house prices and affordability

B Fingleton, Dept of Economics, Strathclyde University

For material relating to these lectures see

http://personal.strath.ac.uk/bernard.fingleton/

Introduction

- affordability is a major policy issue that has increasingly become a concern for UK Government as house prices have risen dramatically in recent years in relation to wages

- This is partly because of the importance of affordability for the recruitment and retention of key workers

- Political reasons, voter disaffection as housing costs continue to rise

What is affordability?

- The relevant variables are the price of houses and the level of incomes and the relation between the two.

What is affordability?

- affordability is defined here as an area's mean house price divided by the mean annual wage level available from employment in the area.

Year 2000 prices

- Cambridge £194591 £364.9pw 10.66
- Hackney £185341 £559.8pw 6.62
- Glasgow £78090 £332.8pw 4.69
- 'ten years ago house prices were 3.5 times people's annual salary' now 'house prices are 6 times annual salary', speech delivered by the Rt. Hon. John Prescott (The Deputy Prime Minister) on 1st April 2005.

What is affordability?

- Different definitions exist
  - one closely related measure of market affordability is <u>median</u> house prices to <u>median</u> incomes
  - but the emphasis on access to housing might suggest a case for focusing on <u>lowest quartile</u> house prices to lowest quartile incomes
  - Or, the proportion of households that can only afford acceptable accommodation with assistance

  - *Affordability Targets: Implications for Housing Supply*
  - http://www.communities.gov.uk/publications/housing/affordabilitytargetsimplications

The solution to the low affordability problem

- Government policy is to <u>increase the supply</u> of housing in order to improve affordability

- BUT this expansion in housing supply is also to be accompanied by an expansion in employment.

- The outcome is that there will also be an <u>increase in the demand</u> for housing

- The main thesis in these lectures is that in some areas <u>affordability may worsen</u>, not improve

Two Separate Models

- a spatial econometric model of house prices, a reduced form from demand and supply functions

- a spatial econometric model of wage levels

- The ratio of price to wage gives the affordability ratio

Using models for scenarios

- Using the models, I then simulate the effect on prices of Government inspired increases in housing supply
- I look at the implications of this for the price/wage ratio
- Bottom line, does affordability improve with additional supply?

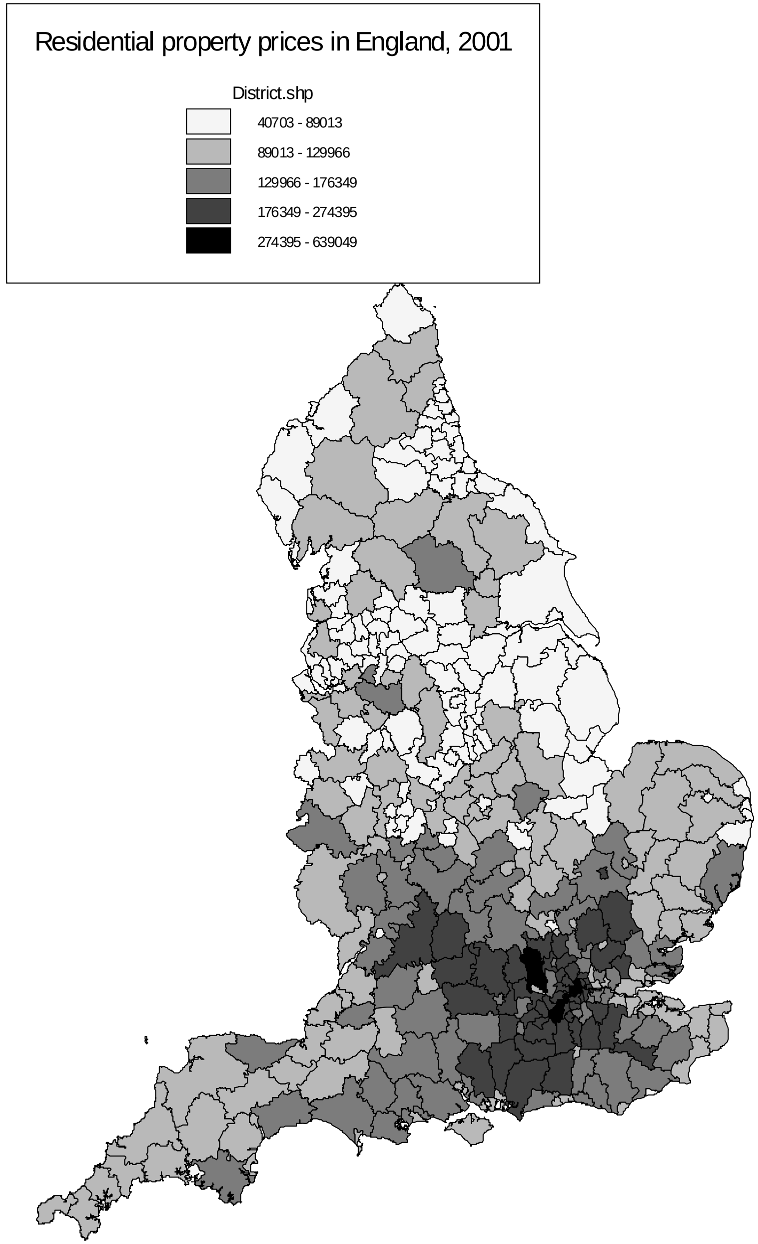
a spatial econometric model of house prices

- Spatial means that the data are spatial series not time series
- They relate to wage or price variations across local authority areas at a snapshot in time, for example…..

Mean weekly wage, year 2000

Edinburgh_City_of	£354.2
Falkirk	£332.9
Fife	£292.8
Glasgow_City	£332.8
Highland	£294.1

Mid_Suffolk	£286.9
St_Edmundsbury	£299.5
Suffolk_Coastal	£325.1
City_of_London	£815.0
Camden	£535.7
Hackney	£559.8
Fulham	£484.6


Residential property prices in England, 2001
District.shp
40703 - 89013
89013 - 129966
129966 - 176349
176349 - 274395
274395 - 639049

a spatial econometric model of house prices

- Demand function (q demanded on lhs)
- Supply function (q supplied on lhs)
- Reduced form   (p on lhs)

a spatial econometric model of house prices :demand function

- Housing demand depends on wage levels (*w*) and employment levels (*E*), combining to give total income level (*wE*)
- Housing demand from within the local area *j* is a function of <u>income from local jobs</u>, equal to the mean local wage rate (*w*) times the local employment level (*E*).
- Housing demand in area *j* also depends on income from jobs <u>within commuting distance</u> of *j*

a spatial econometric model of house prices :demand function

Demand from area j $w_j E_j$

Demand from area j 's commuting field $w_j^c E_j^c$

The contribution to demand from jobs within commuting distance will depend on how far they are away from j

We give less weight to jobs that are further away because the cost of travelling from j will be more, so fewer Workers will actually commute from j

a spatial econometric model of house prices :demand function

For area *k*, its income level is $w_k E_k$

But if *k* is far from *j*, we give it less weight

We could measure the weight as a function of distance from *j* to *k* D_{jk}

A good function is a negative exponential one, since this falls away Rapidly so that the weight reduces quickly as distance increases, then Reduces more slowly. This would seem to be appropriate, as we would Anticipate a bigger fall off in the first 20 miles than in the next 20 miles and so on

Notice we multiply by a factor to allow for Area *j*'s transport infrastructure $\exp(-\delta_j D_{jk})$

a spatial econometric model of house prices :demand function

Demand for housing at *j* depends not just on jobs at location *k*, but also jobs at locations *l*, *m*, *n*,……etc

So to get the overall demand at *j* from commuting we have to sum across all other areas, thus

$$w_j^c E_j^c = \sum_k \exp(-\delta_j D_{jk}) w_k E_k, j \neq k, D_{jk} \leq 100km$$

In this *k* now denotes typical area *k*, exp(-…) is the weight assigned
To each area depending on its distance from *j* and on *j*’s transport
Infrastructure
If the distance to *j* > 100 km, then we set the weight to zero
In the negative exponential, it would still have a small positive weight

a spatial econometric model of house prices :demand function

Other determinants of the quantity of housing demanded at *j*

- <u>Amenity</u> at *j*
- <u>Price</u> of housing at, and near to, *j*
- other <u>unmodelled factors</u> such as demand coming from non-wage earners such as the retired and students, and the effects of criminality, social quality of the neighbourhood, local taxes, etc.. These Unmodelled factors are represented by a stochastic error

<u>Amenity</u> and local public goods denoted collectively by A_j

<u>Price locally</u> denoted by p_j <u>Price nearby</u> denoted by Wp_j

<u>Unmodeled factors</u> denoted by ω

a spatial econometric model of house prices :demand function

To summarise

$$q_j = f(w_j E_j, w_j^c E_j^c, A_j, p_j, Wp_j, \omega_j)$$

More exactly, the demand function is

$$q_j = a_0 + a_1 w_j E_j + a_2 w_j^c E_j^c + a_3 A_j - a_4 p_j + a_5 Wp_j + \omega_j$$

a spatial econometric model of house prices :demand function

•Housing demand is negatively related to the price of housing .

•Given that high prices drive down demand, it is assumed that high prices ‘nearby’ will cause demand to spill over into *j* .

•We refer to this as a displaced demand effect. Hence it is assumed that demand at *j* will be positively related to the average of prices in surrounding areas

The average price in areas contiguous to *j* is denoted by Wp_j

a spatial econometric model of house prices :supply function

$$q_j = b_0 + b_1 p_j + b_2 O_j - \eta W p_j + \varsigma$$

Quantity supplied at j is
- increasing in price
- Positively related to the existing stock of properties
- Decreasing in average price nearby
- Affected by other unmodeled factors

high prices nearby will attract supply away from j, hence the negative sign for η . This is referred to as a <u>displaced supply effect</u>.

a spatial econometric model of house prices :reduced form

reduced form is obtained by <u>normalizing</u> the supply function with respect to *p*

$$p_j = \frac{1}{b_1} q_j - \frac{b_0}{b_1} - \frac{b_2}{b_1} O_j - \frac{\eta}{b_1} Wp_j + \frac{\varsigma}{b_1}$$

Then substituting for *q* using the demand function, thus

$$p_j = c_1[a_0 + a_1 w_j E_j + a_2 w_j^c E_j^c + a_3 A_j - a_4 p_j + \nu W p_j + \omega] - \\ c_0 - c_2 O_j - c_3 W p_j + \xi$$

a spatial econometric model of house prices :reduced form

Tidying this up gives

$$p_j = \rho W p_j + d_0 + d_1 w_j E_j + d_2 w_j^c E_j^c +$$
$$d_3 A_{Ej} + d_4 A_{Sj} + d_5 A_{Lj} + d_6 O_j + \varepsilon_j$$

Note that the average price nearby has a special coefficient ρ
Symbolizing that it is the <u>net effect</u> of the displaced demand and
Displaced supply effects

Also, <u>Amenity has been broken down</u> into its constituent parts

a spatial econometric model of house prices :reduced form

- number of square km per household A_S
- the square of the distance of the area from London A_L
- the level of educational attainment A_E

1998 key stage 2 tests taken by 11-year-old pupils

Table 2. Estimates of house price models

Dependent variable			p			
	parameter est.	t ratio	parameter est.	t ratio	parameter est.	t ratio
	OLS		ML		2sls	
Constant	-505505.98	-6.08	-587509.75	-8.83	-663715.83	-5.85
wE	786.50	9.68	385.29	5.72	298.89	3.91
w^cE^c	46.37	10.96	16.58	4.06	9.68	2.08
O	-0.5329	-5.24	-0.2338	-2.83	-0.1635	-1.86
A_E	160644.78	7.48	161626.69	9.42	177105.79	6.08
A_S	374005.79	3.15	295210.48	3.11	263968.53	2.68
A_L	-0.3674	-6.77	-0.1067	-2.26	-0.0502	-0.99
ρ	-------	-------	0.6300	12.99	0.7624	12.29
R^2, $\bar{R}^2$	0.6260		0.7614		0.7642	
Standard Error	39141.35		31252.73		31401.28	
Log likelihood	-4230.3372		-4165.39		-------	
Residual correlation	I = 13.49		LM = 0.7251		Z = -0.6496	
Degrees of freedom	346		345		345	

$\bar{R}^2$ = Squared Correlation actual and fitted. For the OLS model we use the conventional R^2 statistic.

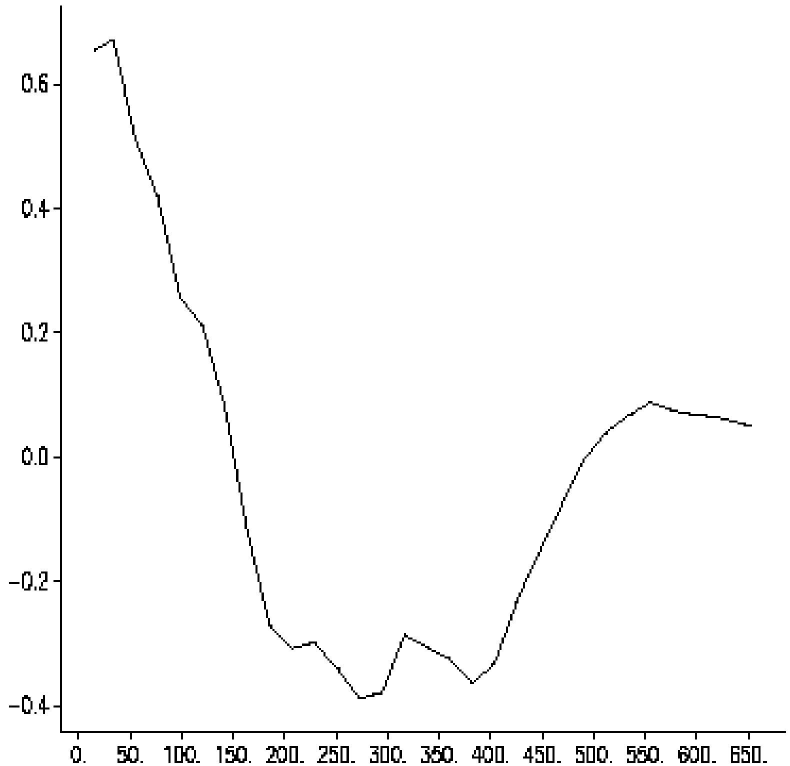
LM is distributed as chi-squared 1 under the null hypothesis of no residual spatial autocorrelation

I is the standardised value of Moran's I statistic for residual spatial autocorrelation.

Z is the standardised value from the Anselin-Kelejian(1997) statistic for residual spatial autocorrelation with a spatial lag.

The spatial autocorrelation tests use the matrix W defined above.

a spatial econometric model of house prices :estimation



Scaled Moran's I (lag correlation) for property price levels

a spatial econometric model of house prices :estimation

•the residuals for the OLS estimated model are highly spatially autocorrelated, the residual in nearby places is similar

The residual contains omitted variable *Wp*, suggesting that if we introduce *Wp* into the regression, the residuals will not be autocorrelated

•Both the ML and 2sls estimates (which allow the endogenous variable *Wp*) show that *Wp* is a significant variable for the model

The residual spatial autocorrelation is eliminated when *Wp* is present in the model

a spatial econometric model of house prices :results

•prices in area *j* affect, and are affected by, prices ‘nearby’

•house prices increase significantly with increasing local demand (wE)

•with increasing demand within commuting distance ($w^c E^c$)

•they fall significantly with increasing stock (O)

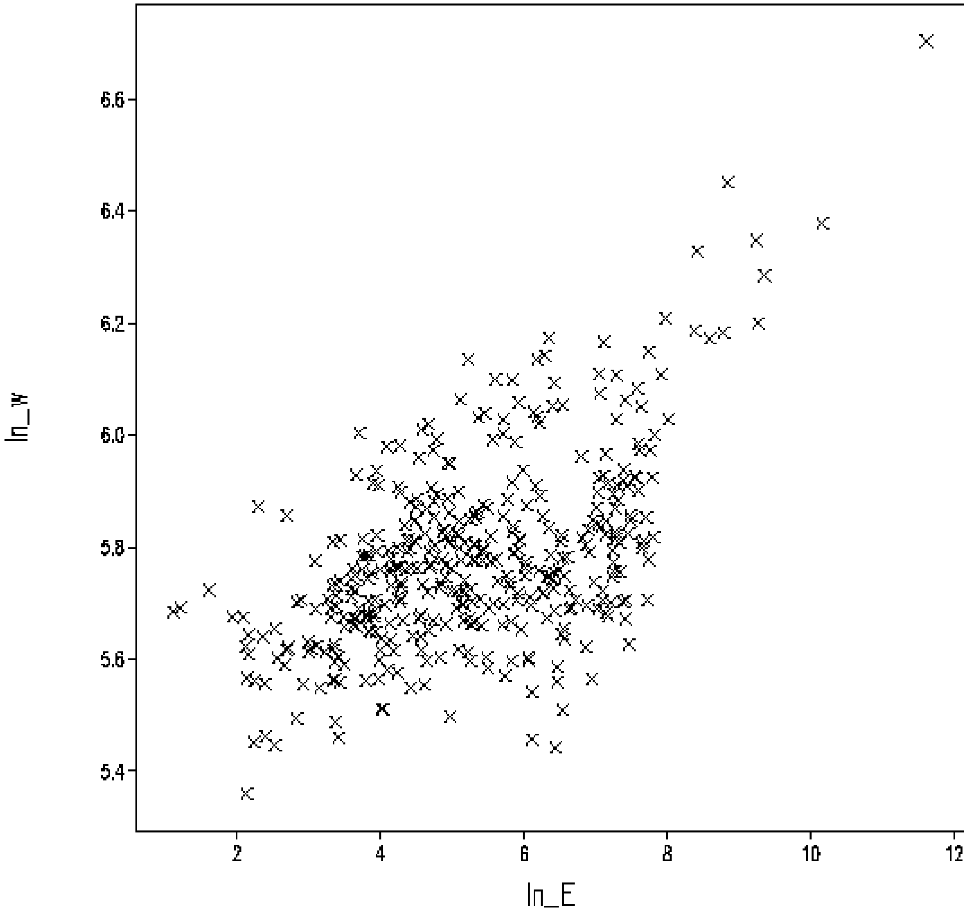
•prices increase significantly as a result of better amenity
better schooling locally (A_E),
when there is more space per household (A_S),
and when distance from London (A_L) is less

The wages model

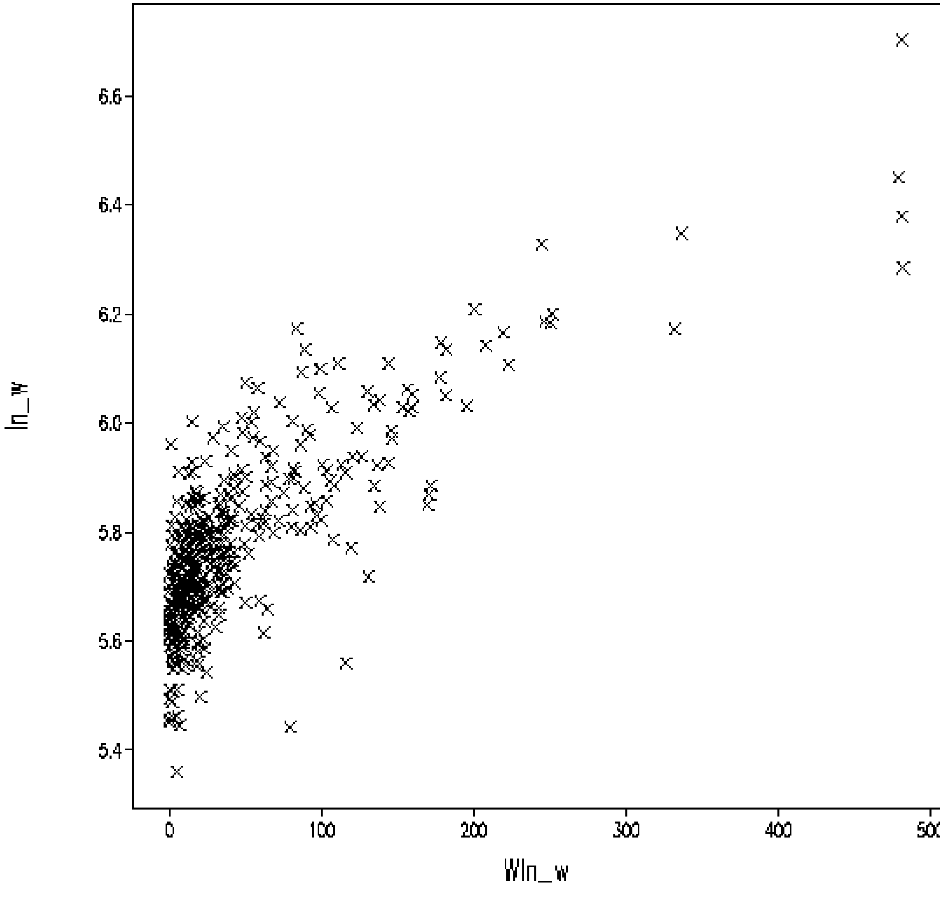
- theoretical base is Dixit-Stiglitz theory of monopolistic competition
- ‘love of variety effect’ for producer services sector $\rightarrow$ higher wages in areas with higher employment density $E' = E / sq.km.$

$$\ln(w) = k + (\gamma - 1)\ln(E')$$

log weekly wage rate in 2000 versus employee density



wage level and wages levels in ‘neighbouring’ areas



The wages model – with covariates

$$\ln w = k_1 + \lambda \tilde{W} \ln w + (\gamma - 1) \ln E' + \tau \ln T + \pi \ln F + \Psi$$

Ln T

Log of the location quotient of employees in the computing and R&D sectors

allows for spatial concentrations of highly skilled and highly qualified employees

Ln F

Log of the percentage the percentage of residents with no qualifications

link between labour inefficiency and inadequate schooling

Wages model : alternative specifications

Table 3. Estimates of wages models

Dependent variable	*lnw*		*lnw*	
	parameter est.	t ratio	parameter est.	t ratio
	OLS		ML spatial lag	
Constant	6.242 (6.110)	54.04 (51.59)	4.256768	9.91
lnE	0.04741 (0.04324)	11.55 (10.37)	0.040105	9.64
lnT	0.06853 (0.07828)	7.18 (8.07)	0.049419	5.05
lnF	-0.2054 (--0.1579)	-5.80 (-4.28)	-0.161836	-4.58
city	(0.468)	(3.84)	-------	-------
λ	-------	-------	0.323	4.823
$\overline{R}^2$	0.580 (0.596)		0.6137	
Standard Error	0.114 (0.112)		0.109407	
Log-likelihood	266.7528 (274.0634)		278.539192	
Residual correlation LM (error)= LM (lag) = Z = Z^1 =	 37.69 69.87 6.544 6.860	 (29.97) (77.37) (5.852) (6.139)	LM = 0.003177	
Degrees of freedom	349 (348)		348	

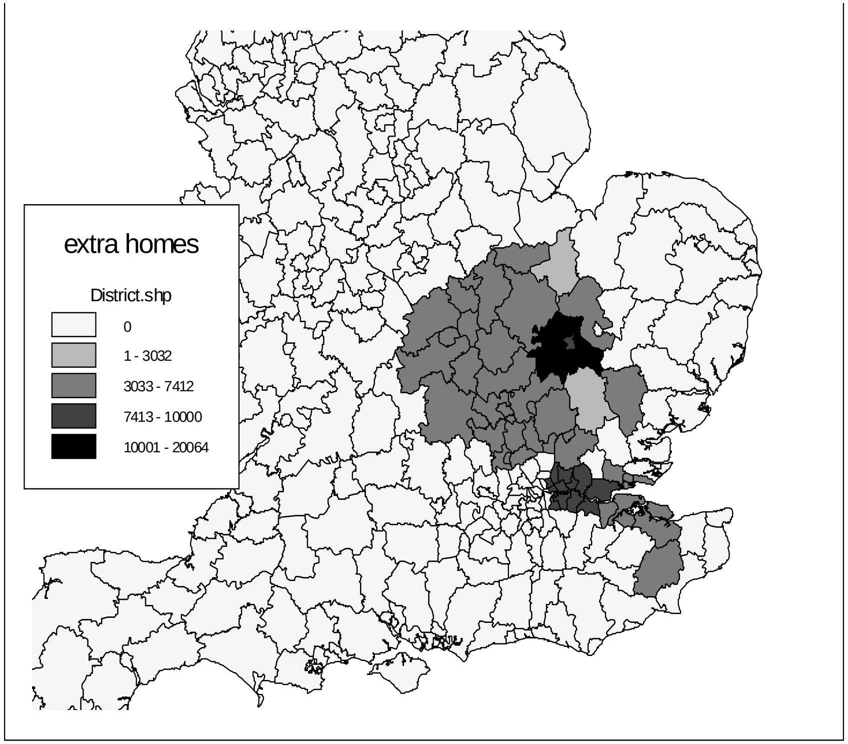
Interpretation of wages model

- doubling city density causes wages to rise by about ln(2**0.04) = 2.8%
- coefficient estimates for the labour efficiency variables *lnT* and *lnF* are significant and appropriately signed
- spatial lag coefficient is also significantly different from zero, indicating strong interaction in wage levels across areas
- OLS diagnostics indicate significant spatial autocorrelation without spatial lag
- Elimination of London from data does not alter estimates greatly

Simulations : increasing housing supply

- growth areas - ODPM's 'Sustainable Communities : homes for all' (HMSO 2005) new homes by 2016
  - Thames gateway and East London (120,000)
  - Cambridge and district (48,000)
  - Milton Keynes/S Midlands, Stansted, Peterborough, Ashford (252,000)

Conjectural allocation of additional homes in the greater South East



Simulations

$$p_j^s = \hat{\rho} \sum_{k \neq j} W_{jk} p_k^s + \hat{d}_0 + \hat{d}_1 w_j E_j + \hat{d}_2 w_j^C E_j^c + \hat{d}_3 \tilde{O}_j +$$
$$\hat{d}_4 A_{Ej} + \hat{d}_5 \tilde{A}_{Sj} + \hat{d}_6 A_{Lj} + \hat{\varepsilon}_j$$

$$p^S = (I - \hat{\rho} W)^{-1} (X^S \hat{d} + \hat{\varepsilon})$$

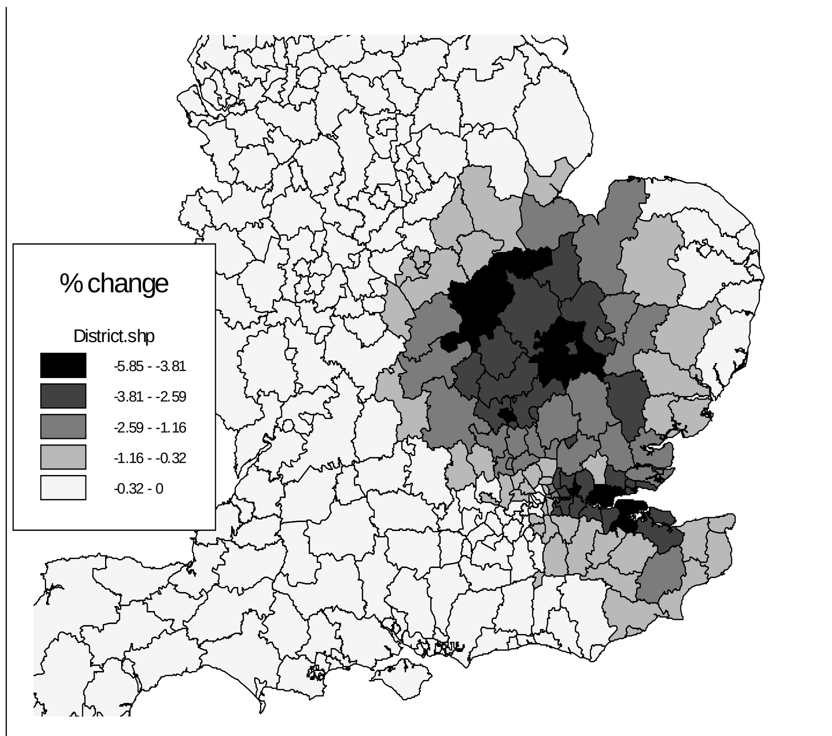
Simulations –direct impacts

Direct Impact Of Additional Homes

$$O_j \rightarrow \tilde{O}_j$$

$$A_{Sj} \rightarrow \tilde{A}_{Sj} = km_j^2 / \tilde{O}_j$$

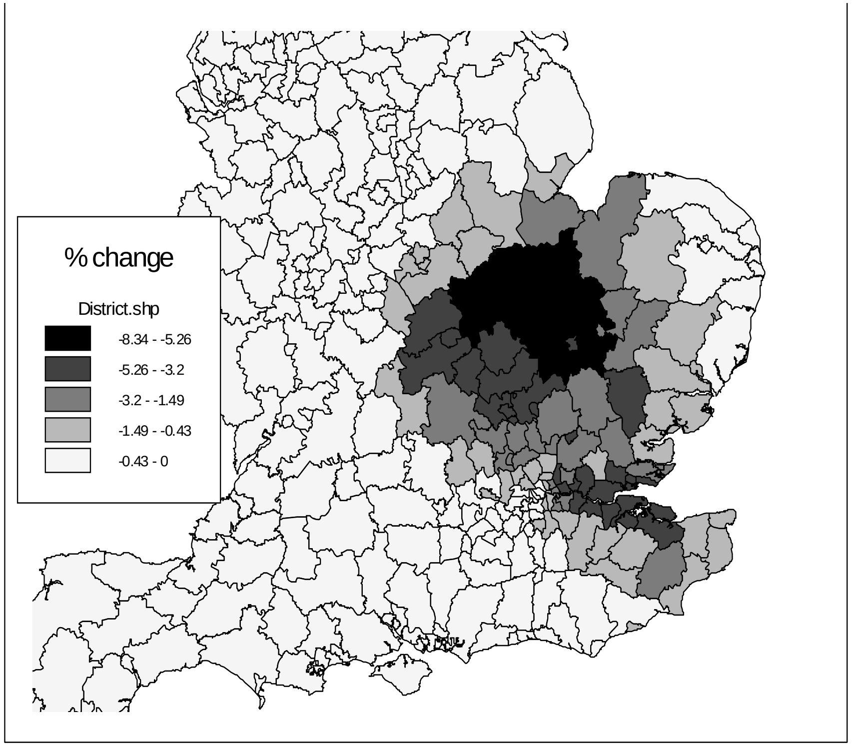
The % change in prices and affordability (initial estimate) as a result of the increased homes



Cambridge city = -3.44%

Hackney = -2%

The % change in prices and affordability as a result of the increased number of homes and amenity loss due to extra density



Cambridge city =–4.54%
Hackney =-2.07%

Simulations - indirect impacts

- Associated employment growth

$$E_i \longrightarrow \tilde{E}_i$$

- ‘we expect 120 000 new homes and 180 000 new jobs to be delivered in the Thames Gateway by 2016’ : each new home is associated with 1.5 jobs
- ODPM’s ‘Sustainable Communities : homes for all’
- Dividing total employment in England in 2000 by the number of households (owner occupiers), one obtains a ratio of 1.55

Simulations – effect on wages

New employment level changes employment density hence wages

$$\tilde{O}_j \longrightarrow \tilde{E}_j \longrightarrow \tilde{E}'_j = \tilde{E}_j / sq.km \longrightarrow w^S$$

Since wages partly depend on employment density

$$\ln w^S = \hat{k} + \hat{\lambda} W \ln w^S + (\hat{\gamma} - 1) \ln \tilde{E}' + \hat{\tau} \ln T + \hat{\zeta}$$

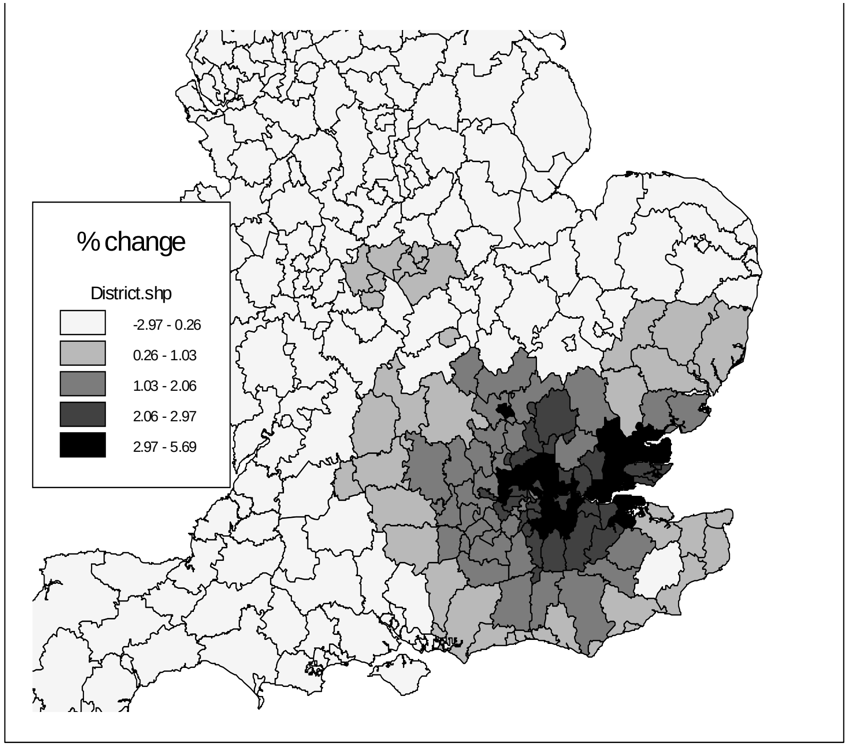
$$\ln w^S = (I - \hat{\lambda} W)^{-1} (X^S \hat{f} + \hat{\zeta})$$

Prices dependent on simulated wages, employment, households And amenity

$$p_j^s = \hat{\rho} \sum_{k \neq j} W_{jk} p_k^s + \hat{d}_0 + \hat{d}_1 w_j^S \tilde{E}_j + \hat{d}_2 w_j^{SC} \tilde{E}_j^c + \hat{d}_3 \tilde{O}_j + \hat{d}_4 A_{Ej} + \hat{d}_5 \tilde{A}_{Sj} + \hat{d}_6 A_{Lj} + \hat{\varepsilon}_j$$

$$p^S = (I - \hat{\rho} W)^{-1} (X^S \hat{d} + \hat{\varepsilon})$$

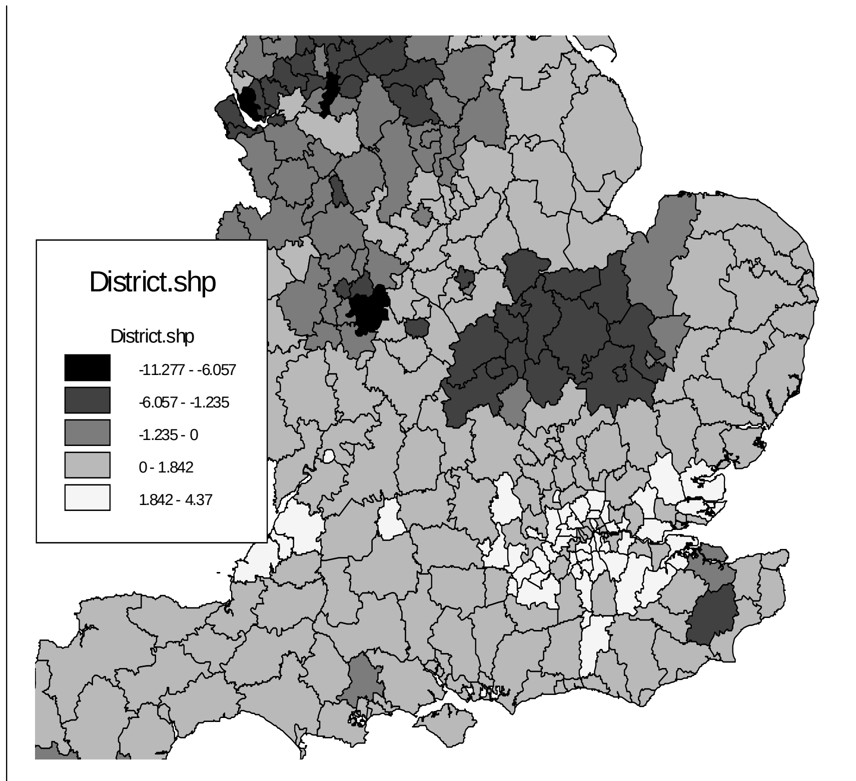
The % change in prices as a result of the change in wages, employment, households And amenity



Affordability

- affordability growth is $\ln(p/w) - \ln(p^s/w^s)$
- actual affordability is 2001 price per UALAD divided by annual wage level earned from jobs located in each UALAD in 2000
- Simulated affordability is simulate price (p^s) divided by simulated wage w^s

The change in affordability



Cambridge
Wages +0.91%
Prices –1.28%
Aff. +2.19%

Hackney
Wages +0.52%
Prices +2.26%
Aff. -1.74%

Conclusions

- expanding housing in the greater South East could reduce affordability
- there are knock-on effects across the Greater South East
  - house prices and affordability a result of policy intervention elsewhere