Online Appendix

24th September 2013

1 Robustness checks for homeownership and LTV effects

Here, we check for robustness in the impact of price levels and volatilities on ownership (Table 1) and LTV (Table 2). We report results for both OLS and IV (with land scarcity as the instrument), for volatilties measured using different windows (5 years, as in the main text, and 10 years also), for different year cross-sections (2000, as in the main text, and 1990 also), and for different datasets for LTV (AHS and MIRS).

For homeownership, the observed patterns are robust to choice of cross-section, volatility window and year. In each case, we see the strong negative relationships described in the main text. Looking at the OLS specification, the effect of price is very similar across years: a doubling of house prices is associated with a fall in the ownership rate of between 21 and 24 percentage points. The IV results are very similar. With regards to volatility, changing the window of measurement has little effect on the coefficients for each cross-section. But, the results do vary across years: the OLS effects are larger in 2000, and the IV effects larger in 1990. Still, the reduced form effect of the land scarcity instrument (in the final row) is very similar across years.

In Table 2, the estimated effects are remarkably similar in magnitude across the AHS and MIRS datasets for the 2000 cross-section, for all variables. In each case, there is a strongly significant negative effect, consistent with the main text. The results are not very sensitive to the chosen volatility window either. However, the effects on LTV in the 1990 cross-section (as measured by MIRS), while negative, are all statistically insignificant. This is a result of smaller coefficients, rather than larger standard errors. In Figure 1, we explore this further: we plot the estimated coefficients from reduced form regressions of LTV (from the MIRS data) on land scarcity, separately by year (over 1978-2008). The dashed lines are 95 percent confidence intervals. The effect has always been negative, though it was small and insignificant until the mid-1990s (averaging about -0.5). It has grown steadily since though, reaching almost -2 in 2008.

2 Disaggregation of price and volatility effects

Table 3 provides the detail for a discussion in Appendix B in the main text. The idea is to show that the strong positive relationship between local land share and price levels/volatilities is entirely a composition effect: the land value component (as opposed to structure cost) is larger and more volatile. The same is true when we instrument land share with land scarcity: the effect appears to be causal.

In Panel A, we regress price levels and volatilities - and their individual components - on land share, for the 2000 cross-section. This is based on the 42 MSA sample, for which we have the Davis-Palumbo land share data; in this sample, land share varies from 0.15 to 0.85. A 0.1 increase (a 10 percentage point increase) in the land share is associated with a 21 percent increase in local house prices. This effect is entirely due to variation in land value, rather than structure cost. Also, a 0.1 increase in the land share is associated with a 0.0081 increase in price volatility. The effect of land share on the volatilities of land value and structure costs are statistically insignificant. Evidently then, the positive relationship between overall price risk and land share is entirely due to a composition effect (land values are much more volatile than structure costs).

Panels B and C give the reduced form and 2SLS effects of land share on the disaggregated price levels and volatilities, where land scarcity is the instrument for land share. The IV effects in Panel C are qualitatively and quantitatively similar to the OLS effects in Panel A.

3 Land scarcity slopes for parametrization

In Section 4 of the main text, we describe the parametrization of the model. Our method is to compare cities with different scarcity of land, which we take as an exogenous variable. These cities differ in a number of dimensions that are important for the model: specifically, levels and volatilities of local house prices and wages, and local land share. In Table 4, we report the OLS reduced form estimates of these variables on land scarcity, our instrument. In the paper, we use these estimates to characterize cities with high and low land scarcity; see Section 4 in the paper for further details.

As a robustness exercise, Tables 5 and 6 report the land scarcity slopes for house price volatility and wage volatility respectively, varying the time window used to calculate volatility in each column. In each table, the first column (volatility window 1995-2000) gives the estimates used in the parametrization in the paper. The mean house price volatility grows significantly as the window is extended: the constant in the regression is more than double for the 1985-2009 window as compared to 1995-2000. The land scarcity slope also grows with the volatility window, largely due to recent cyclicality: the slope approximately doubles when the boom and bust of the 2000s is included. For reference, if we changed our calibration sample to 1986-2000, the mean city by land scarcity would have as much house price volatility as the 75th percentile city does in the 1996-2000 calibration.We already know from the counterfactual section in the body of the paper that that would have only a small affect on the model output, particularly as regards homeownership.

The coefficients on wage volatility are more robust to changes in the volatility window. The coefficient on land scarcity hardly changes at all across the columns of Table 6. But, the constant does grow somewhat as the window is extended: it is almost twice as large for the 1985-2009 window, as compared to 1995-2000.

Tables and figures

Table 1: Effects on homeownership of price, volatility and land scarcity

Year sample	2000			1990		
	OLS	IV	Observations	OLS	IV	Obs
Log house price	-0.235***	-0.254***	221	-0.214***	-0.233***	191
	(0.013)	(0.024)		(0.012)	(0.022)	
Volatility (5yr window)	-4.952***	-6.755***	221	-2.815***	-8.162***	153
	(0.402)	(0.795)		(0.228)	(2.132)	
Volatility (10yr window)	-4.378***	-5.689***	215	-2.630***	-13.390**	98
	(0.323)	(0.642)		(0.519)	(5.552)	
Land scarcity	-0.245***	-	221	-0.263***	-	191
	(0.032)	-		(0.036)	-	

This table reports coefficients from linear cross-city regressions of the local homeownership rate for both 2000 and 1990 on a range of variables: log house price, two measures of volatility (5yr and 10yr windows) and land scarcity. For the IV results, we use land scarcity as an instrument for prices and volatility. Note that 1990 has fewer observations because the set of MSAs in the census changed between 1990 and 2000. Local homeownership rates are conditional on household characteristics, and are constructed as described in Section 2.1 in the main text, using the IPUMS 5 percent census extracts of 1990 and 2000. We include volatility measures (constructed as described in Section 2.1) for both a 5 year window (i.e 1995-2000 for 2000; 1985-1990 for 1990) and a 10 year window (1990-2000 for 2000; 1980-1990 for 1990). The 1990 samples are smaller beause the set of MSAs has changed between years. And, the samples for some volatility windows are smaller because the FHFA time series for prices are longer for some cities than others. All regressions are weighted by census sample counts. SEs in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 2: Effects on LTV of price, volatility and land scarcity

Dataset, year	AHS, 2000			MIRS, 2000			MIRS, 1990		
	OLS	IV	Observations	OLS	IV	Obs	OLS	IV	Obs
Log house price	-0.064***	-0.076***	42	-0.055***	-0.071***	25	-0.014	-0.021	25
	(0.011)	(0.020)		(0.009)	(0.014)		(0.012)	(0.018)	
Volatility (5yr window)	-0.995***	-1.830***	42	-1.153***	-1.695***	25	-0.241	-0.645	25
	(0.329)	(0.612)		(0.242)	(0.406)		(0.156)	(0.629)	
Volatility (10yr window)	-0.703***	-1.543***	42	-0.783***	-1.579***	25	-0.347	-0.908	25
	(0.262)	(0.547)		(0.215)	(0.485)		(0.268)	(0.864)	
Land scarcity	-0.072***	-	42	-0.078***	-	25	-0.028	-	25
	(0.023)	-		(0.019)	-		(0.026)	-	

This table reports coefficients from linear cross-city regressions of local mean LTV ratio on a range of variables: log house price, two measures of volatility (5yr and 10yr windows) and land scarcity. For the IV results, we use land scarcity as an instrument for prices and volatility. The first set of columns corresponds to the AHS in 2000; here, LTV ratios are conditional on household characteristics, and are constructed as described in Section 2.1 in the main text. For the MIRS, we report estimates for both 2000 and 1990. We include volatility measures (constructed as described in Section 2.1) for both a 5 year window (i.e 1995-2000 for 2000; 1985-1990 for 1990) and a 10 year window (1990-2000 for 2000). The FHFA data does not extend back sufficiently to calculate 10yr volatilities for 1990. All regressions are weighted by census sample counts. SEs in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Explaining cross-city variation in local price levels and volatilities

PANEL A: OLS (2000)

	(1) Log HP	(2) Log LV	(3) Log SC	(4) Vol HP	(5) Vol LV	(6) Vol SC
Land share	2.110***	4.594***	0.128	0.081***	-0.044	0.004
	(0.151)	(0.168)	(0.155)	(0.012)	(0.035)	(0.004)
Constant	11.239***	9.224***	11.505***	-0.006	0.100***	0.008***
	(0.072)	(0.080)	(0.074)	(0.006)	(0.017)	(0.002)
Observations	42	42	42	42	42	42
R-squared	0.830	0.949	0.017	0.519	0.037	0.022

PANEL B: Reduced Form (2000)

	(1) Log HP	(2) Log LV	(3) Log SC	(4) Vol HP	(5) Vol LV	(6) Vol SC
Land scarcity	0.975***	2.076***	-0.008	0.052***	0.016	0.004
	(0.241)	(0.482)	(0.122)	(0.011)	(0.028)	(0.003)
Constant	11.888***	10.653***	11.565***	0.014***	0.075***	0.009***
	(0.088)	(0.175)	(0.044)	(0.004)	(0.010)	(0.001)
Observations	42	42	42	42	42	42
R-squared	0.290	0.317	0.000	0.350	0.008	0.033

PANEL C: IV (2000)

	(1) Log HP	(2) Log LV	(3) Log SC	(4) Vol HP	(5) Vol LV	(6) Vol SC
Land share	2.075***	4.419***	-0.018	0.110***	0.034	0.008
	(0.246)	(0.276)	(0.255)	(0.021)	(0.060)	(0.007)
Constant	11.254***	9.302***	11.571***	-0.019**	0.065**	0.006**
	(0.112)	(0.126)	(0.117)	(0.010)	(0.028)	(0.003)
Observations	42	42	42	42	42	42
R-squared	0.829	0.948	0.000	0.449	0.000	0.000

HP is house price, LV is land value, SC is structure cost. Price levels (Log **) are means over the four quarters of 2000. Volatility ("Vol") is standard deviation over annual growth rates in prices (measured at first quarter of each year), between 1995 and 2000. Instrument in IV columns is land scarcity. Observations are weighted by city size. SEs in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Land scarcity slopes for key parameters

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Log house price	Log wage	House price volatility	Wage volatility	Land share
Land scarcity	0.966***	0.193***	0.036***	0.012***	0.470***
	(0.100)	(0.062)	(0.004)	(0.003)	(0.099)
Constant	11.760***	10.431***	0.015***	0.008***	0.306***
	(0.034)	(0.021)	(0.001)	(0.001)	(0.036)
Observations	221	221	221	221	42
R-squared	0.299	0.042	0.276	0.087	0.361

Log house price is estimated for 2000 using data from the 5 percent census extract. Log wage is taken from metropolitan-level data of 2000 from the BEA. House price volatility is the standard deviation over annual growth rates in prices (measured at first quarter of each year), between 1995 and 2000, taken from the FHFA. Wage volatility is constructed in the same way using data from annual BEA data. Land share is taken from Davis and Palumbo (2008). In each case, the regressor is land scarcity (taken from Saiz, 2010). Observations are weighted by census sample size. SEs in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Robustness of land scarcity slope for house price volatility

	(1)	(2)	(3)	(4)	(5)
Volatility window	1995-2000	1990-2000	1985-2000	1985-2009	1990-2009
Land scarcity	0.036***	0.043***	0.049***	0.084***	0.094***
	(0.004)	(0.005)	(0.009)	(0.010)	(0.009)
Constant	0.015***	0.019***	0.030***	0.033***	0.027***
	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Observations	221	215	163	163	215
R-squared	0.276	0.269	0.156	0.308	0.322

This table estimates cross-city OLS regressions of local house price volatility on land scarcity, where volatility is calculated using a different time window in each column. House price volatility is the standard deviation over annual growth rates in prices (measured at first quarter of each year), over the reported time interval, taken from the FHFA. The results in the main text use the 1995-2000 interval in the first column, and this result matches column 3 of Table 4 above. The sample size is smaller for intervals including earlier years, because the FHFA metropolitan sample has grown over time. Observations are weighted by census sample size. SEs in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Robustness of land scarcity slope for wage volatility

	(1)	(2)	(3)	(4)	(5)
Volatility window	1995-2000	1990-2000	1985-2000	1985-2009	1990-2009
Land scarcity	0.012***	0.011***	0.009***	0.010***	0.012***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.008***	0.012***	0.012***	0.014***	0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	221	221	221	221	221
R-squared	0.087	0.122	0.104	0.092	0.092

This table estimates cross-city OLS regressions of local wage volatility on land scarcity, where volatility is calculated using a different time window in each column. Wage volatility is the standard deviation over annual growth rates in prices, over the reported time interval, taken from the BEA. The results in the main text use the 1995-2000 interval in the first column, and this result matches column 4 of Table 4 above. Observations are weighted by census sample size. SEs in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

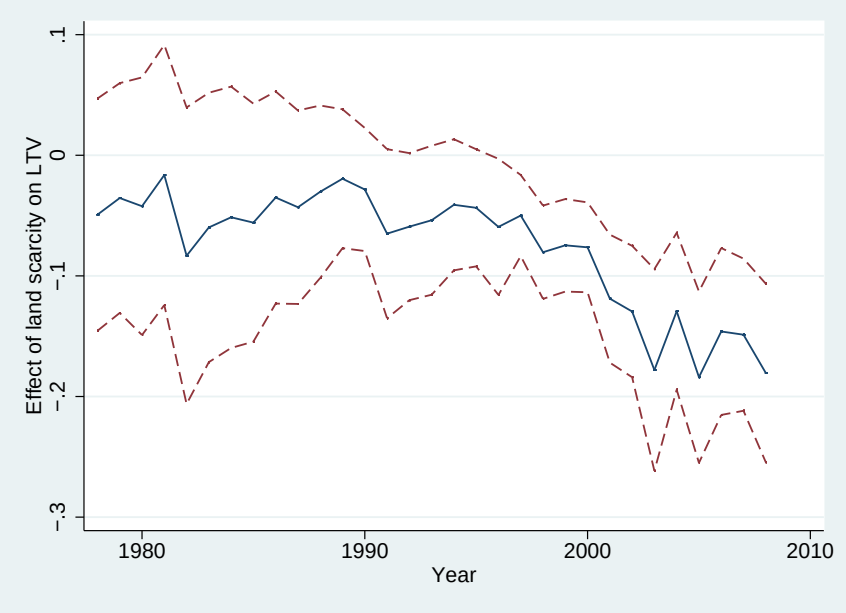

Figure 1: Changing effect of land scarcity on LTV

The blue line gives estimated coefficients from OLS regressions of LTV (from the MIRS data) on land scarcity, separately by year (over 1978-2008). The dashed lines are 95 percent confidence intervals.