Online Appendix to
The Effect of Homeownership on the Option Value of Regional Migration

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Contents

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A Introduction and Notation

This is the online appendix for *The Effect of Homeownership on the Option Value of Regional Migration*. The appendix is available on my website at `https://floswald.github.io/pdf/homeownership-appendix.pdf` as well as on the dedicated website of Quantitative Economics `http://qeconomics.org/`. In this document I number sections alphabetically (A, B, ...) and equations with roman numbers (I, II, ...). Standard latin numbering (1, 2, ...) refers to the main text.

B Dimensionality Reduction: Factor Model

This section is concerned with the dimensionality reduction of regional house prices and income time series, as undertaken in the main text in section 3.2.

B.1 Data Description and Problem Outline

Here we present detailed results for the regional house price and income data. This part is related to section 2.4 in the main text. The main issue we face can easily be illustrated with a series of figures which show the time series of regional prices and incomes. Starting with figures B.1 we see the relationship between a national house price index with it's regional counterparts in the raw data. Figure B.2 shows the same for the regional income data. What is noteworthy in both cases is that each regional series seems strongly correlated with the national series, however, each region in a different kind of way.

Tables B.1 and B.2 give the cross-correlation of the detrended series from the preceding plots. We observe that those are large throughout. Finally, table B.3 shows that each series independently is very persistent by measuring their first order partial autocorrelation coefficients.

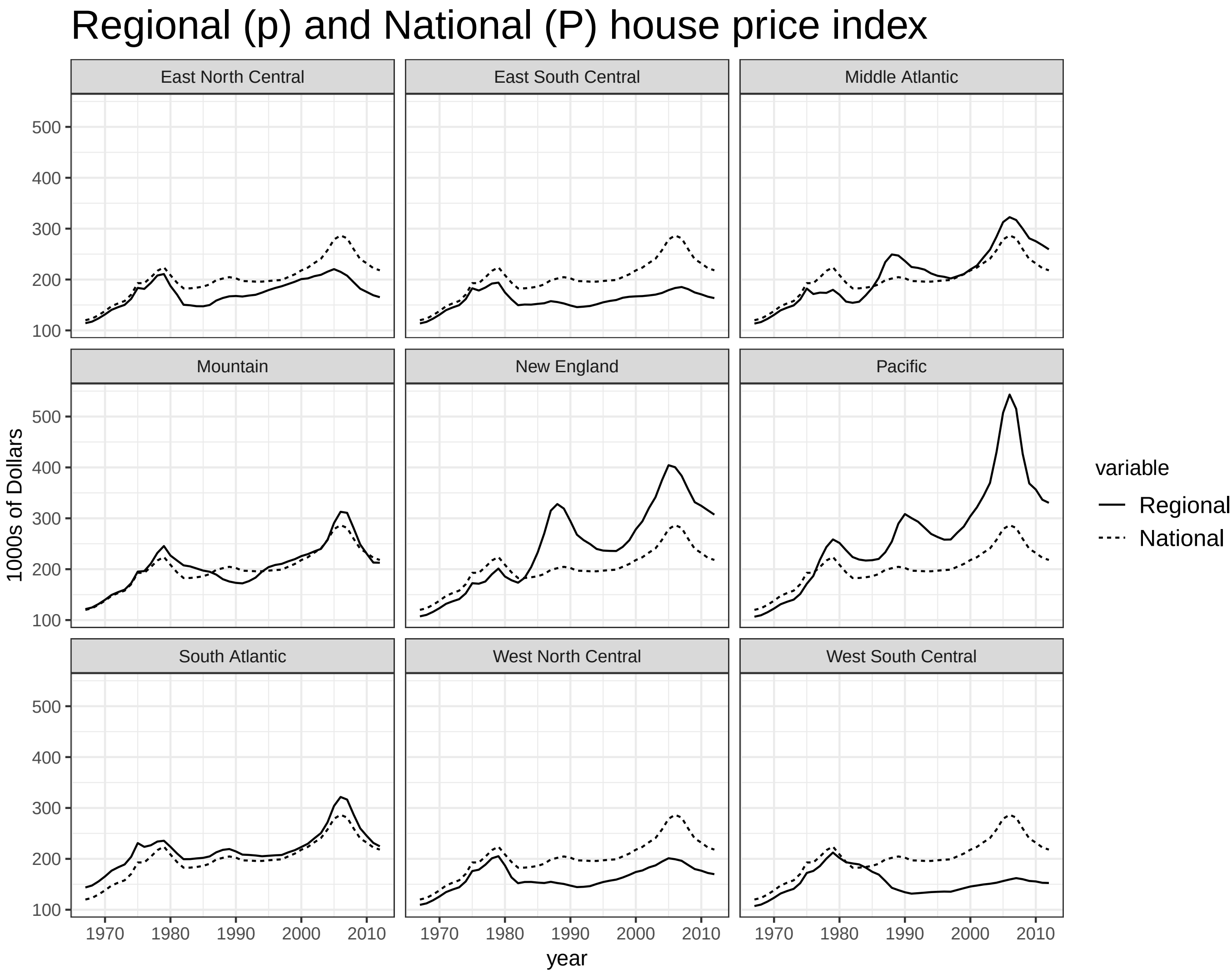

Figure B.1: Regional House Price indices vs National average in the data. This dataset uses the first observation in SIPP data (1996) to project the median house value by region backwards until 1967, using the FHFA house price index for each Census Division.

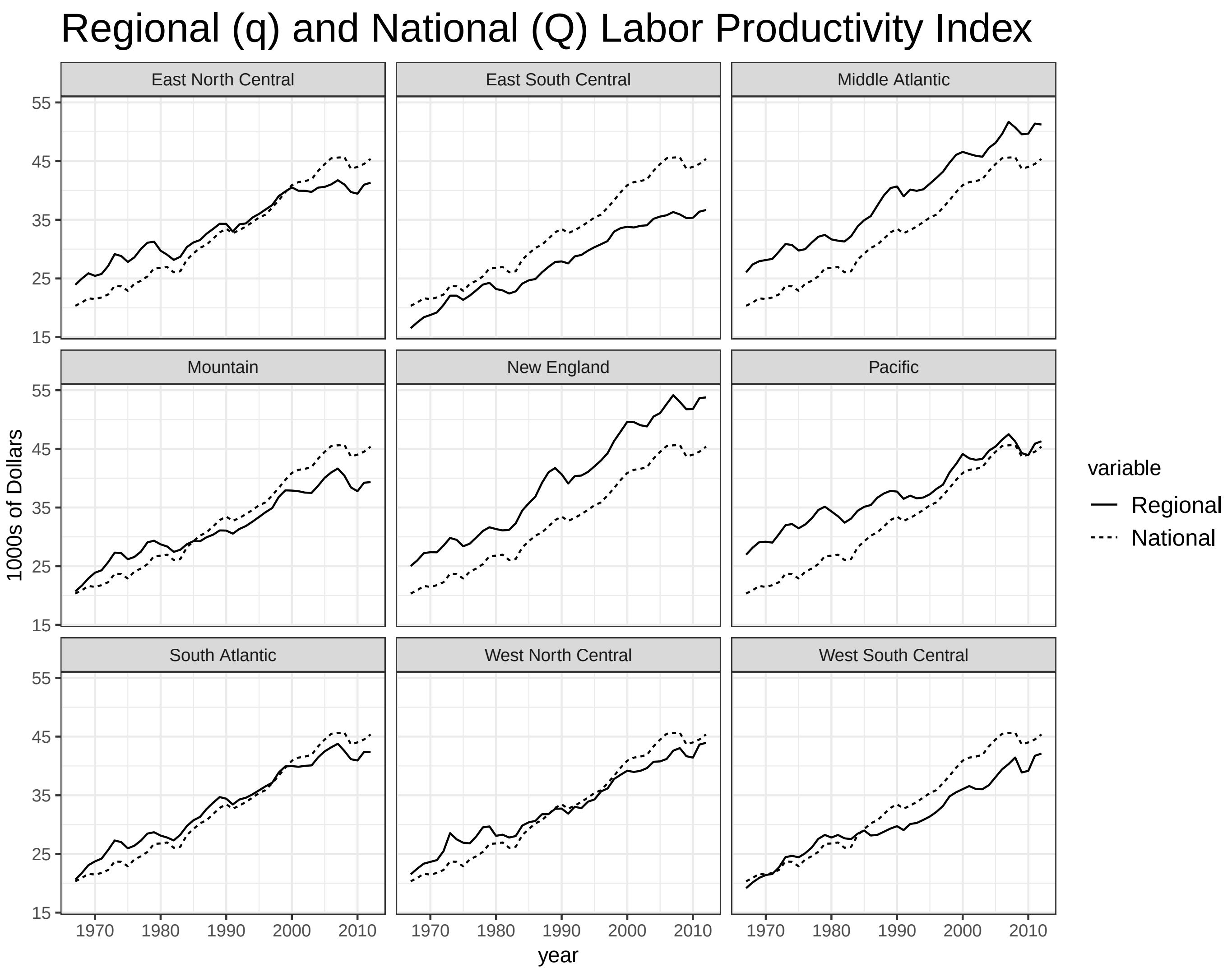

Figure B.2: Regional per capita personal income q_{dt} from BEA vs the national average index Q, for which I use real per capital GDP.

	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
ENC	1.00	0.95	0.90	0.87	0.88	0.90	0.92	0.89	0.75
ESC	0.95	1.00	0.86	0.88	0.85	0.85	0.94	0.86	0.72
MdA	0.90	0.86	1.00	0.87	0.94	0.91	0.92	0.78	0.72
Mnt	0.87	0.88	0.87	1.00	0.83	0.90	0.96	0.80	0.83
NwE	0.88	0.85	0.94	0.83	1.00	0.92	0.90	0.73	0.68
Pcf	0.90	0.85	0.91	0.90	0.92	1.00	0.90	0.79	0.76
StA	0.92	0.94	0.92	0.96	0.90	0.90	1.00	0.80	0.74
WNC	0.89	0.86	0.78	0.80	0.73	0.79	0.80	1.00	0.77
WSC	0.75	0.72	0.72	0.83	0.68	0.76	0.74	0.77	1.00

Table B.1: Cross-correlations between detrended q series

	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
ENC	1.00	0.91	0.67	0.69	0.68	0.47	0.71	0.93	0.69
ESC	0.91	1.00	0.66	0.72	0.59	0.32	0.73	0.90	0.79
MdA	0.67	0.66	1.00	0.63	0.91	0.59	0.85	0.63	0.32
Mnt	0.69	0.72	0.63	1.00	0.54	0.75	0.88	0.68	0.67
NwE	0.68	0.59	0.91	0.54	1.00	0.51	0.69	0.62	0.27
Pcf	0.47	0.32	0.59	0.75	0.51	1.00	0.80	0.41	0.25
StA	0.71	0.73	0.85	0.88	0.69	0.80	1.00	0.67	0.50
WNC	0.93	0.90	0.63	0.68	0.62	0.41	0.67	1.00	0.78
WSC	0.69	0.79	0.32	0.67	0.27	0.25	0.50	0.78	1.00

Table B.2: Cross-correlations between detrended p series

Division	p	q
ENC	0.89	0.93
ESC	0.86	0.93
MdA	0.93	0.94
Mnt	0.91	0.93
NwE	0.94	0.94
Pcf	0.94	0.92
StA	0.91	0.93
WNC	0.89	0.92
WSC	0.92	0.91

Table B.3: First order partial autocorrelation coefficients of both q and p from raw (i.e. not detrended) time series.

B.2 Factor Model

In the main text I propose a factor model to reduce the 9-dimensional process for a regional price. The aggregate factor $\mathbf{F}$ has two components and evolves according to the following model:

$$\begin{aligned} \mathbf{F}_t &= A\mathbf{F}_{t-1} + \nu_{t-1} \\ \nu_t &\sim N\left(\begin{bmatrix}0\\0\end{bmatrix}, \Sigma\right) \\ \mathbf{F}_t &= \begin{bmatrix}Q_t\\P_t\end{bmatrix}. \end{aligned} \tag{I}$$

The mapping from aggregate $\mathbf{F}_t$ into regions d is assumed to be

$$\begin{bmatrix}q_{dt}\\p_{dt}\end{bmatrix} = \mathbf{a}_d\mathbf{F}_t. \tag{II}$$

The empirical implementation estimates $\mathbf{a}_d$ in a SUR model:

$$\begin{aligned} \begin{bmatrix}q_{dt}\\p_{dt}\end{bmatrix} &= \mathbf{a}_d\mathbf{F}_t + \eta_{dt} \\ \eta_{dt} &\sim N\left(\begin{bmatrix}0\\0\end{bmatrix}, \Omega_d\right) \end{aligned} \tag{III}$$

B.3 Factor Model Estimates and Performance

The estimates for aggregate model (I) are given in the main text. Here we show estimates for model (III) in table B.4. We see that each region has separate outcome equations for both q_d and p_d, parameterized by different coefficients $\mathbf{a}_d$. Finally, the residuals between both outcome equations q_d and p_d are allowed to be correlated.

Moving on to gauging the prediction quality of this model, consider figure B.3 which is the counterpart to figure 3 in the main text. As was visible there, the model is able to successfully predict most movements in the regional series, taking as input only the two-dimensional factor $\mathbf{F}_t$.

B.4 Transformation of Aggregate to Regional Shocks

To investigate how aggregate shocks are translated into regional shocks, I fix $\mathbf{F}_t$ at its mean value except for $t = 2000$ when I shock component Q_t by -10% ($P_t = \overline{P}$ throughout this exercise). The transformation of this into regional deviations of q_{dt} are displayed in figure B.4. This shows that the

	East North Central		East South Central		Middle Atlantic		Mountain	
	q_{dt}	p_{dt}	q_{dt}	p_{dt}	q_{dt}	p_{dt}	q_{dt}	p_{dt}
$\mathbf{a_{0d}}$	12.30^{***}	61.10^{***}	3.74^{***}	88.19^{***}	8.42^{***}	-34.84^{**}	8.38^{***}	5.89
	(0.72)	(10.51)	(0.60)	(7.15)	(0.64)	(12.00)	(0.67)	(10.85)
Q_t	0.62^{***}	-0.84	0.70^{***}	-1.53^{***}	1.00^{***}	2.87^{***}	0.56^{***}	-1.23^{*}
	(0.03)	(0.49)	(0.03)	(0.34)	(0.03)	(0.56)	(0.03)	(0.51)
P_t	0.01	0.70^{***}	0.01	0.61^{***}	-0.01^{*}	0.75^{***}	0.03^{***}	1.20^{***}
	(0.01)	(0.10)	(0.01)	(0.07)	(0.01)	(0.12)	(0.01)	(0.10)
R^2	0.97	0.74	0.98	0.73	0.99	0.92	0.98	0.89
Adj. R^2	0.97	0.72	0.98	0.72	0.99	0.91	0.97	0.89
Num. obs.	92	92	92	92	92	92	92	92

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

	New England		Pacific		South Atlantic		West N Central		West S Central	
	q_{dt}	p_{dt}	q_{dt}	p_{dt}	q_{dt}	p_{dt}	q_{dt}	p_{dt}	q_{dt}	p_{dt}
$\mathbf{a_{0d}}$	3.77^{***}	-114.58^{***}	13.32^{***}	-214.09^{***}	6.54^{***}	39.23^{***}	7.75^{***}	62.46^{***}	5.46^{***}	106.64^{***}
	(0.64)	(20.60)	(0.56)	(17.11)	(0.64)	(5.32)	(0.71)	(7.80)	(0.93)	(12.75)
Q_t	1.18^{***}	4.54^{***}	0.55^{***}	3.08^{***}	0.75^{***}	-1.47^{***}	0.72^{***}	-1.69^{***}	0.63^{***}	-3.73^{***}
	(0.03)	(0.97)	(0.03)	(0.81)	(0.03)	(0.25)	(0.03)	(0.37)	(0.04)	(0.60)
P_t	-0.01^{*}	1.05^{***}	0.03^{***}	1.91^{***}	0.01	1.14^{***}	0.01	0.78^{***}	0.02^{*}	0.85^{***}
	(0.01)	(0.20)	(0.01)	(0.16)	(0.01)	(0.05)	(0.01)	(0.07)	(0.01)	(0.12)
R^2	0.99	0.89	0.98	0.95	0.98	0.97	0.98	0.81	0.96	0.53
Adj. R^2	0.99	0.89	0.98	0.95	0.98	0.96	0.98	0.80	0.96	0.51
Num. obs.	92	92	92	92	92	92	92	92	92	92

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table B.4: Aggregate to Regional price mappings. This table shows the estimated coefficients from equation (II), which relates the aggregate factors (Q_t, P_t) to regional income and house price (q_{dt}, p_{dt}).

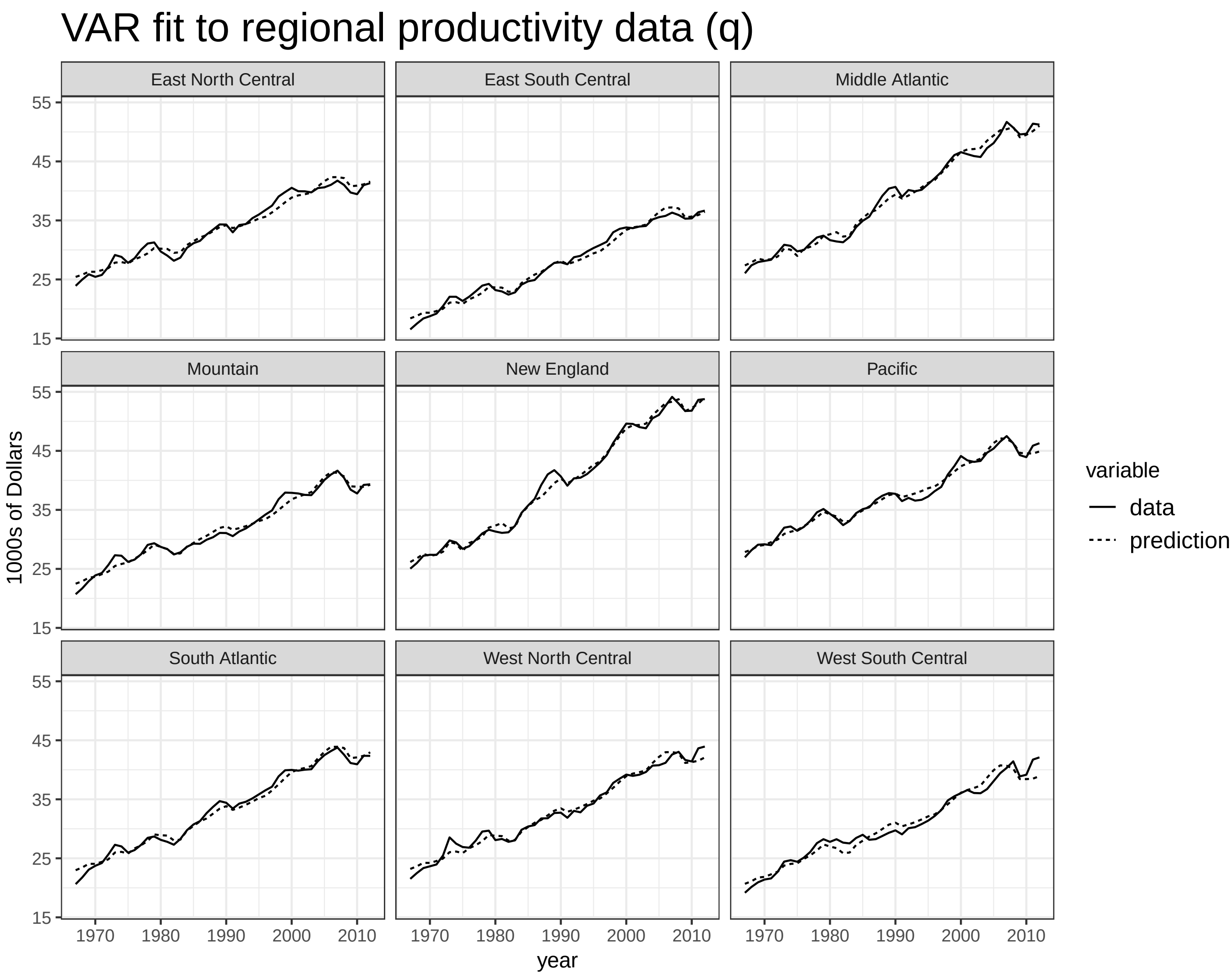

Figure B.3: This figure shows the observed and predicted time series for mean income by Census Division. The prediction is obtained from the VAR model in (II), which relates the aggreate series $\{Q_t, P_t\}_{t=1968}^{2012}$ to mean labor productivity $\{q_{dt}\}_{t=1968}^{2012}$ for each region d. Agents use this prediction in the model, i.e. from observing an aggregate value $\mathbf{F}_t = (P_t, Q_t)$ they infer a value for q_{dt} for each region above.

	$R^2 : p_{st} \sim p_{dt}$	$R^2 : q_{st} \sim q_{dt}$
East North Central	0.68	0.95
East South Central	0.93	0.96
Middle Atlantic	0.93	0.93
Mountain	0.68	0.83
New England	0.89	0.85
Pacific	0.72	0.83
South Atlantic	0.65	0.72
West North Central	0.73	0.96
West South Central	0.91	0.95

Table B.5: R^2 from pooled OLS regression of state level indices p_{st}, q_{st} on corresponding Division level indices p_{dt}, q_{dt}.

model generates considerable variation in the size of the resulting local shock, which is a desirable feature. A similar size regional shock in all regions would not seem very realistic.

B.5 State level vs Division level

An important question is how much information is lost in terms of price variation by looking at Census Divisions, rather than States, for example. In this subsection I show that the Division level index captures a very large share of the variation in state-level indices. I have both prices available at state level, hence I can form q_{st}, p_{st} for state s in period t, and run the following regression model:

$$\begin{aligned} q_{st} &= \beta_0 + \beta_1 q_{dt} + u_{st}, s \in d, t = 1967, \dots, 2012 \\ p_{st} &= \alpha_0 + \alpha_1 p_{dt} + u_{st}, s \in d, t = 1967, \dots, 2012 \end{aligned} \tag{IV}$$

The aim of those regressions is to measure how much state level variation is captured by the corresponding Divison level indices q_{dt} and p_{dt}. Tables B.6 and B.7 show the results. The main interest lies, however, in the implied R^2 of each regression, as a summary statistic of how much of the state level variation is captured by the simple models in IV. Those are in table B.5.

C Individual Income Process

For ease of reading, I reproduce here equation (21) in the main text:

$$\ln y_{ijdt} = \beta_0 + \eta_d \ln q_{dt} + \beta_1 j_{it} + \beta_2 j_{it}^2 + \beta_3 j_{it}^3 + \beta_4 \text{college}_{it} + z_{it}$$

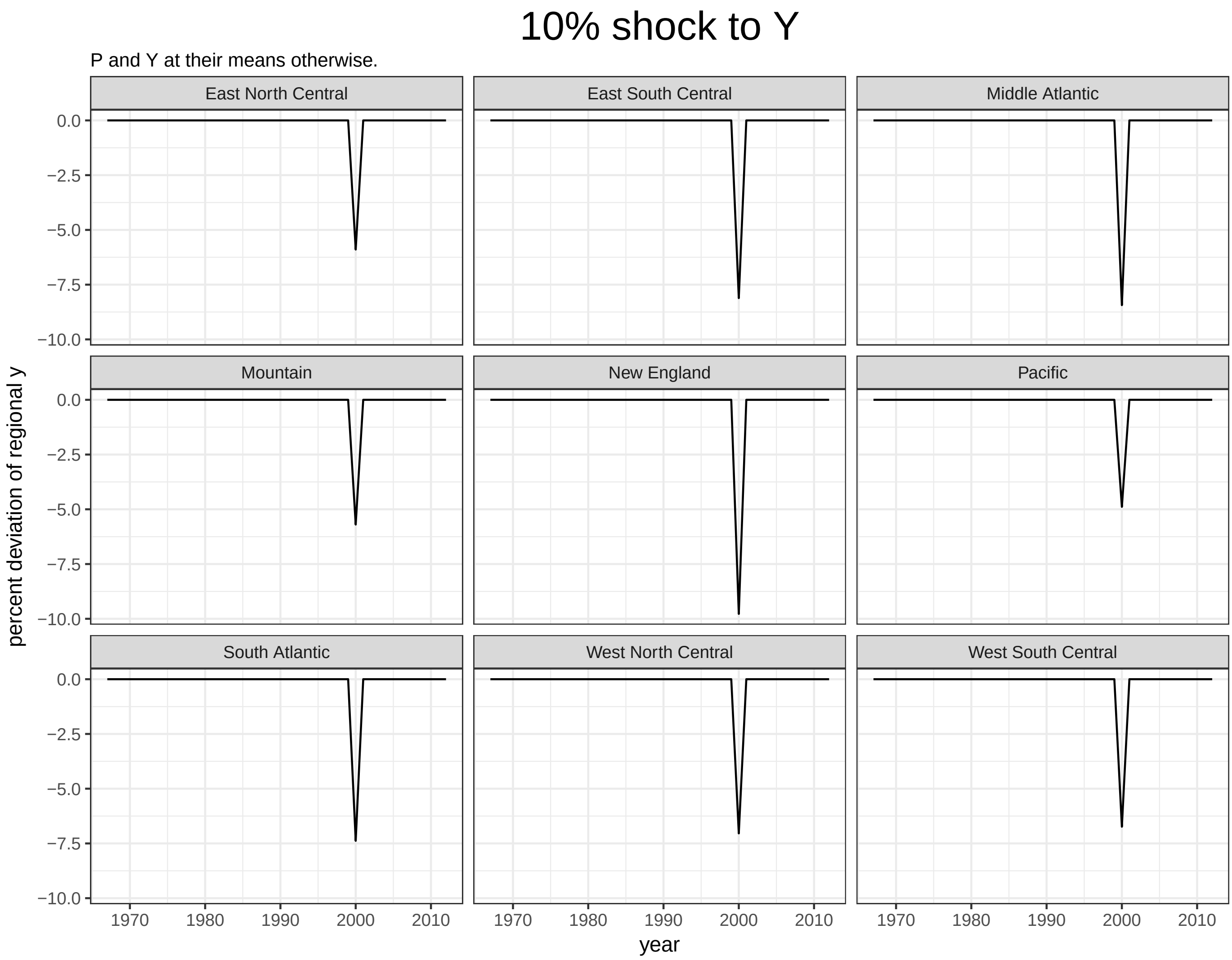

Figure B.4: Illustrating the transformation of aggregate shocks into regional counterparts. This exercise keeps the aggregate $\mathbf{F}_t$ constant at its mean level except for period $t = 2000$ where the Y_t component (only) is reduced by 10% relative to its mean. The panels show the resulting deviation in regional labor productivity q_{dt}.

	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
(Intercept)	-1.5256	1.2818	-3.3706	1.5956	3.2099	21.2355^{**}	-13.6953	-13.7760	6.4931
	(9.5468)	(4.3549)	(5.1850)	(10.0489)	(4.5463)	(9.8682)	(8.8513)	(8.8382)	(5.0437)
p_division	1.0284^{***}	0.9848^{***}	1.0317^{***}	1.0101^{***}	0.9499^{***}	0.9891^{***}	1.1273^{***}	1.1236^{***}	0.9745^{***}
	(0.0624)	(0.0275)	(0.0329)	(0.0487)	(0.0267)	(0.0549)	(0.0544)	(0.0503)	(0.0305)
R^2	0.6795	0.9264	0.9282	0.6760	0.8915	0.7169	0.6489	0.7350	0.9093
Adj. R^2	0.6770	0.9257	0.9273	0.6744	0.8908	0.7147	0.6473	0.7335	0.9084
Num. obs.	130	104	78	208	156	130	234	182	104
RMSE	18.0259	8.1438	11.7245	40.0695	16.7027	38.1318	33.4040	26.7202	11.7850

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table B.6: state vs region level price indices.

	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
(Intercept)	−0.3940	0.0367	−0.2981	0.9375*	0.4123	1.3076	0.8293	−0.8430***	−0.2505
	(0.3900)	(0.2959)	(0.7022)	(0.5428)	(0.7033)	(0.8098)	(0.7731)	(0.2970)	(0.3771)
y_division	0.9996***	0.9836***	1.0115***	0.9643***	0.9087***	0.9558***	1.0170***	1.0149***	0.9580***
	(0.0125)	(0.0116)	(0.0195)	(0.0185)	(0.0191)	(0.0233)	(0.0254)	(0.0097)	(0.0133)
R^2	0.9498	0.9636	0.9299	0.8332	0.8484	0.8346	0.7243	0.9581	0.9504
Adj. R^2	0.9496	0.9634	0.9296	0.8329	0.8480	0.8341	0.7239	0.9580	0.9502
Num. obs.	340	272	204	544	408	336	612	476	272
RMSE	1.9891	1.7760	3.2089	3.7663	5.0093	3.9581	6.5525	2.0783	2.1218

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

Table B.7: state vs region level price indices.

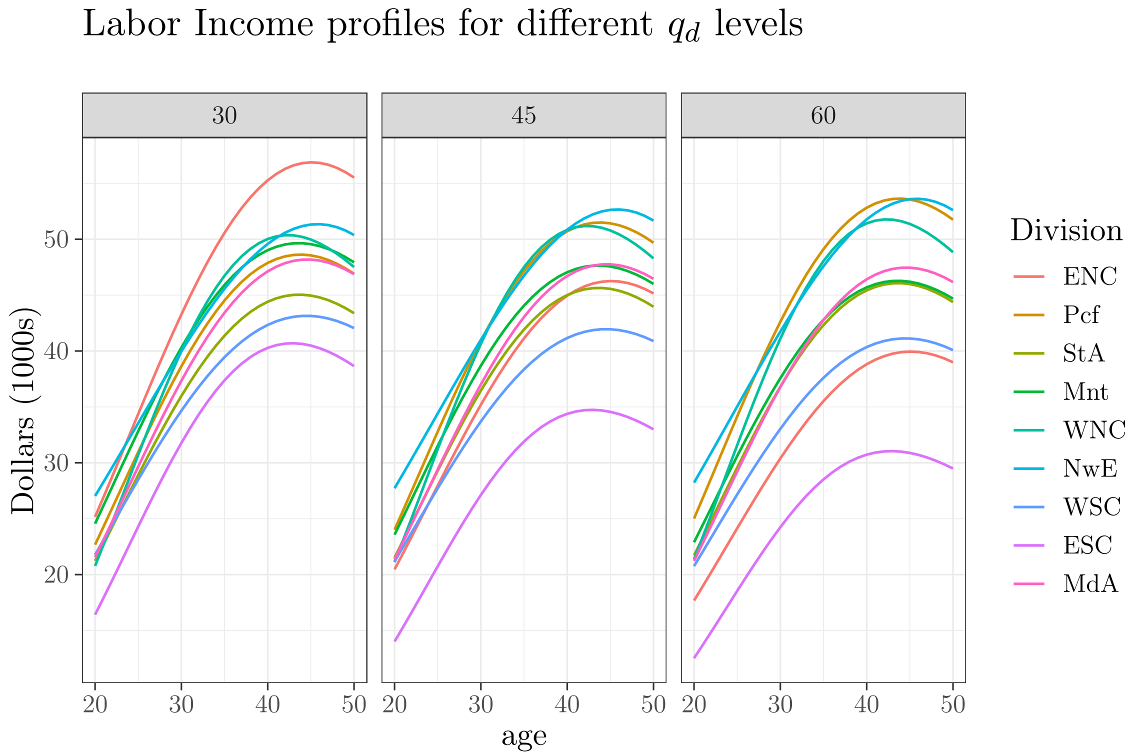

Figure C.1: Age profiles as predicted by the empirical implementation of individual labor income, equation (21), for three different levels of regional mean productivity q. Notice that in the model as well as in the data it is never the case that all regions have the same level of average income.

where $\text{college}_{it} = 1$ if i has a college degree, zero else, and where z_{it} are the regression residuals. Results from this estimation are shown in table C.1.

C.1 Estimation of G_{move}

To specify the transition matrix of movers' z, I require a measure of each mover's rank in the respective distribution of z in both origin and destination location. Ultimately I want know how persistent z ranks are, when moving across regions. To operationalize this, I assume that net of a shift in the mean, income distributions are identical across regions. This allows me to compare ranks across different regions. To this end, I estimate the following model of log income for all individuals who move in period t:

$$\ln y_{idt} = \beta_0 + \beta_1 \text{college}_{it} + \delta p(\text{age}_{it}) + \gamma_d + z_{it} \tag{V}$$

where $p(\text{age})$ is a third order polynomial in age and γ_d is a Division fixed effect. Notice the slight difference to the income equation (21) in the main text, which allows the fixed effect to vary over time.

	ENC	Pcf	StA	Mnt	WNC	NwE	WSC	ESC	MdA
Intercept	2.755***	0.287	0.605	1.328**	−0.326	1.869***	1.359***	0.955	0.780*
	(0.435)	(0.327)	(0.332)	(0.500)	(0.408)	(0.538)	(0.302)	(0.538)	(0.386)
q_d	−0.510***	0.141*	0.033	−0.101	0.040	0.062	−0.069	−0.391**	−0.022
	(0.105)	(0.066)	(0.074)	(0.115)	(0.086)	(0.100)	(0.059)	(0.124)	(0.076)
college	0.539***	0.546***	0.610***	0.464***	0.477***	0.568***	0.637***	0.645***	0.636***
	(0.008)	(0.009)	(0.008)	(0.012)	(0.011)	(0.014)	(0.010)	(0.014)	(0.010)
age	0.153***	0.169***	0.168***	0.160***	0.241***	0.073**	0.138***	0.235***	0.168***
	(0.014)	(0.015)	(0.014)	(0.020)	(0.018)	(0.027)	(0.016)	(0.022)	(0.018)
age^2	−0.002***	−0.003***	−0.003***	−0.003***	−0.004***	−0.001	−0.002***	−0.004***	−0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
age^3	0.000***	0.000***	0.000***	0.000***	0.000***	−0.000	0.000**	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R^2	0.121	0.117	0.131	0.099	0.110	0.120	0.139	0.131	0.131
Adj. R^2	0.121	0.117	0.131	0.098	0.110	0.120	0.139	0.130	0.131
Num. obs.	47476	40828	54636	19404	25338	15092	30753	19577	35699
RMSE	0.834	0.862	0.874	0.841	0.839	0.873	0.833	0.893	0.902

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table C.1: Regional Mean Income to Individual level income mapping. This is the empirical implementation of equation (21) in the main text, as explained in section 5.1. The estimated equation is $\log y_{idt} = \beta_0 + \eta_d \log \overline{y}_{dt} + \beta_1 \text{age}_{it} + \beta_2 \text{age}_{it}^2 + \beta_3 \text{age}_{it}^3 + u_{it}$ and the coefficients η are denoted with the Division names.

Copula Params	ρ	S.E.
$G_{\text{move}}(z_t, z_{t+1})$	0.58832	NA
Margins	$E(u)$	$sd(u)$
u_t	0.00	0.91689
u_{t+1}	0.00	0.97678

Table C.2: Normal Copula estimates for the standardized ranks u_{it}, u_{it+1} of wage residuals z_{it} and z_{it+1} for individuals who move in period t. The algorithm was not able to compute a standard error for ρ because of a flat hessian.

This is not of interest to recover the rank of z in a stationary distribution.

From (V) we obtain cross sectional distributions for z_{it} (i.e. z in current location) and z_{it+1} in the new location k. The procedure relies crucially on the assumption that individuals have to move to the new region before they can discover z_{t+1}. One could account for a potential selection effect on z_t by moving estimation of this part into the structural model and jointly estimate behavioural and wage related parameters. The model provides a set of exclusion restrictions that would allow to do this in theory. Identification of a potential selection effect may be difficult, however, because the sample of movers is relatively small.

Remember that the copula is given as

$$C(u_1, u_2) = F\left(F_1^{-1}(u_1), F_2^{-1}(u_2)\right)$$

so that it is necessary to specify 1) the copula family and 2) both margins F_1, F_2. Visual inspection of the margins lead me to assume normal margins, see figure C.2. Estimation itself is based on the respective rank of z in the empirical distributions. Denoting the standardized values by $(\hat{u}_{it}, \hat{u}_{it+1})$, the next step involves fitting the a normal copula via maximum likelihood to this data. The results are shown in table C.2, and they indicate a correlation between $\hat{u}_{it}$ and $\hat{u}_{it+1}$ of 0.59. This estimate together with the marginal distibutions of z_{it} and z_{it+1} are used in the structural model, where I use the current value of z, evaluated in the marginal distribution of z_{it} for a mover together with the copula estimate $\hat{G}_{\text{move}}$ to draw the next value of z'. The contours of the corresponding density function of copula C are shown in figure C.3.

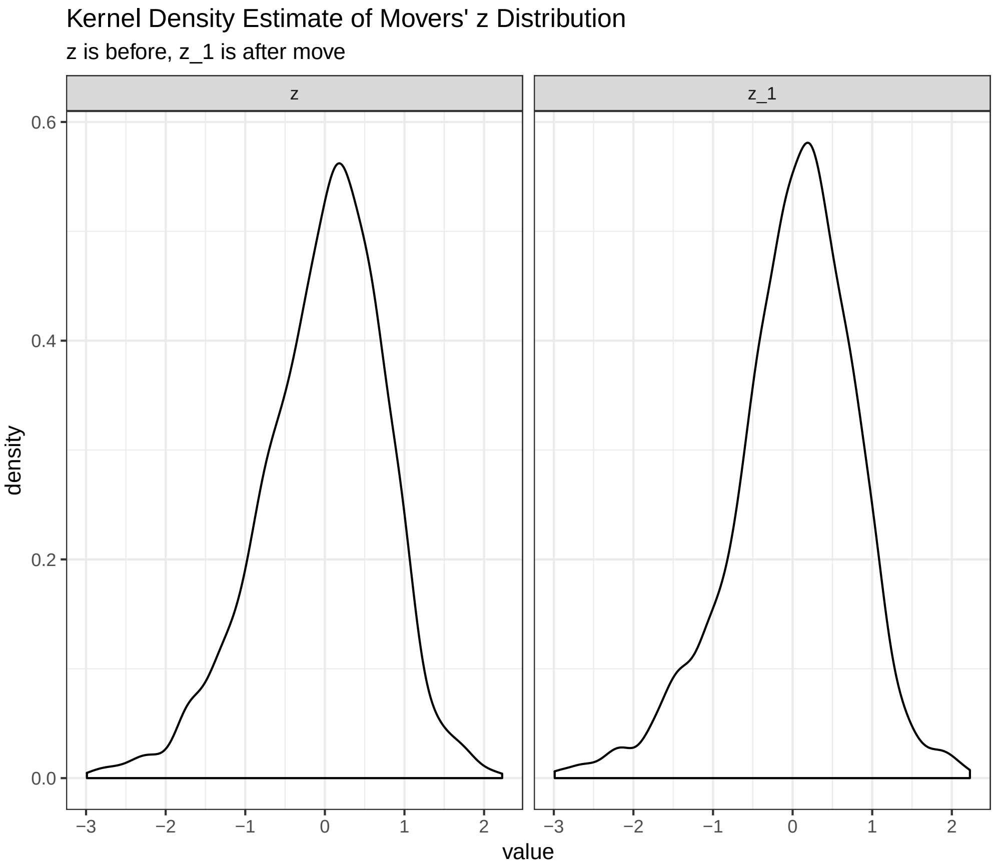

Figure C.2: Densities of wage residual z in equation (V) of movers today (z) and tomorrow (z_1).

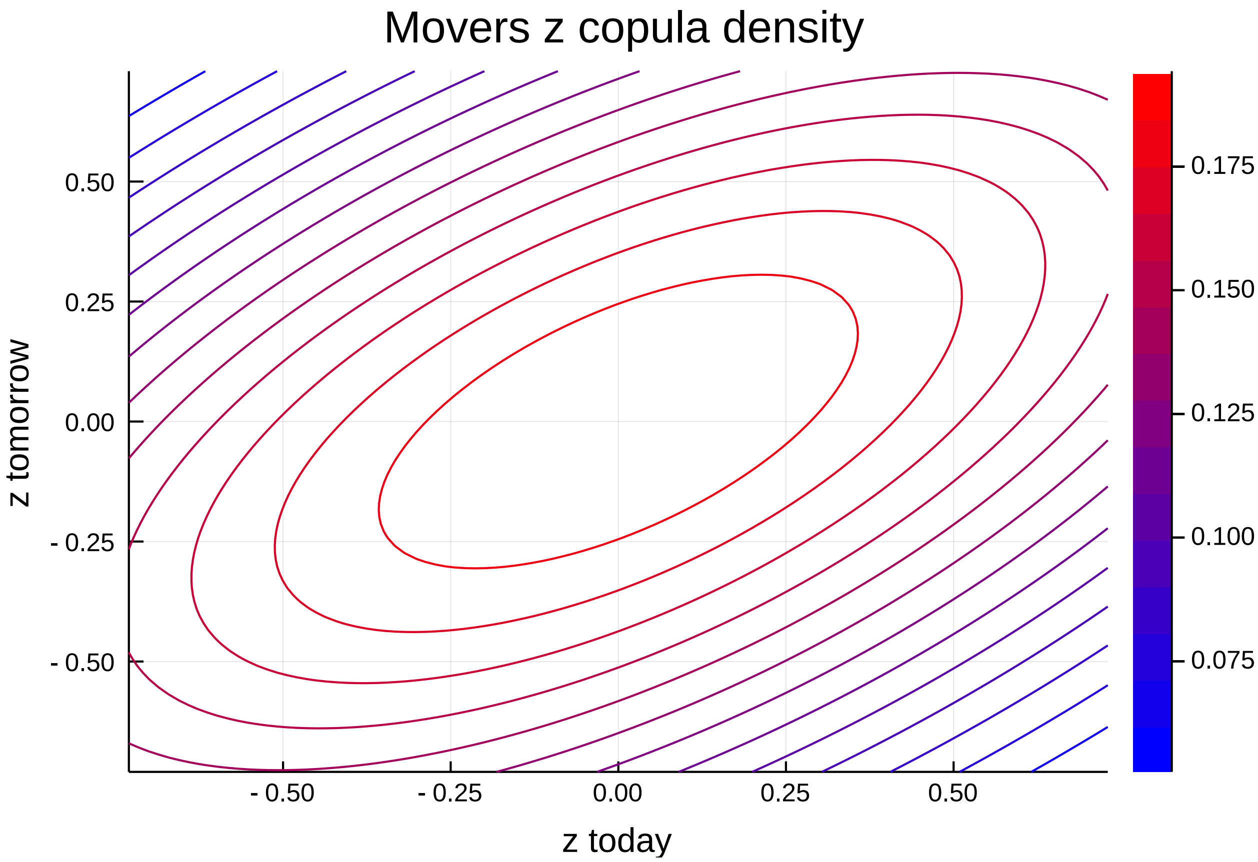

Figure C.3: Contours of copula density which is the estimate of the transition matrix of movers' z, denoted G_{move} in the text.

D Structural Model Fit

The fit is displayed in tables D.1 and D.2. The upper panel of table D.1 shows moments related to mobility, the lower panel shows moments related to homeownership. Regarding mobility, the fit is very good overall. The estimates for the auxiliary model defined in (24) representing the age profile in ownership also provide a good fit to the data. Looking at table D.2 we see that the average flows into each region are very close to the data.

Moving on to moments related to ownership, we see that the unconditional mean of ownership is identical to the data moment. Conditioning by region provides a more varied picture, with some regions overestimated and others underestimated. The reason for this is that there is heterogeneity in ownership rates by region which is not easily accounted for by the fundamentals of regional house price and mean income alone.[1] Remember that by taking prices and incomes as given, the model is restricted to only few levers that affect the homeownership rate. The main parameters in this respect are the utility premia ξ_1, ξ_2 and the weight in the final period utility ω. The model at the moment overpredicts ownership in later periods of life. This is visible from the intercept of the auxiliary model (23), which relates the ownership rate to an age profile. The reason for this is that in a model where age and wealth are the main dimensions of variation across households, as soon as a certain wealth threshold is crossed, all agents become owners. In other words, the model cannot account for wealthy houeholds who prefer not to own.[2]

Given that the CRRA coefficient γ is taken as fixed in the current implementation of the model, the moments relating to wealth resulting from the model can be viewed as some form of model validation. The model moments in table D.3 are not included in the SMM objective function, that is, they are not targeted by the estimation algorithm. The model overpredicts total wealth accumulation, related to the above mentioned slight overprediction of owners at old age. Finally, figure D.1 provides graphical display of auxiliary models and out of sample prediction for wealth moments.

[1]There is large degree of house price heterogeneity at the local level with is not in the model but which contributes to the average ownership rate at the regional level. Local building regulations, rent control or certain topographical features all influence the actual house price that the local level; The price index used in the model incurs some unavoidable aggregation error in this respect, and the same holds for my estimate of the average rent to price ratio.

[2]One way to improve in this dimension would be to introduce different types of housing preferences.

E Additional Results

E.1 Elasticity of Migration wrt positive price shock

The overall population elasticity is on average -0.1. Inflow elasticities are unambigously negative for both incoming buyers and renters: both find the region more expensive, hence stay away. Regarding outflows, the picture is more nuanced. Notice that owners experience a positive wealth shock in this case, which may (or may not) tip the balance towards moving to another region, when previously this was suboptimal. On aggregate, a one percent price increase leads to 1.1% increase in renter outflows, much larger than the corresponding 0.4% increase in owner outflows.

E.2 Comparative Statics of a Regional Price Shock

The aim of this section is to illustrate how the model reacts to regional price shocks in a comparative statics sense. This means that I will shock one region at a time with a regional house price and income shock, which deviates the observed price and income series to an unexpectedly lower level in the year 2000. All other regions are kept constant at baseline, observed, prices. The purpose of this exercise is to show how regions differ in response to a given shock. It is important to understand that the same sized shock can have very different results in different regions.

The exercise is set up in partial equilibrium, as is indeed the model. In the present context where we are interested in a ceteris paribus effect of shocking one region only at each time, this seems to be only a small limitation. We proceed thus in the folling fashion: Every region is taken through different combinations of counterfactual regional price and income shocks. For each region d, both p_{dt} and q_{dt} may deviate in the year $t = 2000$ by $\pm 5\%$ with respect to their observed (and expected) level, by surprise, and proceed at this deviated level for ever after. The results from this are collected in tables E.2 through E.10. Figure E.1 provides an illustration of a prototypical regional shock. Notice that the correlation between shocks is implied from the estimate of the covariance matrix for the regional price models III.

Moments related to mobility		
Moment	Data	Model
$E[\text{move}]$	0.010	0.009
$E[\text{move}\|T]$	0.004	0.001
$E[\text{move}\|s=0]$	0.009	0.009
$E[\text{move}\|s=1]$	0.008	0.009
$E[\text{move}\|h_{t-1}=0]$	0.014	0.018
$E[\text{move}\|h_{t-1}=1]$	0.004	0.002
$Cov(\text{move}, h)$	-0.002	-0.004
$Cov(\text{move}, s)$	-0.0002	-0.0001
$E[\text{moved never}]$	0.83	0.91
$E[\text{moved once}]$	0.07	0.07
$E[\text{moved twice+}]$	0.09	0.03
Auxiliary model (24): $\text{move}_{it} = \beta_{0,m} + \beta_{1,m} t_{it} + \beta_{2,m} t_{it}^2 + u_{it}$		
$\beta_{0,m}$	0.06	0.04
$\beta_{1,m}$	-0.002	-0.002
$\beta_{2,m}$	$2.49798e{-05}$	$3.96453e{-05}$
Moments related to homeownership		
$E[h_{t-1}]$	0.54	0.55
$E[h_{t-1}\|\text{ENC}]$	0.60	0.59
$E[h_{t-1}\|\text{ESC}]$	0.60	0.51
$E[h_{t-1}\|\text{MdA}]$	0.49	0.57
$E[h_{t-1}\|\text{Mnt}]$	0.54	0.56
$E[h_{t-1}\|\text{NwE}]$	0.51	0.47
$E[h_{t-1}\|\text{Pcf}]$	0.44	0.49
$E[h_{t-1}\|\text{StA}]$	0.56	0.56
$E[h_{t-1}\|\text{WNC}]$	0.64	0.53
$E[h_{t-1}\|\text{WSC}]$	0.55	0.60
$E[h_{t-1}\|s=0]$	0.50	0.50
$E[h_{t-1}\|s=1]$	0.57	0.58
$E[h_{t-1}=1, h_t=0\|T]$	0.01	0.02
$Cov(h_{t-1}, s)$	0.02	0.02
Auxiliary model (23): $h_{it-1} = \beta_{0,h} + \beta_{1,h} t_{it} + \beta_{2,h} t_{it}^2 + u_{it}$		
$\beta_{0,h}$	-0.845	0.084
$\beta_{1,h}$	0.061	0.004
$\beta_{2,h}$	-0.0006	0.0010

Table D.1: Empirical targets and corresponding model moments. The auxiliary models reference equations in the main text.

Moments of Population Flows		
Moment	Data	Model
E[flow to ENC]	0.147	0.146
E[flow to ESC]	0.059	0.069
E[flow to MdA]	0.083	0.079
E[flow to Mnt]	0.120	0.119
E[flow to NwE]	0.043	0.046
E[flow to Pcf]	0.143	0.143
E[flow to StA]	0.161	0.160
E[flow to WNC]	0.125	0.125
E[flow to WSC]	0.119	0.115

Table D.2: Empirical targets and corresponding model moments for population flows.

Non-targetted moments		
Moment	Data	Model
$E[\text{wealth}\|t \in [20, 30]]$	36.087	45.803
$E[\text{wealth}\|t \in (30, 40]]$	81.908	95.204
$E[\text{wealth}\|t \in (40, 50]]$	139.435	220.426
E[wealth|ENC]	99.289	116.034
E[wealth|ESC]	76.308	97.921
E[wealth|MdA]	106.083	152.629
E[wealth|Mnt]	81.196	141.256
E[wealth|NwE]	125.487	176.194
E[wealth|Pcf]	112.368	202.983
E[wealth|StA]	89.979	146.198
E[wealth|WNC]	102.394	108.024
E[wealth|WSC]	66.846	97.241
$E[\text{wealth}\|h_{t-1} = 0]$	20.127	50.478
$E[\text{wealth}\|h_{t-1} = 1]$	157.199	213.290

Table D.3: Non-targeted model and data moments. This set of moments does not enter the SMM objective function and can thus be seen as a form of external validation of the model.

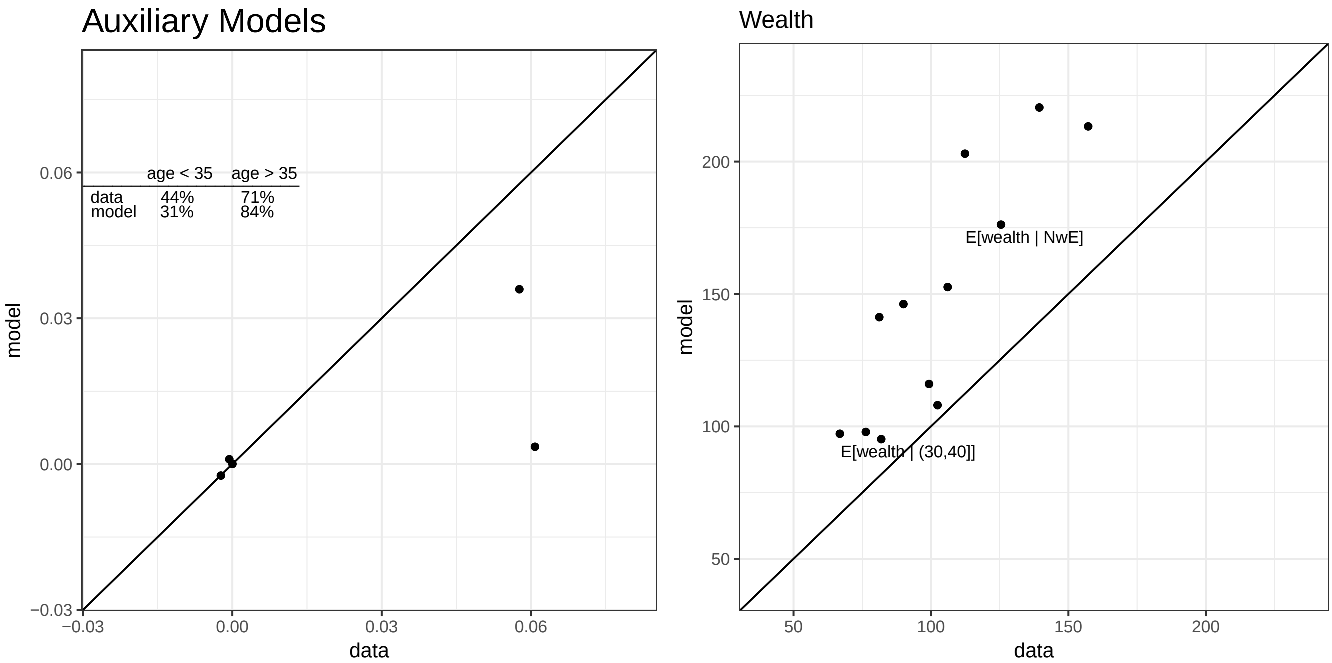

Figure D.1: Left panel: Parameters of the auxiliary models and table with resulting implications for the model generated ownership rate (inset). Right panel: out of sample predictions about average wealth conditional on age and region. Wealth moments are not included in the SMM objective function.

		Inflows			Outflows		
Division	Population	Total	Buyers	Renters	Total	Owners	Renters
Aggregate	−0.1	−0.9	−1.1	−0.7	1.0	0.4	1.1
East North Central	−0.0	−0.6	−1.3	−0.4	0.4	1.2	0.4
East South Central	−0.1	−0.8	0.3	−0.7	−0.0	0.0	−0.0
Middle Atlantic	−0.1	−0.7	−0.7	−0.6	0.8	−0.8	0.9
Mountain	−0.2	−1.1	−1.7	−1.0	0.9	0.4	1.0
New England	−0.1	−1.2	−0.9	−1.1	0.0	0.9	−0.0
Pacific	−0.4	−1.5	−2.1	−1.3	4.4	0.3	5.0
South Atlantic	−0.1	−1.1	−1.2	−0.9	1.0	−0.3	1.2
West North Central	−0.1	−0.4	−1.0	−0.3	0.1	2.2	0.0
West South Central	−0.1	−0.8	−1.6	−0.3	1.0	−0.0	1.1

Table E.1: Elasticities with respect to an unexpected and permanently positive price shock by region. Statistics are computed identically as in table 9 in the main text.

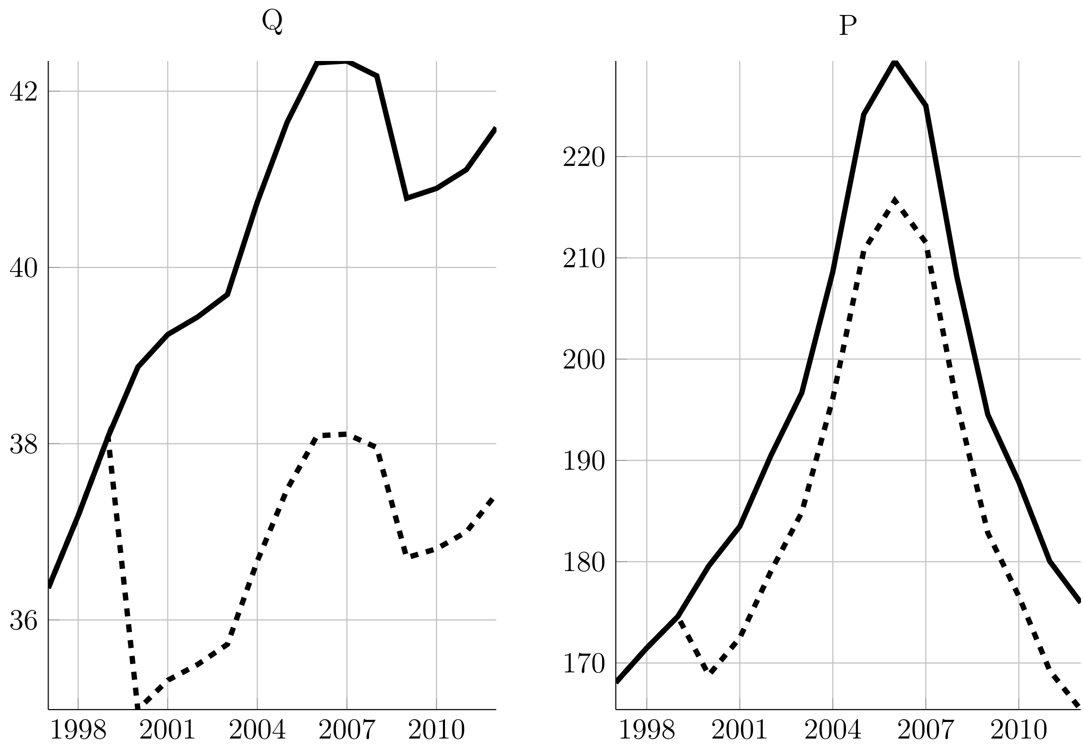

Figure E.1: Comparative Statics of Regional Shock. Dashed line is the shocked series for a given region. This picture applies a 10% shock to Q and a 6% shock to P. Both y-axis are in thousands of dollars.

Shocks by Region									
Moment	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
$\%\Delta v$	−2.715	−4.749	−3.252	−3.453	−3.463	−3.133	−3.195	−3.166	−3.923
$\%\Delta c$	−5.015	−4.922	−4.908	−4.819	−4.884	−4.934	−4.970	−5.182	−4.693
Stayers									
$\%\Delta w$	−0.303	−0.009	−0.278	−0.173	−0.148	−0.750	−0.423	−0.098	−0.061
$\%\Delta h$	−0.057	−0.003	−0.037	−0.015	0.027	0.340	−0.062	−0.127	−0.020
$\%\Delta a$	0.856	0.039	1.099	0.385	−0.079	−2.649	2.078	0.409	−0.196
$\%\Delta y$	−0.371	−0.013	−0.171	−0.101	−0.106	−0.405	−0.300	−0.122	−0.077
$\%\Delta v$	−0.398	−0.020	−0.129	−0.091	−0.047	−0.335	−0.387	−0.110	−0.118
$\%\Delta u$	−0.477	−0.092	−0.161	−0.196	−0.086	−0.683	−0.909	−0.209	−0.137
Movers									
$\%\Delta w$	−0.277	−0.002	−0.385	−0.225	−0.312	−0.620	−0.369	−0.202	−0.006
$\%\Delta h$	−0.117	0.016	0.068	−0.052	0.296	1.050	0.237	−0.383	−0.039
$\%\Delta a$	7.349	−0.775	4.817	1.713	−8.486	−29.921	5.702	5.937	−2.897
$\%\Delta y$	−0.471	−0.023	−0.393	−0.229	−0.318	−0.578	−0.549	−0.345	−0.163
$\%\Delta v$	−0.674	−0.046	−0.277	−0.192	−0.149	−0.543	−0.728	−0.306	−0.266
$\%\Delta u$	−1.582	−0.291	−0.360	0.316	−0.412	−0.661	−0.572	−0.785	−0.621
ps=0.95, qs=0.95									

Table E.2: shocks by region

Shocks by Region									
Moment	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
$\%\Delta v$	-4.005	-6.569	-4.930	-5.253	-5.375	-5.496	-4.515	-4.150	-5.280
$\%\Delta c$	-5.553	-5.512	-5.510	-5.235	-5.121	-5.304	-5.645	-5.445	-5.406
Stayers									
$\%\Delta w$	0.109	0.034	-0.078	-0.039	-0.071	-0.268	-0.021	0.042	0.070
$\%\Delta h$	-0.176	-0.015	-0.086	-0.021	-0.022	0.279	-0.182	-0.092	-0.043
$\%\Delta a$	0.389	0.110	1.668	0.091	0.747	-1.313	2.885	-0.436	-0.300
$\%\Delta y$	-0.366	-0.011	-0.170	-0.095	-0.113	-0.410	-0.280	-0.117	-0.065
$\%\Delta v$	-0.528	-0.035	-0.180	-0.118	-0.066	-0.451	-0.499	-0.137	-0.143
$\%\Delta u$	-0.417	-0.099	-0.264	-0.263	-0.046	-1.011	-0.977	-0.149	-0.185
Movers									
$\%\Delta w$	0.151	0.201	-0.094	-0.002	-0.204	-0.299	0.017	0.087	0.296
$\%\Delta h$	-0.432	0.042	-0.055	-0.211	0.094	1.222	-0.218	-0.292	-0.201
$\%\Delta a$	6.814	-3.095	7.330	4.433	0.766	-27.880	12.538	-1.099	-3.543
$\%\Delta y$	-0.427	0.030	-0.399	-0.203	-0.343	-0.613	-0.506	-0.346	-0.120
$\%\Delta v$	-0.939	-0.060	-0.406	-0.265	-0.214	-0.770	-1.044	-0.418	-0.358
$\%\Delta u$	-1.511	-0.340	-0.792	0.646	-0.576	-0.359	-0.351	-0.613	-0.912
ps=1.0, qs=0.95									

Table E.3: shocks by region

Shocks by Region									
Moment	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
$\%\Delta v$	−5.144	−8.338	−6.601	−6.860	−7.316	−8.699	−6.253	−4.749	−5.675
$\%\Delta c$	−6.080	−5.977	−5.776	−5.840	−5.419	−5.558	−6.043	−5.962	−6.299
Stayers									
$\%\Delta w$	0.554	0.068	0.108	0.089	0.031	0.129	0.306	0.171	0.171
$\%\Delta h$	−0.368	−0.011	−0.149	−0.042	−0.026	0.128	−0.322	−0.108	−0.095
$\%\Delta a$	1.893	0.003	2.329	−0.223	1.119	1.694	3.602	0.002	−0.155
$\%\Delta y$	−0.360	−0.011	−0.168	−0.090	−0.112	−0.415	−0.275	−0.120	−0.060
$\%\Delta v$	−0.616	−0.044	−0.217	−0.150	−0.074	−0.551	−0.605	−0.163	−0.155
$\%\Delta u$	−0.560	−0.079	−0.346	−0.340	−0.092	−1.258	−1.088	−0.240	−0.251
Movers									
$\%\Delta w$	0.684	0.363	0.139	0.227	−0.131	0.012	0.454	0.293	0.534
$\%\Delta h$	−0.936	0.195	−0.133	−0.208	−0.062	1.303	−0.572	−0.416	−0.364
$\%\Delta a$	14.677	−6.038	10.287	1.692	7.699	−16.625	18.354	−2.517	−5.837
$\%\Delta y$	−0.374	0.043	−0.410	−0.181	−0.364	−0.617	−0.462	−0.350	−0.074
$\%\Delta v$	−1.155	−0.072	−0.496	−0.337	−0.283	−0.987	−1.352	−0.508	−0.416
$\%\Delta u$	−1.707	−0.364	−0.911	0.550	−1.044	−1.326	−0.717	−0.722	−0.926
ps=1.05, qs=0.95									

Table E.4: shocks by region

Shocks by Region									
Moment	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
$\%\Delta v$	1.037	1.998	1.397	1.383	1.568	1.937	1.367	0.907	0.479
$\%\Delta c$	0.607	0.484	0.880	0.535	0.335	0.725	0.668	0.354	0.843
Stayers									
$\%\Delta w$	-0.514	-0.055	-0.250	-0.209	-0.081	-0.524	-0.434	-0.121	-0.133
$\%\Delta h$	0.116	0.006	0.065	0.080	0.053	0.157	0.117	0.011	0.080
$\%\Delta a$	-0.741	0.057	-0.723	-1.275	-0.573	-3.217	-0.770	0.145	-0.256
$\%\Delta y$	$9.742e-05$	-0.005	0.001	-0.004	0.010	0.012	-0.005	0.004	-0.009
$\%\Delta v$	0.094	0.012	0.057	0.041	0.028	0.149	0.139	0.032	0.025
$\%\Delta u$	-0.039	-0.054	0.120	0.044	-0.029	0.004	-0.027	-0.129	-0.035
Movers									
$\%\Delta w$	-0.552	-0.175	-0.375	-0.285	-0.115	-0.282	-0.494	-0.316	-0.268
$\%\Delta h$	0.335	-0.016	0.016	0.143	0.078	0.023	0.517	-0.211	0.305
$\%\Delta a$	-1.484	0.093	-2.715	-4.409	-4.957	-13.386	-9.410	10.447	1.247
$\%\Delta y$	-0.014	-0.024	0.036	0.001	0.055	0.071	0.003	0.020	-0.044
$\%\Delta v$	0.322	0.027	0.167	0.099	0.100	0.356	0.475	0.130	0.079
$\%\Delta u$	0.671	0.124	0.198	0.064	0.034	0.087	0.740	0.234	0.505
ps=0.95, qs=1.0									

Table E.5: shocks by region

Shocks by Region									
Moment	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
$\%\Delta v$	$1.961e{-}14$	0.00	0.00	0.00	0.00	0.00	$-1.870e{-}14$	$2.126e{-}14$	0.00
$\%\Delta c$	0.00	0.00	$-1.587e{-}14$	0.00	0.00	0.00	$1.673e{-}14$	0.00	0.00
Stayers									
$\%\Delta w$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$\%\Delta h$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$\%\Delta a$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$\%\Delta y$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$\%\Delta v$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$\%\Delta u$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Movers									
$\%\Delta w$	$1.115e{-}14$	$1.115e{-}14$	$1.115e{-}14$	$1.115e{-}14$	$1.115e{-}14$	$1.115e{-}14$	$1.115e{-}14$	$1.115e{-}14$	$1.115e{-}14$
$\%\Delta h$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$\%\Delta a$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$\%\Delta y$	$-1.560e{-}14$	$-1.560e{-}14$	$-1.560e{-}14$	$-1.560e{-}14$	$-1.560e{-}14$	$-1.560e{-}14$	$-1.560e{-}14$	$-1.560e{-}14$	$-1.560e{-}14$
$\%\Delta v$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$\%\Delta u$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ps=1.0, qs=1.0									

Table E.6: shocks by region

Shocks by Region									
Moment	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
$\%\Delta v$	−1.044	−1.641	−1.552	−1.304	−2.001	−2.222	−1.423	−0.749	−1.094
$\%\Delta c$	−0.508	−0.707	−0.434	−0.522	−0.385	−0.326	−0.557	−0.414	−0.929
Stayers									
$\%\Delta w$	0.406	0.054	0.202	0.147	0.091	0.570	0.404	0.112	0.118
$\%\Delta h$	−0.175	0.006	−0.086	−0.038	−0.045	−0.067	−0.174	−0.029	−0.026
$\%\Delta a$	0.490	−0.194	0.859	−0.093	0.898	1.139	1.558	−0.272	0.006
$\%\Delta y$	0.004	0.003	−0.004	0.001	−0.011	−0.010	0.001	−0.001	0.002
$\%\Delta v$	−0.116	−0.010	−0.050	−0.035	−0.025	−0.103	−0.122	−0.037	−0.032
$\%\Delta u$	−0.069	−0.083	−0.068	−0.061	−0.104	−0.075	−0.203	−0.053	−0.027
Movers									
$\%\Delta w$	0.516	0.202	0.266	0.196	0.155	0.380	0.443	0.268	0.314
$\%\Delta h$	−0.387	0.097	−0.244	−0.081	−0.091	0.081	−0.474	−0.185	−0.214
$\%\Delta a$	3.271	−2.220	5.400	−0.966	7.947	1.083	9.208	−1.343	−0.198
$\%\Delta y$	0.031	0.034	−0.030	0.007	−0.045	−0.028	0.009	−0.014	0.034
$\%\Delta v$	−0.259	−0.024	−0.150	−0.094	−0.075	−0.315	−0.402	−0.115	−0.108
$\%\Delta u$	−0.390	−0.039	−0.310	0.001	−0.294	−0.738	−0.665	−0.064	−0.239
ps=1.05, qs=1.0									

Table E.7: shocks by region

Shocks by Region									
Moment	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
$\%\Delta v$	4.474	8.075	5.739	5.545	6.092	6.711	5.401	4.411	4.675
$\%\Delta c$	6.052	5.992	6.377	5.889	5.594	6.443	6.271	5.634	6.051
Stayers									
$\%\Delta w$	−0.523	−0.105	−0.162	−0.221	−0.069	−0.167	−0.394	−0.158	−0.238
$\%\Delta h$	0.362	0.019	0.146	0.137	0.020	0.011	0.252	0.099	0.146
$\%\Delta a$	−1.007	−0.187	−2.006	−2.510	−1.288	−4.277	−2.306	0.350	0.039
$\%\Delta y$	0.437	0.004	0.229	0.143	0.142	0.512	0.364	0.161	0.085
$\%\Delta v$	0.624	0.048	0.269	0.201	0.100	0.633	0.697	0.177	0.193
$\%\Delta u$	0.312	−0.209	0.262	0.295	0.011	0.217	0.591	−0.018	0.305
Movers									
$\%\Delta w$	−0.628	−0.276	−0.198	−0.192	0.271	0.569	−0.424	−0.340	−0.415
$\%\Delta h$	1.329	0.010	0.390	0.374	0.153	−1.079	1.115	0.338	0.962
$\%\Delta a$	−15.853	1.081	−14.824	−12.228	−12.398	−5.943	−36.297	3.443	−5.036
$\%\Delta y$	0.603	0.017	0.573	0.339	0.557	1.062	0.735	0.490	0.193
$\%\Delta v$	1.463	0.174	0.765	0.522	0.413	1.543	1.902	0.637	0.571
$\%\Delta u$	2.804	0.929	1.440	1.172	1.002	2.488	2.218	1.019	1.739
ps=0.95, qs=1.05									

Table E.8: shocks by region

Shocks by Region									
Moment	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
$\%\Delta v$	3.649	6.220	4.305	4.511	4.633	4.747	4.085	3.632	4.332
$\%\Delta c$	5.455	5.423	5.780	5.222	5.066	5.848	5.663	5.244	5.369
Stayers									
$\%\Delta w$	−0.120	−0.023	0.044	−0.019	0.066	0.322	0.016	−0.025	−0.095
$\%\Delta h$	0.190	0.012	0.086	0.063	−0.020	−0.146	0.121	0.083	0.064
$\%\Delta a$	−1.812	0.076	−2.107	−1.527	−0.528	−1.396	−2.773	0.054	0.379
$\%\Delta y$	0.440	0.011	0.218	0.138	0.129	0.481	0.364	0.154	0.089
$\%\Delta v$	0.516	0.035	0.200	0.154	0.074	0.463	0.528	0.139	0.160
$\%\Delta u$	0.260	−0.175	0.152	0.192	0.014	0.029	0.701	−0.057	0.271
Movers									
$\%\Delta w$	−0.174	−0.070	0.122	0.116	0.374	0.817	0.080	−0.055	−0.120
$\%\Delta h$	0.708	0.019	0.156	0.162	−0.029	−1.089	0.526	0.195	0.429
$\%\Delta a$	−12.871	1.839	−12.919	−5.985	−3.878	7.004	−30.605	0.549	−2.191
$\%\Delta y$	0.597	0.039	0.522	0.321	0.491	0.923	0.707	0.453	0.225
$\%\Delta v$	1.115	0.123	0.556	0.408	0.282	1.030	1.331	0.498	0.443
$\%\Delta u$	1.395	0.602	1.134	0.987	0.419	1.155	2.104	0.700	1.165
ps=1.0, qs=1.05									

Table E.9: shocks by region

Shocks by Region									
Moment	ENC	ESC	MdA	Mnt	NwE	Pcf	StA	WNC	WSC
$\%\Delta v$	2.708	4.459	2.936	3.163	3.064	2.961	2.688	2.823	3.080
$\%\Delta c$	4.916	4.852	5.027	4.770	4.834	5.154	4.979	4.788	4.498
Stayers									
$\%\Delta w$	0.393	0.027	0.295	0.181	0.157	0.941	0.458	0.103	0.056
$\%\Delta h$	0.070	0.012	−0.024	0.022	−0.060	−0.246	−0.095	0.038	0.027
$\%\Delta a$	−1.233	−0.093	−0.747	−1.086	0.047	0.686	−1.033	0.006	0.058
$\%\Delta y$	0.441	0.013	0.212	0.136	0.117	0.470	0.362	0.150	0.096
$\%\Delta v$	0.425	0.023	0.140	0.119	0.045	0.337	0.374	0.101	0.111
$\%\Delta u$	0.216	−0.105	0.029	0.220	−0.065	0.026	0.369	−0.032	0.214
Movers									
$\%\Delta w$	0.420	0.094	0.457	0.350	0.512	1.281	0.619	0.222	0.180
$\%\Delta h$	0.227	0.107	−0.195	0.081	−0.253	−0.881	−0.117	0.006	0.169
$\%\Delta a$	−10.154	−2.189	−2.226	−7.965	7.724	11.460	−15.757	−0.305	−2.651
$\%\Delta y$	0.595	0.060	0.484	0.318	0.421	0.798	0.671	0.430	0.238
$\%\Delta v$	0.824	0.087	0.366	0.261	0.190	0.619	0.839	0.348	0.299
$\%\Delta u$	1.650	0.616	0.925	0.854	0.526	0.571	1.259	0.408	1.058
ps=1.05, qs=1.05									

Table E.10: shocks by region

Region	Young	Old	own,30	rent,30	$z_{0.2}$	$z_{0.8}$	ATE
Aggregate	37.9 %	9.6 %	5.3 %	23.4 %	17.7 %	23.4 %	23.4 %
East North Central	17.8 %	1.9 %	8.3 %	12.5 %	5.2 %	9.2 %	11.1 %
East South Central	49.9 %	2.7 %	1.2 %	16.6 %	27.2 %	37.4 %	41.5 %
Middle Atlantic	37.7 %	8.0 %	2.5 %	18.9 %	9.9 %	43.5 %	32.2 %
Mountain	25.6 %	10.7 %	1.8 %	17.4 %	16.4 %	24.9 %	14.4 %
New England	63.4 %	2.2 %	8.9 %	30.1 %	13.7 %	36.9 %	42.8 %
Pacific	99.6 %	−6.5 %	2.3 %	20.8 %	34.0 %	−0.4 %	12.8 %
South Atlantic	15.6 %	5.8 %	−9.3 %	12.7 %	9.5 %	13.2 %	11.6 %
West North Central	30.4 %	10.6 %	3.0 %	24.6 %	15.1 %	33.7 %	26.0 %
West South Central	18.9 %	4.3 %	2.2 %	13.1 %	16.6 %	14.5 %	16.8 %

Table E.11: Consumption compensation demanded after migration shutdown in scenario 2, i.e. regional prices decrease both by 1% as a result of the shutdown of migration. See table 12 in the main text for the baseline experiment.

E.3 Migration Shutdown with Changing Prices

This section presents the results from the experiment in section 6.4 in the main text under scenarios 2 and 3:

1. Baseline $\{q_{dt}, p_{dt}\}_{t=1997}^{2012}$: Loss of migrants has negligible impact on regional prices.
2. 1% shock to $\{q_{dt}, p_{dt}\}_{t=1997}^{2012}$: Local productivity suffers a small loss.
3. 5%/10% shock: Large productivity decline and amplified effect on house prices.

Starting in table E.11 with scenario 2, we see the general pattern from the baseline experiment without changing prices going through: Individuals dislike the counterfactual world, with strong differences across regions and betwen age groups, and between renters and owners at young age. With the 1% shock on regional income and house price, the compensation demanded is slightly higher everywhere as compared to the baseline in table 12.

Table E.12 presents the corresponding results for scenario 3, where the trend from scenario 2 continues: We see the same pattern, just larger numbers.

Region	Young	Old	own,30	rent,30	$z_{0.2}$	$z_{0.8}$	ATE
Aggregate	58.0 %	11.8 %	11.3 %	26.4 %	27.1 %	30.2 %	33.4 %
East North Central	21.8 %	6.4 %	12.5 %	14.2 %	9.7 %	13.2 %	15.5 %
East South Central	54.4 %	3.9 %	11.2 %	18.3 %	26.1 %	41.8 %	44.7 %
Middle Atlantic	78.1 %	8.8 %	11.2 %	22.3 %	23.0 %	54.9 %	52.1 %
Mountain	42.0 %	12.1 %	4.7 %	21.3 %	18.1 %	31.7 %	22.1 %
New England	67.4 %	−0.7 %	6.0 %	32.0 %	9.3 %	39.7 %	43.0 %
Pacific	99.7 %	−6.7 %	5.5 %	24.4 %	70.2 %	7.4 %	30.8 %
South Atlantic	33.9 %	9.0 %	−3.8 %	15.7 %	16.5 %	21.3 %	22.0 %
West North Central	34.8 %	16.2 %	10.4 %	26.6 %	18.7 %	38.9 %	31.1 %
West South Central	28.3 %	6.7 %	9.4 %	15.6 %	21.8 %	19.1 %	22.6 %

Table E.12: Consumption compensation demanded after migration shutdown in scenario 3, i.e. regional prices and incomes decrease by 10% and 5% respectively as a result of the shutdown of migration. See table 12 in the main text for the baseline experiment.

F Welfare Measure

Denoting the lifetime utility from the baseline and policy regimes under consumption tax Δc by V and $\hat{V}(\Delta c)$ respectively, the equalizing consumption tax Δc^* solves

$$\begin{aligned} V - \hat{V}(\Delta c) &= 0 \\ V &= \frac{1}{JN}\sum_{i=1}^{N}\sum_{t=1}^{J}\max_{k\in D}\left\{v\left(x_{it},k\right)+\varepsilon_{ikt}\right\} \\ &= \frac{1}{JN}\sum_{i=1}^{N}\sum_{t=1}^{J}u(c_{it}^*,h_{it}^*,k_{it}^*;x_{it})+\beta\mathbb{E}_{z,s,\mathbf{F}}\left[\overline{v}\left(x_{it+1}\right)|z_{ij},s_{ij},\mathbf{F}_t\right] \\ \hat{V}((\Delta c)) &= \frac{1}{JN}\sum_{i=1}^{N}\sum_{t=1}^{J}u((\Delta c)\,\hat{c}_{it},\hat{h}_{it},\hat{k}_{it};\hat{x}_{it})+\beta\mathbb{E}_{z,s,\mathbf{F}}\left[\overline{v}\left(\hat{x}_{it+1}\right)|z_{ij},s_{ij},\mathbf{F}_t\right] \end{aligned}$$

where N is the number of simulated individuals and y^* indicates the optimal choice of variable y. In other words, the welfare measure is the average of over realized value functions (**??**) in a given simulation. Notice that the policy functions and resulting lifecycle profiles $\hat{x}_{it}$ are different under the policy, for example $\hat{c} \neq c$. Then, a value $(\Delta c)^* > 1$ implies that agents would be indifferent between any proposed policy change if consumption were scaled up in every period, i.e. they would demand a subsidy. In the opposite case of $(\Delta c)^* < 1$ they would be happy to give up a fixed proportion $(\Delta c)^*$ of period consumption if they were given the opportunity to participate in the policy.

G Initial Conditions and Cohort Setup

The SIPP estimation sample runs from 1998 through 2012. The data moments the model is supposed to replicate are weighted averages over this period, where the weights are the SIPP sampling weights. When reconstructing an artificial sample from the model simulation, care must be taken to replicate the shocks experienced by each cohort in the data leading up to the point where they are observed.

The data is subset to the ages allowed for in the model, i.e. 20–50. I compute data moments, for example the average homeownership rate in region d, or the average total wealth of age group 40–45 in d, as averages over the entire sample period:

$$\begin{aligned}
\text{mean_own_data}_d &= \frac{1}{15}\sum_{t=1998}^{2012}\left(\frac{1}{N_{dt}}\sum_{i\in d,t}^{N_{dt}}\omega_{it}\mathbf{1}\left[h_{it}=1\right]\right)\\
\text{mean_wealth_data_40_45}_d &= \frac{1}{15}\sum_{t=1998}^{2012}\left(\frac{1}{N_{dt,j\in[40,45]}}\sum_{i\in d,t,j\in[40,45]}^{N_{dt,j\in[40,45]}}\omega_{it}w_{ijt}\right)
\end{aligned}$$

where N_{dt} is the number of people in d at date t, and ω_{it} is a person's crossectional weight, and $i \in d, t$ stands for i is in d at date t. Similarly, $i \in d, t, j \in [40, 45]$ stands for i is in d at date t and age j in [40,45].

This means that for the second data moment, for example, 40 year-olds from 1998 contributed as well as 40 year-olds from the 2012 cohort. Needless to say, those cohorts faced a different sequence of house price shocks leading up the point of observation. For individuals "born" before the first data period, i.e. 1998, I construct regional house price and regional income series going back until 1968. Simulating individuals from the 1968 cohort for a full lifetime of J=30 years until the reach age 50 brings them into the year 1998, where they form the group of 50 year-olds in that particular year. This sort of staggered simulation is carried out until the final cohort is born in 2012 at age 20. No simulation needs to take place for any individual alive at years after 2012.

H Census Divisions

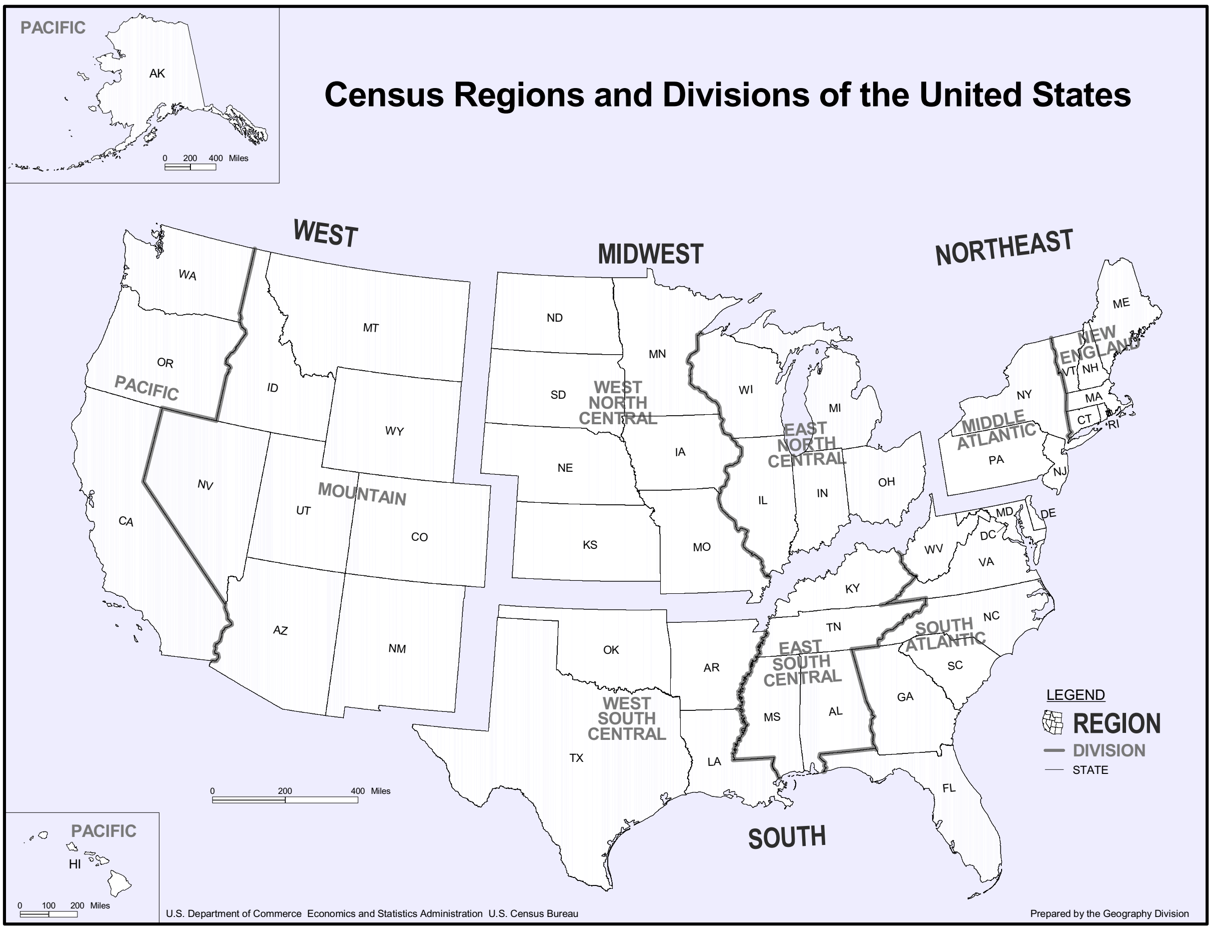

Figure H.1: Census Division Map, taken from `https://www.census.gov/geo/maps-data/maps/pdfs/reference/us_regdiv.pdf`. The Divisions are from left to right Pacific, Moutain, West North Central, West South Central, East North Central, East South Central, New England, Middle Atlantic and South Atlantic.

Division	Abbreviation	States
New England	NwE	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
Middle Atlantic	MdA	New Jersey, New York, Pennsylvania
South Atlantic	StA	Delaware, Florida, Georgia, Maryland, N Carolina, S Carolina, DC, West Virginia
West North Central	WNC	Iowa, Kansas, Minnesota, Missouri, Nebraska, N Dakota, S Dakota
West South Central	WSC	Arkansas, Louisiana, Oklahoma, Texas
East North Central	ENC	Illinois, Indiana, Michigan, Ohio, Wisconsin
East South Central	ESC	Alabama, Kentucky, Mississippi, Tennessee
Pacific	Pcf	Alaska, California, Hawaii, Orgeon, Washington
Mountain	Mnt	Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming

Table H.1: Census Division abbreviations and characteristics. Shows average ownership rates over 1997–2011 and median price to income ratios for the same period. The (unobserved) house price for renters is computed assuming an implied user cost of owning of 5%, i.e. $p_{rent} = \frac{rent}{0.05}$.