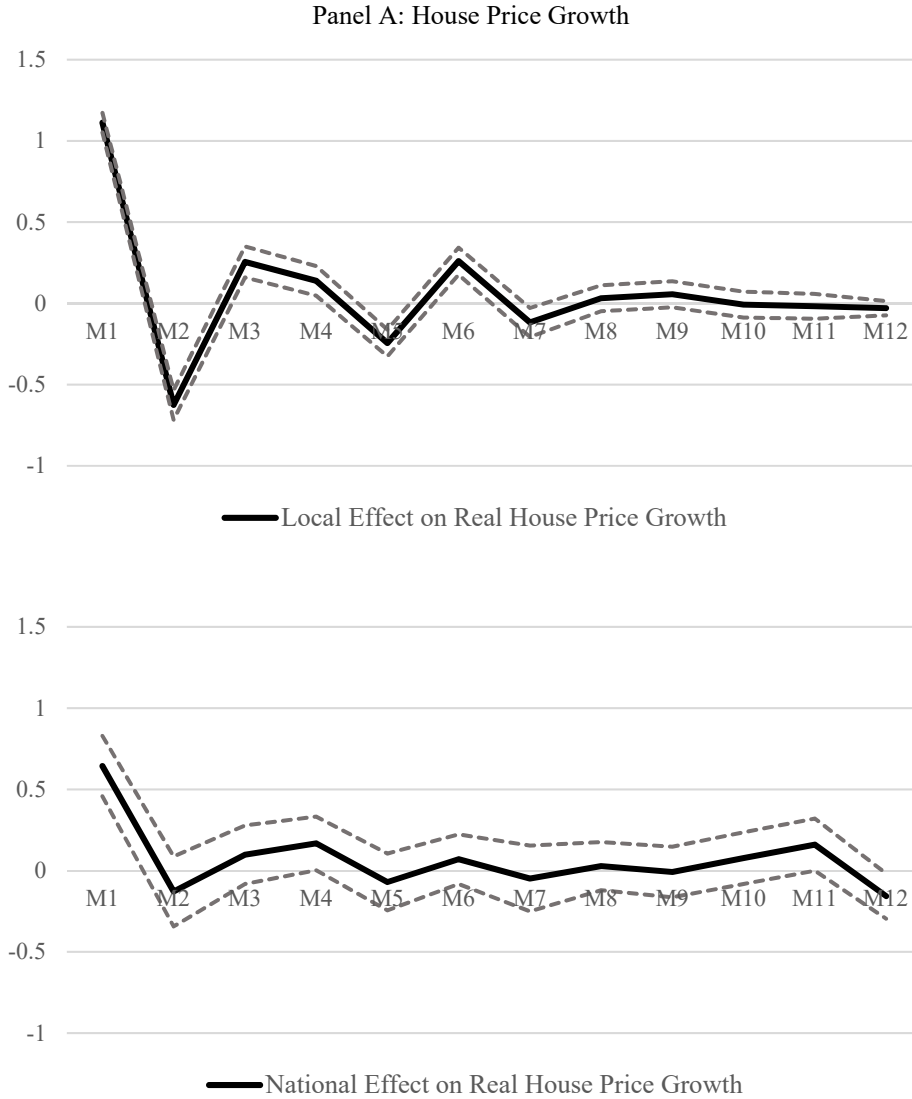| Variable	Obs.	Mean	Std. Dev.
Real House Price	3,378,005	0.10%	1%
CLTV	2,001,211	0.11%	3%
DTI	2,135,081	0.12%	3%
Delinquency Rate	2,101,678	3.43%	46%
Foreclosure Rate	2,082,162	-0.05%	34%

Appendix A5: Robustness: The Importance of Local Economic Variables and Upper Bound to R^2

This table shows similar analysis to the one presented in Table 5 where all housing variables are measured at monthly changes. In particular, the table shows the upper bound to R^2 of local zip-code level variables that can be explained by different levels of aggregation. The local zip-code level housing variables are regressed on contemporaneous geography by time fixed effects at the city, county, metro, states, and national level and the unadjusted R^2 is reported in each cell. Further, all housing variables are demeaned at zip-code level and winsorized at 1%. CLTV, DTI, delinquency rates, and foreclosures data are from Jul 2005-Dec 2017; real house price data are from Jan 1997-Dec 2017.

Aggregation\Variable	CLTV Change	DTI Change	Delinquency Change	Foreclosure Change	Real House Price Change
	(1)	(2)	(3)	(4)	(5)
National	3.91%	1.23%	1.05%	0.46%	23.17%
State	6.52%	2.02%	1.75%	1.31%	25.71%
Metro	14.61%	8.06%	7.79%	6.44%	39.85%
County	16.62%	10.18%	9.68%	8.43%	45.13%
City	60.36%	58.85%	62.68%	57.45%	73.19%
Zip Code	100%	100%	100%	100%	100%

Appendix A6: Predictability of Housing Variables and the Importance of Local Indicators
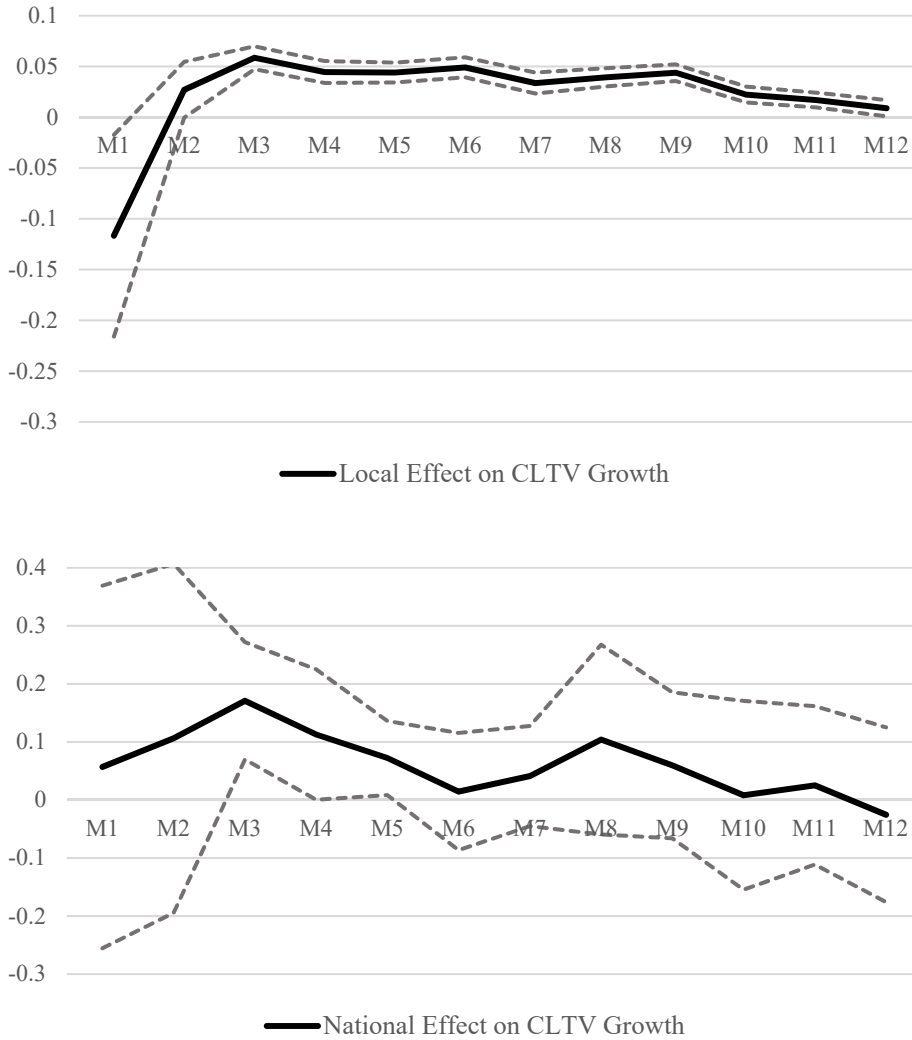
The two figures plot the AR(12) coefficients form a regression of a given zip-code level variable (in the monthly growth rate) on twelve lags of that variable measured at the zip code level (top figure) and the national level (bottom figure). Panel A shows the results for house price growth, Panel B for CLTV growth, Panel C for DTI growth, Panel D for delinquency rate growth, and Panel E for foreclosure rate growth. Two grey lines indicate the 95% confidence intervals.

Panel A: House Price Growth

Local Effect on Real House Price Growth

National Effect on Real House Price Growth

Appendix A6: Predictability of Housing Variables and the Importance of Local Indicators (continued)

The two figures plot the AR(12) coefficients of zip-code level loan to value ratio (CLTV) growth on lagged zip-code level CLTV growth (upper panel) and lagged national level CLTV growth (lower panel). The underlying CLTV data are from Jul 2005-Dec 2017 at monthly frequency. The two grey lines indicate the 95% confidence intervals.

Panel B: CLTV Growth

The two figures plot the AR(12) coefficients of zip-code level debt to income ratio (DTI) growth on lagged zip-code level DTI growth (upper panel) and lagged national level DTI growth (lower panel). The underlying DTI data are from Jul 2005-Dec 2017 at monthly frequency. The two grey lines indicate the 95% confidence intervals.
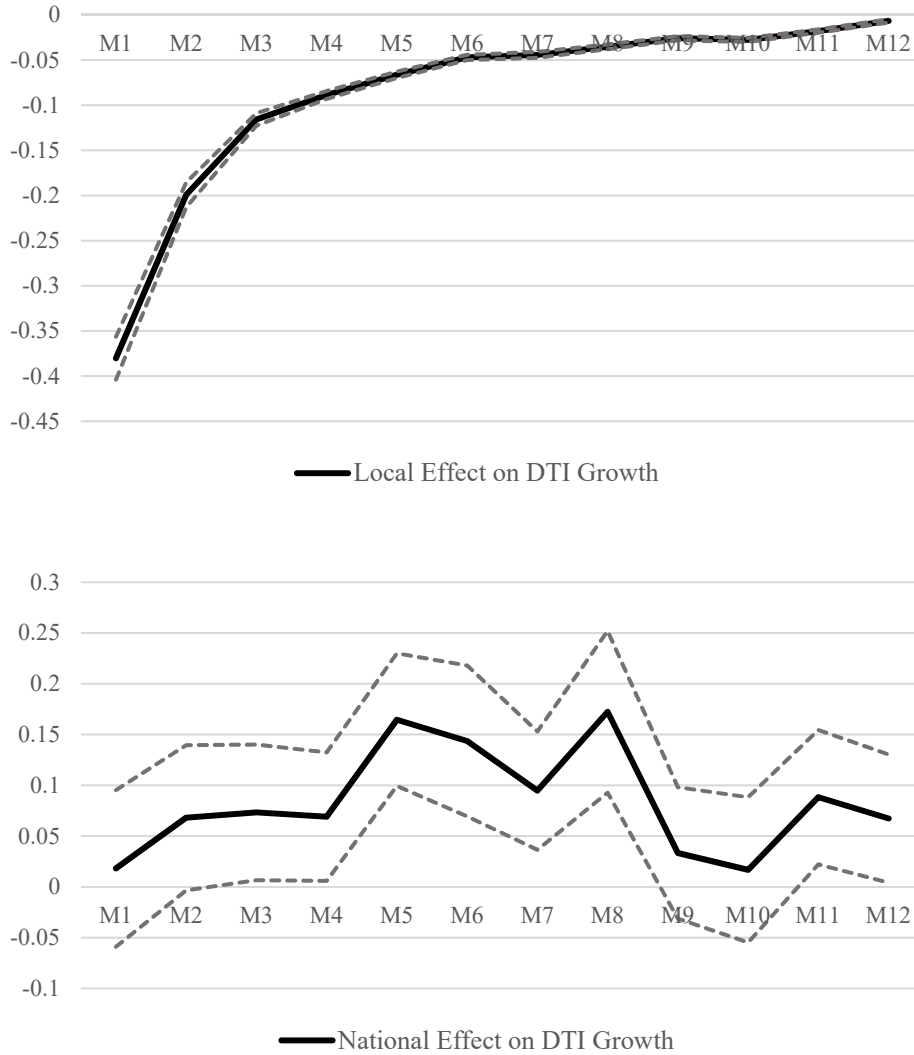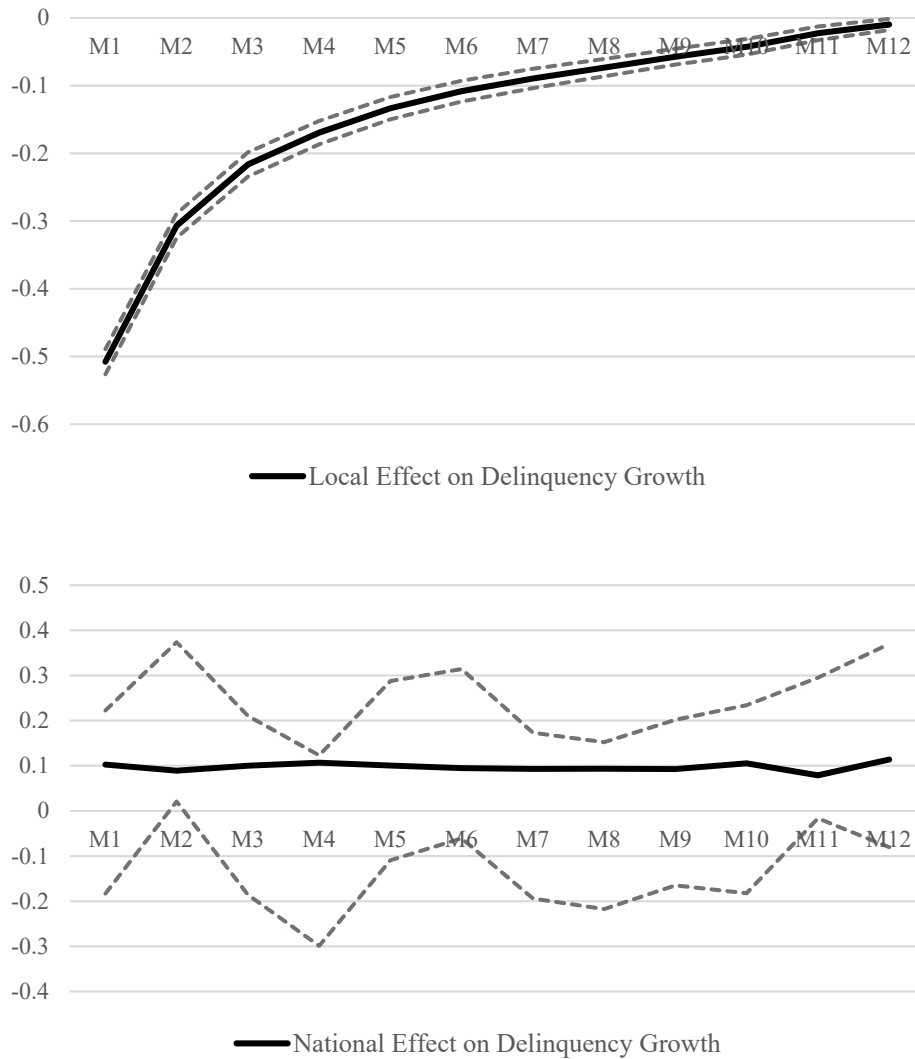
Panel C: Debt to Income Growth

Local Effect on DTI Growth

National Effect on DTI Growth

Appendix A6: Predictability of Housing Variables and the Importance of Local Indicators (continued)

The two figures plot the AR(12) coefficients of zip-code level delinquency growth on lagged zip-code level delinquency growth (upper panel) and lagged national level delinquency growth (lower panel). The underlying delinquency data are from Jul 2005-Dec 2017 at monthly frequency. The two grey lines indicate the 95% confidence intervals.

Panel D: Delinquency Rate Growth

Appendix A6: Predictability of Housing Variables and the Importance of Local Indicators (continued)

The figures plot the AR(12) coefficients of zip-code level foreclosure growth on lagged zip-code level foreclosure growth (upper panel) and lagged national level foreclosure growth (lower panel). The underlying foreclosure data are from Jul 2005-Dec 2017 at monthly frequency. The two grey lines indicate the 95% confidence intervals.

Panel E: Foreclosure Rate Growth

— Local Effect on Foreclosure Growth

— National Effect on Foreclosure Growth
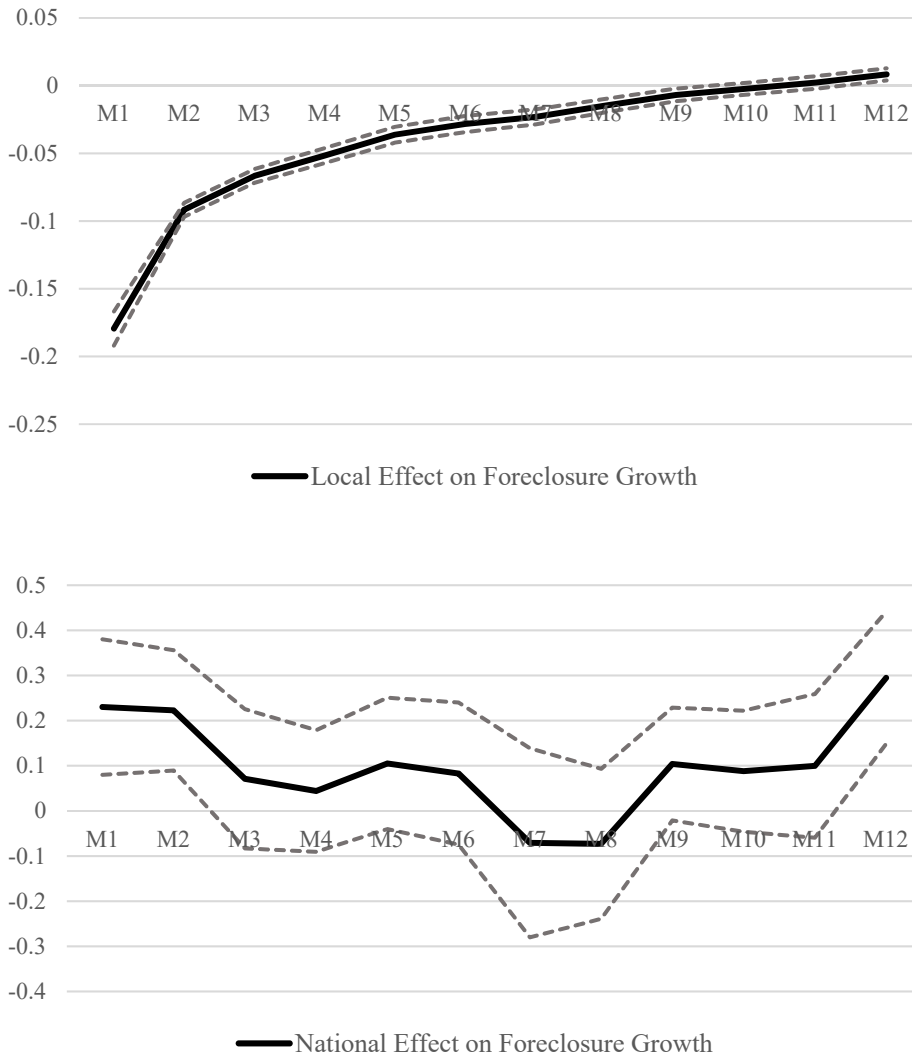
Appendix A7: Major Interest Rate Indices

This figure shows major interest rate indices (6 month LIBOR and 1-Year Treasury) to which ARM loans reset along with the Fed funds rate. We also mark on this figure the ARM reset period we focus on in our analysis in Section 5.1.1.
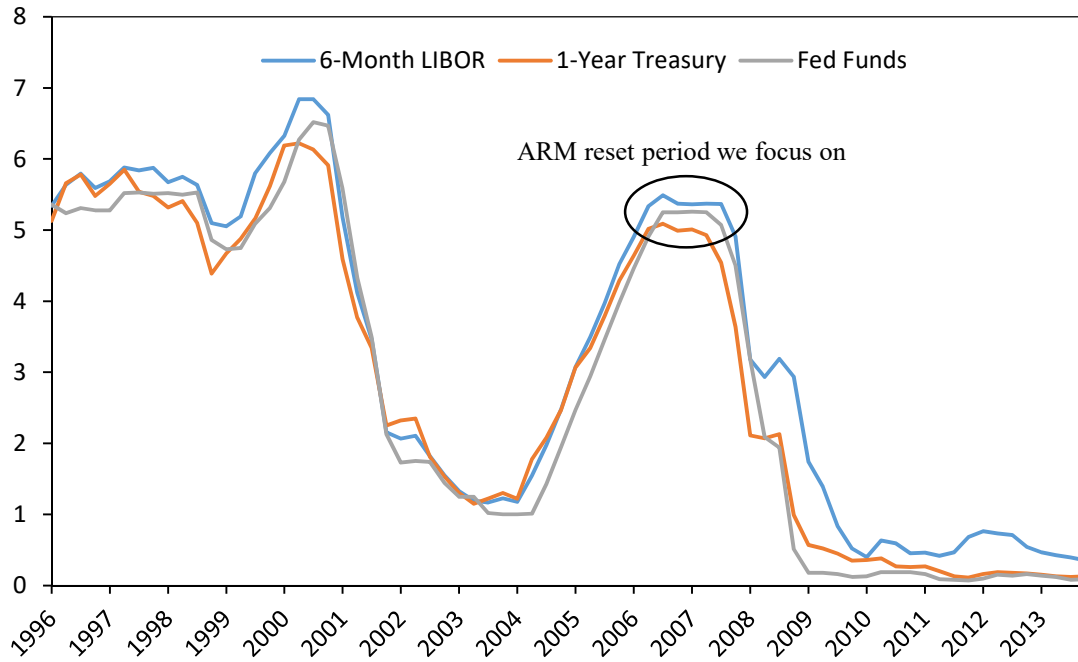
Appendix A8: Example of Zip Code Zillow Index

This figure shows average house price index for the zip code 85023 in Phoenix, Arizona. *Source:* Zillow.com.

85023 Home Prices & Values

ZILLOW HOME VALUE INDEX

$234,700

7.3% 1-year change   2.5% 1-year forecast

Jul 2016   Aug 2017   Aug 2018

MARKET TEMPERATURE

Cool

Buyers' Market   Sellers' Market

The median home value in 85023 is $234,700. 85023 home values have gone up 7.3% over the past year and Zillow predicts they will rise 2.5% within the next year. The median list price per square foot in 85023 is $143, which is lower than the Phoenix average of $155. The median price of homes currently listed in 85023 is $249,900. The median rent price in 85023 is $1,250, which is lower than the Phoenix median of $1,300.

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