Supplements to:

Holly, S., M.H. Pesaran and T. Yamagata (2010), "The Spatial and Temporal Diffusion of House Prices in the UK"

S.1 Data

S.1.1 UK Regional Data

Regional house prices (nominal, in British Pounds) in the UK are downloaded from the Homepage of the Nationwide Building Society and covers the period 1973q4 to 2008q2 (http://www.nationwide.co.uk/hpi/historical.htm), which are quality adjusted house price series collected by the Nationwide Building Society. In UK parlance these quality adjusted house prices are referred to as 'mix adjusted'. The mix adjustment of the house price index is intended to correct for price variations due to location and physical characteristics of the housing stock. The regional price series are then deflated by the UK consumer price index (nominal consumers' expenditure divided by constant price consumers' expenditure) which is obtained from the Office of National Statistics.

S.1.1.1 New York Data

The New York house price index covers the shorter sample period of 1975q4 to 2008q2 and is constructed using data from the Federal Housing Finance Agency (FHFA). The areas included in the calculation of the NY house price series are the New York-White Plains-Wayne Metropolitan Division comprises the counties of Bergen, NJ, Bronx, NY, Hudson, NJ, Kings, NY, New York, NY, Passaic, NJ, Putnam County, NY, Queens, NY, Richmond, NY, Rockland, NY, and Westchester, NY. (http://www.fhfa.gov/Default.aspx?Page=87). The New York house price index is then deflated by the consumer price index of New York-Northern New Jersey-Long Island, NY-NJ-CT-PA, obtained from U.S. Bureau of Labor Statistics. The CPI data for New York is monthly (Series id: CUURA101SA0). Quarterly indices are constructed as simple averages of the monthly series.

S.2 UK regional house price models using California and Florida house prices instead of New York

The California state house price index (1975q4-2008q2) is obtained from the Federal Housing Finance Agency (FHFA), which is deflated by the CPI of Los Angeles-Riverside-Orange County, obtained from Bureau of labor statistics. The Florida state house price

index (1978q1-2008q2) is obtained from the Federal Housing Finance Agency (FHFA), which is deflated by the CPI of Miami-Fort Lauderdale County, obtained from Bureau of labor statistics. Tables 10a and 11a (10b and 11b) report corresponding results to two rows of Table 10 and first row of Table 11 in the paper, replacing New York house price with California house price (Florida house price).

Table 10a: Effects of California House Price Changes on London, with London Treated as the Dominant Region in the UK (1975Q4-2008q2.)

Lag-orders $\{\hat{k}_{ia}, \hat{k}_{ib}, \hat{k}_{i,CA}\}$ selected by SBC										
Regions (i)	EC1 $(\phi_{0,CL})$	EC2 (ϕ_{0s})	Own Lag effects	Neighbour Lag Effects	California Lag Effects	California Contemporaneous Effects	Wu-Hausman Statistics	$\hat{k}_{ia}$	$\hat{k}_{ib}$	$\hat{k}_{i,CA}$
California	–	–	0.910^{***} (11.211)	–	–	–	–	6	-	-
London	–	–	-0.012 (0.074)	0.656^{***} (3.954)	–	0.063 (0.628)	0.546	1	1	0

Notes: The table report the estimates of the model for Table 10 but replacing New York house price with California house price.

Table 11a: F Statistics for Joint Significance of Contemporaneous and Lagged Effects of California House Price Changes in the UK Regional House Price Equations

Regions	F Statistics	p-values
London	1.709	0.169

Notes: The table report the estimates of the model for Table 11 but replacing New York house price with California house price. The F statistics are for testing the joint hypothesis $H_0 : c_{i,CL,\ell} = 0$, for $\ell = 0, 1, 2$, in the region-specific equations. For London the regression equation used to compute the F statistic is given by $\Delta p_{0t} = intercept + \Sigma_{\ell=1}^{2} a_{0\ell} \Delta p_{0,t-\ell} + \Sigma_{\ell=1}^{2} b_{0\ell} \Delta \bar{p}_{0,t-\ell}^{s} + \Sigma_{\ell=0}^{2} c_{i,CL,\ell} \Delta p_{CL,t-\ell} + \varepsilon_{it}$, which is the same in both panels. The error correction coefficients (ϕ_{is}, and ϕ_{i0}) are restricted as before (see the notes to Table 8). The p-values for the tests are given in the last column.

Table 10b: Effects of Florida House Price Changes on London, with London Treated as the Dominant Region in the UK (1976q1-2008q2)

Lag-orders $\{\hat{k}_{ia}, \hat{k}_{ib}, \hat{k}_{i,FL}\}$ selected by SBC										
Regions (i)	EC1 $(\phi_{0,FL})$	EC2 (ϕ_{0s})	Own Lag effects	Neighbour Lag Effects	Florida Lag Effects	Florida Contemporaneous Effects	Wu-Hausman Statistics	$\hat{k}_{ia}$	$\hat{k}_{ib}$	$\hat{k}_{i,FL}$
Florida	–	–	0.493^{***} (5.756)	–	–	–	–	1	-	-
London	–	–	-0.014 (-0.087)	0.675^{***} (4.136)	–	0.157 (1.352)	-1.429	1	1	0

Notes: The table report the estimates of the model for Table 10 but replacing New York house price with Florida house price.

Table 11b: F Statistics for Joint Significance of Contemporaneous and Lagged Effects of Florida House Price Changes in the UK Regional House Price Equations

Regions	F Statistics	p-values
London	1.489	0.221

Notes: The table report the estimates of the model for Table 11 but replacing New York house price with Florida house price. The F statistics are for testing the joint hypothesis $H_0 : c_{i,FL,\ell} = 0$, for $\ell = 0, 1, 2$, in the region-specific equations. For London the regression equation used to compute the F statistic is given by $\Delta p_{0t} = intercept + \Sigma_{\ell=1}^{2} a_{0\ell} \Delta p_{0,t-\ell} + \Sigma_{\ell=1}^{2} b_{0\ell} \Delta \bar{p}_{0,t-\ell}^{s} + \Sigma_{\ell=0}^{2} c_{i,FL,\ell} \Delta p_{FL,t-\ell} + \varepsilon_{it}$, which is the same in both panels. The error correction coefficients (ϕ_{is}, and ϕ_{i0}) are restricted as before (see the notes to Table 8). The p-values for the tests are given in the last column.

S.2.1 The UK regional house price model with contemporaneous house prices of neighbouring regions

Consider the UK regional house price models with contemporaneous house prices of neighbouring regions: for the base region (London)

$$\Delta p_{0t} = \phi_{0s}(p_{0,t-1} - \bar{p}^s_{0,t-1}) + a_0 + \sum_{\ell=1}^{k_{0a}} a_{0\ell}\Delta p_{0,t-\ell} + \sum_{\ell=0}^{k_{0b}} b_{0\ell}\Delta \bar{p}^s_{0,t-\ell} + \varepsilon_{0t} \tag{S1}$$

and for the remaining regions by

$$\begin{aligned} \Delta p_{it} &= \phi_{is}(p_{i,t-1} - \bar{p}^s_{i,t-1}) + \phi_{i0}(p_{i,t-1} - p_{0,t-1}) \\ &\quad + a_i + \sum_{\ell=1}^{k_{ia}} a_{i\ell}\Delta p_{i,t-\ell} + \sum_{\ell=0}^{k_{ib}} b_{i\ell}\Delta \bar{p}^s_{i,t-\ell} + \sum_{\ell=0}^{k_{ic}} c_{i\ell}\Delta p_{0,t-\ell} + \varepsilon_{it}, \end{aligned} \tag{S2}$$

for $i = 1, 2, ..., N$.

Since the $\Delta \bar{p}^s_{it}$ is likely to be endogenous, we estimated the model by instrumental variables (IV) estimation. The instruments chosen for $\Delta \bar{p}^s_{it}$ are $\mathbf{z}_{0t} = \left(\Delta p_{0,t-k_{ia}-1}, \Delta \bar{p}^s_{0,t-k_{ib}-1}\right)$ for $i = 0$ and $\mathbf{z}_{it} = \left(\Delta p_{i,t-k_{ia}-1}, \Delta \bar{p}^s_{i,t-k_{ib}-1}, \Delta p_{0,t-k_{ic}-1}\right)$ for $i > 0$.

In order to illustrate how the estimates are computed, denoting $y_{it} = \Delta p_{it}$ and all the weakly exogenous regressors in (S2) as $\mathbf{x}_{1it}$ $(k_1 \times 1)$ and the endogenous regressors as $\mathbf{x}_{2it}$ $(k_2 \times 1)$ (and $\mathbf{x}_{it} = (\mathbf{x}'_{1it}, \mathbf{x}'_{2it})'$) so that $\mathbf{w}_{it} = (\mathbf{x}'_{1it}, \mathbf{z}'_{it})$, the IV estimator is defined by

$$\hat{\boldsymbol{\beta}}_{IV,i} = \left(\mathbf{X}'_i \mathbf{P}_w \mathbf{X}_i\right)^{-1} \mathbf{X}'_i \mathbf{P}_w \mathbf{y}_i$$

where $\mathbf{P}_w = \mathbf{W}_i(\mathbf{W}'_i\mathbf{W}_i)^{-1}\mathbf{W}'_i$, and the typical raw vectors of $\mathbf{X}_i$, $\mathbf{y}_i$ and $\mathbf{W}_i$ are $\mathbf{x}'_{it}$, y_{it} and $\mathbf{w}'_{it}$, respectively. The variance estimator is $\hat{\sigma}^2_i \left(\mathbf{X}'_i \mathbf{P}_w \mathbf{X}_i\right)^{-1}$ with $\hat{\sigma}^2_i = \sum_{t=1}^{T} \hat{\varepsilon}^2_{it}/(T - k)$, $\hat{\varepsilon}_{it} = y_{it} - \mathbf{x}'_{it}\hat{\boldsymbol{\beta}}_{IV,i}$. In addition, three statistics are computed:

- **Sargan's overidentifying restrictions test statistic**:

  $$\hat{\boldsymbol{\varepsilon}}'_i \mathbf{P}_w \hat{\boldsymbol{\varepsilon}}_i / \hat{\sigma}^2_i$$

  which is compared with the critical values from $\chi^2_{3-k_1}$. p-values are reported in the table.

- **Wu-Hausman test statistic:** t-ratio for the coefficient on $\mathbf{P}_w \mathbf{x}_{1i}$.

- **Value of R^2 of the regression of Δp_{it} on 1,** z'_{it}.

These are found as the last three columns the table below.

Table 8a: Estimation Results of Region Specific House Price Diffusion Equation with London as a Dominant Region (1974q1-2008q2)

The same lag orders $\{\hat{k}_{ia}, \hat{k}_{ib}, \hat{k}_{ic}\}$ restrictions on EC terms in Table 8 are adopted										
Regions	EC1 $(\hat{\phi}_{i0})$	EC2 $(\hat{\phi}_{is})$	Own Lag Effects	Neighbour Lag Effects	Neighbour Contemp. Effects	London Lag Effects	London Contemp. Effects	p-value of Sargan's statistics	Wu-Hausman statistics	$R^2_{\Delta p_{it},\ z'_{it}}$
London	–	–	−0.191 (−1.006)	−0.416 (−0.662)	1.822 (1.776)	–	–	0.527	-1.412	0.424
Outer Metrop.	–	–	−0.095 (−1.035)	0.291 (3.167)	0.459 (0.733)	–	0.256 (0.468)	0.676	0.912	0.416
Outer South East	–	–	−0.222 (−2.389)	0.339 (3.222)	0.493 (2.226)	–	0.442 (3.125)	0.249	2.017	0.428
East Anglia	−0.043 (−2.272)	–	−0.098 (−1.102)	0.090 (0.713)	0.728 (2.547)	–	0.225 (1.261)	0.472	0.605	0.445
East Midlands	−0.029 (−1.586)	–	−0.181 (−1.648)	0.623 (4.116)	0.647 (2.267)	−0.275 (−2.067)	0.144 (0.828)	0.000	0.384	0.264
West Midlands	−0.039 (−2.247)	–	−0.296 (−1.933)	0.455 (2.073)	0.758 (1.893)	−0.172 (−1.000)	0.054 (0.222)	0.185	0.863	0.280
South West	−0.125 (−3.834)	–	0.018 (0.132)	0.467 (2.686)	−0.262 (−0.790)	−0.410 (−2.545)	0.828 (3.986)	0.492	4.867	0.258
Wales	–	–	−0.154 (−1.725)	1.114 (4.571)	0.345 (1.129)	−0.676 (−5.269)	0.492 (2.864)	0.180	0.926	0.264
Yorkshire & Humb.	–	–	−0.042 (−0.301)	0.384 (2.714)	0.658 (2.601)	−0.171 (−1.565)	0.300 (2.357)	0.260	0.617	0.271
North West	–	–	0.124 (1.070)	0.398 (1.734)	0.642 (2.686)	−0.240 (−2.299)	0.091 (0.681)	0.211	-0.490	0.152
North	−0.026 (−1.814)	–	−0.269 (−2.966)	0.535 (2.857)	0.583 (1.520)	−0.159 (−1.559)	0.049 (0.306)	0.010	0.750	0.153
Scotland	–	−0.089 (−4.161)	−0.036 (−0.397)	0.042 0.622)	0.213 (1.390)	–	0.257 (3.54)	0.098	1.471	0.143

Notes: The UK regional house price models with contemporaneous house prices of neighbouring regions $\Delta p_{0t} = \phi_{0s}(p_{0,t-1} - \bar{p}^s_{0,t-1}) + a_0 + \sum_{\ell=1}^{k_{0a}} a_{0\ell}\Delta p_{0,t-\ell} + \sum_{\ell=0}^{k_{0b}} b_{0\ell}\Delta\bar{p}^s_{0,t-\ell} + \varepsilon_{0t}$ and $\Delta p_{it} = \phi_{is}(p_{i,t-1} - \bar{p}^s_{i,t-1}) + \phi_{i0}(p_{i,t-1} - p_{0,t-1}) + a_i + \sum_{\ell=1}^{k_{ia}} a_{i\ell}\Delta p_{i,t-\ell} + \sum_{\ell=0}^{k_{ib}} b_{i\ell}\Delta\bar{p}^s_{i,t-\ell} + \sum_{\ell=0}^{k_{ic}} c_{i\ell}\Delta p_{0,t-\ell} + \varepsilon_{it}$, are estimated by instrumental variables (IV) estimation, using the instruments for $\Delta\bar{p}^s_{it}$, $\mathbf{z}_{0t} = \left(\Delta p_{0,t-k_{ia}-1}, \Delta\bar{p}^s_{0,t-k_{ib}-1}\right)$ for $i = 0$ and $\mathbf{z}_{it} = \left(\Delta p_{i,t-k_{ia}-1}, \Delta\bar{p}^s_{i,t-k_{ib}-1}, \Delta p_{0,t-k_{ic}-1}\right)$ for $i > 0$. The last three columns report the p-values of Sargan's overidentifying restrictions test statistic, Wu-Hausman test statistic (t-ratio) for endogeneity of $\Delta\bar{p}^s_{it}$, and the value of R^2 of the regression of Δp_{it} on 1, $\mathbf{z}'_{it}$.