Portfolio Choice with House Value Misperception*

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^{*}The views expressed in this paper are those of the authors and do not represent those of the Federal Reserve System, Federal Reserve Bank of Boston, 1/35 or European Central Bank.



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Contribution: Misperception Matters!

In this paper

We present evidence on housing value misperception, sign, and size •



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In this paper

- We present evidence on housing value misperception, sign, and size
- Develop a model of portfolio allocation with costly acquisition of information,

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In this paper

- We present evidence on housing value misperception, sign, and size
- Develop a model of portfolio allocation with costly acquisition of information,
 - which results in households misvaluing their houses —
 - misperception matters for portfolio, housing, and consumption decisions (spoiler: increases risk aversion)



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- Test model implications with household level data on financial wealth, housing, and portfolio allocation.



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Contribution: Misperception Matters!

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 - misperception matters for portfolio, housing, and consumption decisions (spoiler: increases risk aversion)
- Test model implications with household level data on financial wealth, housing, and portfolio allocation.

Evidence on misperception (too long list), but evidence on sign is mixed (and very relevant for portfolio allocations)

- Benitez-Silva et al. (2008), Agarwal (2007) \rightarrow overvaluation
- Follain and Malpezzi (1981), Goodman and Ittner (1992) \rightarrow undervaluation



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Misperception Definition

Evidence on misperception:

- self-reported housing values vs "market" housing values
- market values built from purchase date (=zero misperception) using price index
 - perceived housing wealth rarely equals market housing wealth

values nisperception) using price index : housing wealth



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- PSID at zipcode level \rightarrow self reported house value
- CoreLogic at zipcode level \rightarrow market value •



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Data

- PSID at zipcode level \rightarrow self reported house value
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Use the CL HPI index to inflate purchase price of house.

 $Misperception = (H \cdot P_{H,t}^{PSID}) - (H \cdot P_{H,0}^{PSID} \times \Delta HPI_{0 \to t}^{CL})$ •



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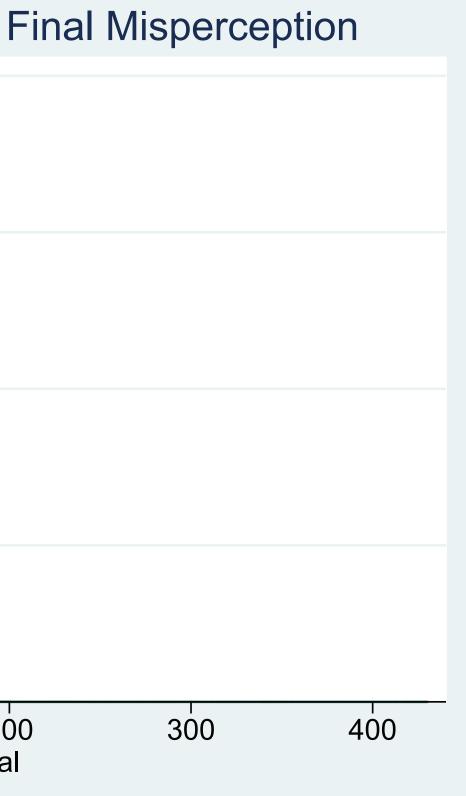
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MISPERCEPTION



Distribution of Misperception

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Misperception cyclicality

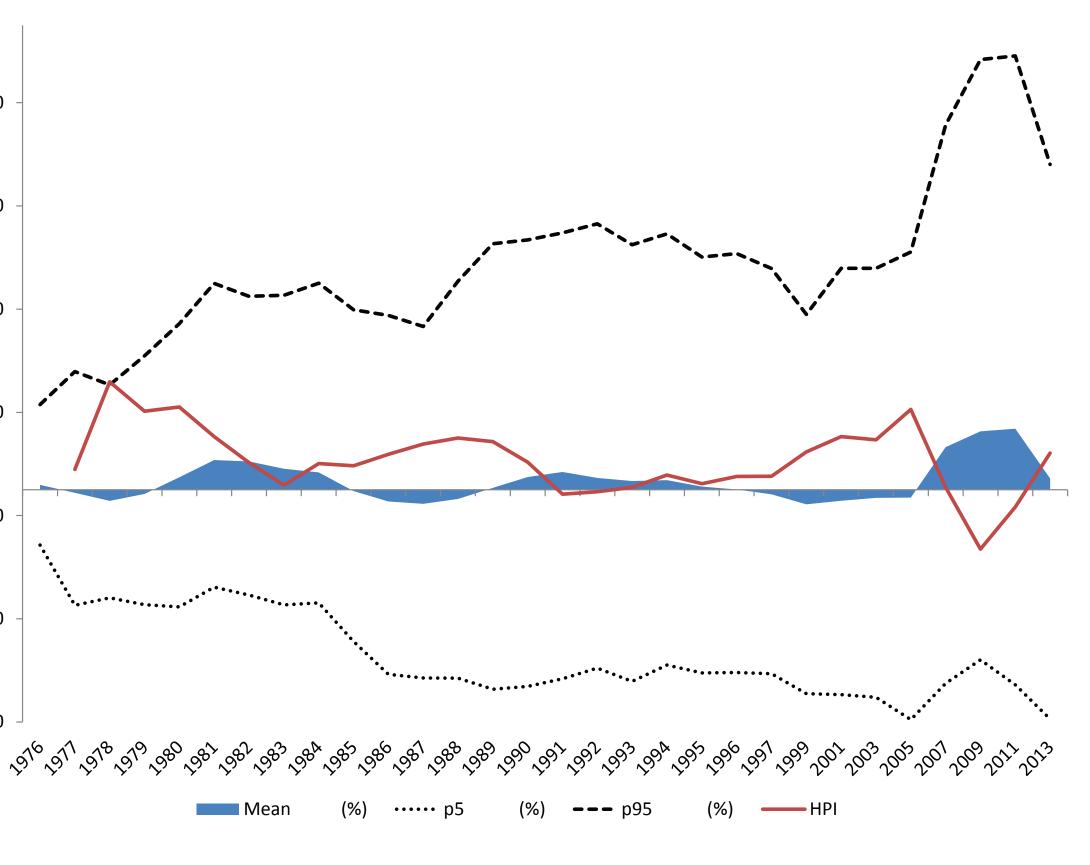
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-45.00 -

(%) ••••• p5

(%)

Mean



Misperception is Persistent

	1 - 2	3	4	5	6	7	8
1984	-3.06	-3.29	0.22	7.41	11.93	6.44	15.33
1985	-4.18	-5.16	-7.43	-4.29	5.05	6.58	2.94
1986	-9.49	-5.09	-7.20	-9.76	-3.88	1.72	7.41
1987	-7.53	-4.11	-9.40	-5.55	-10.97	-1.58	1.09
1988	-1.36	-5.68	-3.35	-7.04	-6.19	-12.89	-0.39
1989	2.94	0.88	3.17	-1.36	-7.85	-1.76	-10.69
1990	1.11	6.45	2.58	-1.07	0.40	0.97	-1.53
1991	1.67	5.60	9.40	3.77	2.26	2.05	2.02
1992	-1.85	2.72	2.45	11.36	2.81	-0.26	2.90
1993	1.68	-3.35	0.98	3.28	4.88	3.05	-2.86
1994	-0.17	-2.46	-3.98	1.49	5.21	6.08	3.36
1995	-1.17	-1.76	-3.43	-6.14	1.06	4.79	8.58
1996	-0.64	-3.96	-2.04	0.29	-7.63	0.03	2.80
1997	-1.04	-0.56	-6.54	-3.74	-1.35	-8.77	-3.93
1999	-6.56	-4.86	-3.86	-7.60	-3.59	-4.71	-9.21
2001	2.86	-8.34	0.96	-4.84	-8.85	-0.70	-3.00
2003	0.14	0.96	-10.41	-0.17	-3.73	-2.97	3.28
2005	1.19	-0.54	-0.20	-13.84	-5.17	-1.41	-2.20
2007	14.82	11.42	9.09	17.61	-4.18	17.10	10.04
2009	8.03	25.42	17.33	12.65	16.69	-3.12	18.34
2011	1.63	7.50	26.77	17.18	12.87	21.33	8.61
2013	-6.14	-3.66	-0.70	13.09	5.99	1.25	4.66
Average	0.07	0.57	1.41	2.19	1.10	1.76	2.57



Risky stock holdings are persistent too

	1985	1990	1995	2000	2002	2	2004
1984	0.015	0.029	0.078				
1989	0.010	0.027	0.057	0.023	0.028		
1994			0.038	0.050	0.044	0.05	4
1999				0.024	0.041	0.04'	7
2001					0.043	0.026	5
2003						0.023	}
2005							
2007							

Median = 0.037



Misperception of housing wealth affects portfolio, consumption, and housing decisions •

Results

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- Misperception of housing wealth affects portfolio, consumption, and housing decisions • Households' value of their houses differs from market value •



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less risky investments

\uparrow Misvaluation \Rightarrow (



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- Misperception of housing wealth affects portfolio, consumption, and housing decisions Households' value of their houses differs from market value

 \uparrow Misvaluation \Rightarrow

lower consumption and lower leverage



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- Misperception of housing wealth affects portfolio, consumption, and housing decisions Households' value of their houses differs from market value

 less risky investments
 lower consumption and lower leverage
 larger housing relative to total wealth \uparrow Misvaluation \Rightarrow



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	less risky investm
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	larger housing rel
	more frequent ac

- nents
- on and lower leverage
- elative to total wealth
- more frequent acquisition of information



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• household sample 1978-2013

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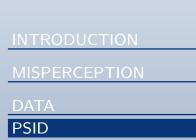
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- household sample 1978-2013 •
- Financial wealth = house value (first and second), business value, other assets, stock • holdings, checking and savings valances, IRAs and annuities, less the mortgage principal on primary residence





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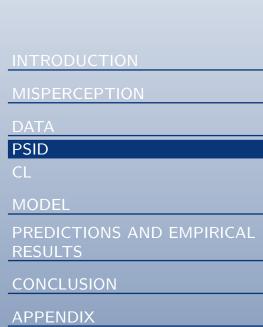
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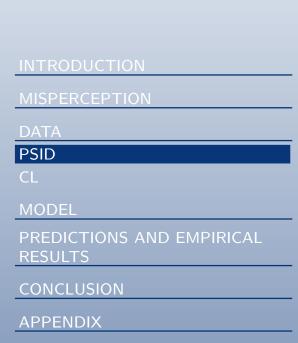
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- All net of debt •





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- Only owners





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- Financial wealth = house value (first and second), business value, other assets, stock holdings, checking and savings valances, IRAs and annuities, less the mortgage principal on primary residence
- All net of debt
- Only owners
- Identify movers, start measuring misperception at purchase time
 - misperception is assumed to be **zero** at purchase



CoreLogic House Prices

• Repeat sales index (monthly, starting 1975), single family combined

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CoreLogic House Prices

- Repeat sales index (monthly, starting 1975), single family combined •
- public record files from First American •



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CoreLogic House Prices

- Repeat sales index (monthly, starting 1975), single family combined •
- public record files from First American
- Representative of all loans (not just GSEs) •



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CoreLogic House Prices

- Repeat sales index (monthly, starting 1975), single family combined
- public record files from First American
- Representative of all loans (not just GSEs)
- Limited coverage at the zipcode level

Use the index to inflate purchase price of house, starting at purchase time

 $Misperception = (H \cdot P_{H,t}^{PSID}) - (H \cdot P_{H,0}^{PSID} \times \Delta HPI_{0 \to t}^{CL})$ •



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Notation:

 $u(C,H) = \frac{1}{1-\gamma} (C^{\beta} H)$ $dH = -\delta H dt$ $dP = P\mu dt + P\sigma dZ_2$ dB = rBdt $dS = S \alpha_S dt +$ $W = B + \Theta + R$

- $P \equiv$ house price
- $S \equiv \text{stock price}$
- $\Theta \equiv$ financial wealth in risky stock
- $B \equiv$ financial wealth in safe assets
- $\phi_o \equiv \text{cost of acquiring info}$
- $\phi_a \equiv \text{cost of moving}$
- $m^i \equiv \text{market value "surprise"}$

$$(H^{1-eta})^{1-\gamma}$$

$$S \sigma_S dZ_1$$

HP



Model cont'd

Value function for acquiring information

$$V(W, H, P) = \max_{C, \Theta, H', \tau} E\left[\int_0^\tau u(C, He^{-\delta t})dt + \mathbb{I}_{H' > H}e^{-\rho\tau}(1-\pi)V\left(W(\tau), He^{-\delta\tau}, + \mathbb{I}_{H' < H}e^{-\rho\tau}\pi V\left(W(\tau), He^{-\delta\tau}, P(\tau)\right)\right)\right]$$

$$W(\tau) = W(\tau^{-}) - \phi_o P(\tau) H(\tau^{-}) + m^i P(\tau)$$
$$P(\tau) = P(\tau^{-})(1 + m^i)$$
$$H(\tau) = H' \text{ and } H(\tau^{-}) = He^{-\delta\tau}$$

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$P(\tau) + \pi \widetilde{V} (W(\tau), H(\tau), P(\tau))$ $+ (1 - \pi) \widetilde{V} (W(\tau), H(\tau), P(\tau))$

 $(\tau^{-})H(\tau^{-})$



Model cont'd

Value function for acquiring information

$$V(W, H, P) = \max_{C,\Theta,H',\tau} E\left[\int_0^\tau u(C, He^{-\delta t})dt + \mathbb{I}_{H'>H}e^{-\rho\tau}(1-\pi)V\left(W(\tau), He^{-\delta\tau}, P(\tau)\right) + \pi \widetilde{V}\left(W(\tau), H(\tau), P(\tau)\right) + \mathbb{I}_{H'$$

$$W(\tau) = W(\tau^{-}) - \phi_o P(\tau) H(\tau^{-}) + m^i P(\tau)$$
$$P(\tau) = P(\tau^{-})(1 + m^i)$$
$$H(\tau) = H' \text{ and } H(\tau^{-}) = He^{-\delta\tau}$$

Value function of adjusting housing

$$\widetilde{V}(W,H,P) = \max_{C,\Theta,H',\tau} E\left[\int_0^\tau u(C,He^{-\delta t})dt + e^{-\rho\tau}\widetilde{V}\left(W(\tau),H(\tau),P(\tau)\right)\right],$$
$$(t) = W(\tau^-) - \phi_a P(\tau)H(\tau^-) - \phi_o P(\tau)H(\tau^-) + m^i P(\tau^-)H(\tau^-).$$

where W(au)

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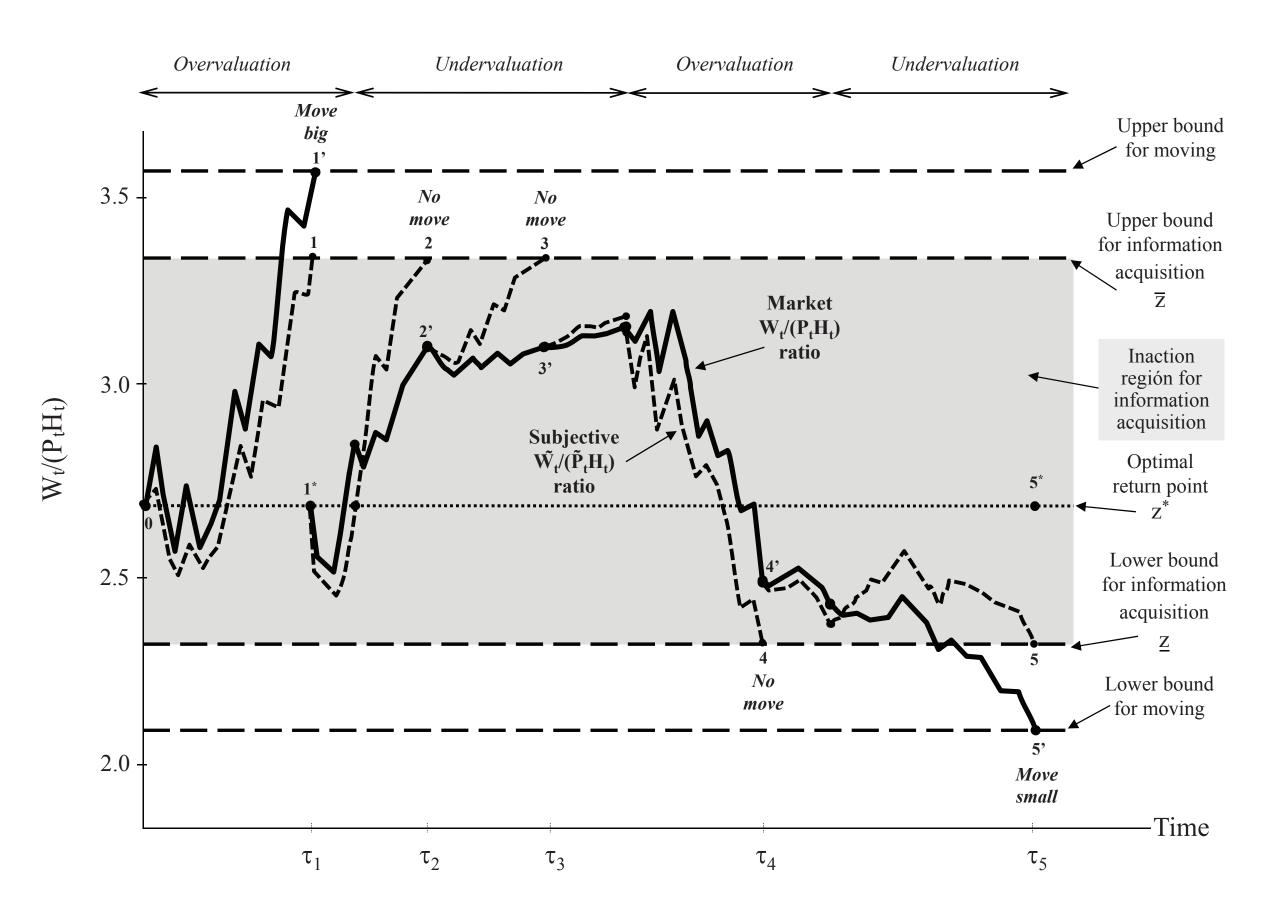
 $(\tau^{-})H(\tau^{-})$

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Illustration of equilibrium

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Equilibrium

The value function of this problem, V(W(t), H(t), P(t)), satisfies the following Hamilton-Jacobi-Bellman (HJB) partial differential equation

 $\sup_{C,\Theta,H',\tau} E\left(dV\left(W,H,P\right) + u\left(C,H\right)dt\right) = 0.$

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The value function of this problem, V(W(t), H(t), P(t)), satisfies the following Hamilton-Jacobi-Bellman (HJB) partial differential equation

> $\sup E(dV(W, H, P) + u(C, H) dt) = 0.$ C,Θ,\hat{H}',τ

Thanks to homogeneity properties, we can rewrite the problem in terms of the wealth-to-housing ratio, z = W/(PH)

$$V(W, H, P) = H^{1-\gamma} P^{\beta(1-\gamma)} V\left(\frac{W}{PH}, 1, 1\right) = H^{1-\gamma} P^{\beta(1-\gamma)} v(z).$$

and solve for v(z). c denotes the scaled control c = C/(PH) and θ the scaled control $\theta = \Theta/(PH).$

Solution



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Solution: Portfolio Allocation and Consumption

Given a wealth-to-housing ratio z, where $v(z) > M^{\frac{1}{2}}$ consumption $c^*(z)$ and portfolio $\theta^*(z)$ and $b^*(z)$

$$c^*(z) = \left(\frac{v_z(z)}{\beta}\right)^{1/(\beta(1-z))}$$

$$\theta^*(z) = -\omega \frac{v_z(z)}{v_{zz}(z)} + \frac{\rho_{PS}\sigma_P}{\sigma_S}(z-1)$$

$$b^*(z) = z - \theta^*(z)$$

for the constant ω defined as $\omega = [\alpha_S - r + (1 - \beta)]$

$$\frac{(z+1-\phi_o)^{1-\gamma}}{1-\gamma}$$
, the agent chooses a optimal

 $-\gamma)-1)$

$$(1-\gamma))\rho_{PS}\sigma_P]/\sigma_S^2.$$



Baseline Calibration

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Variable

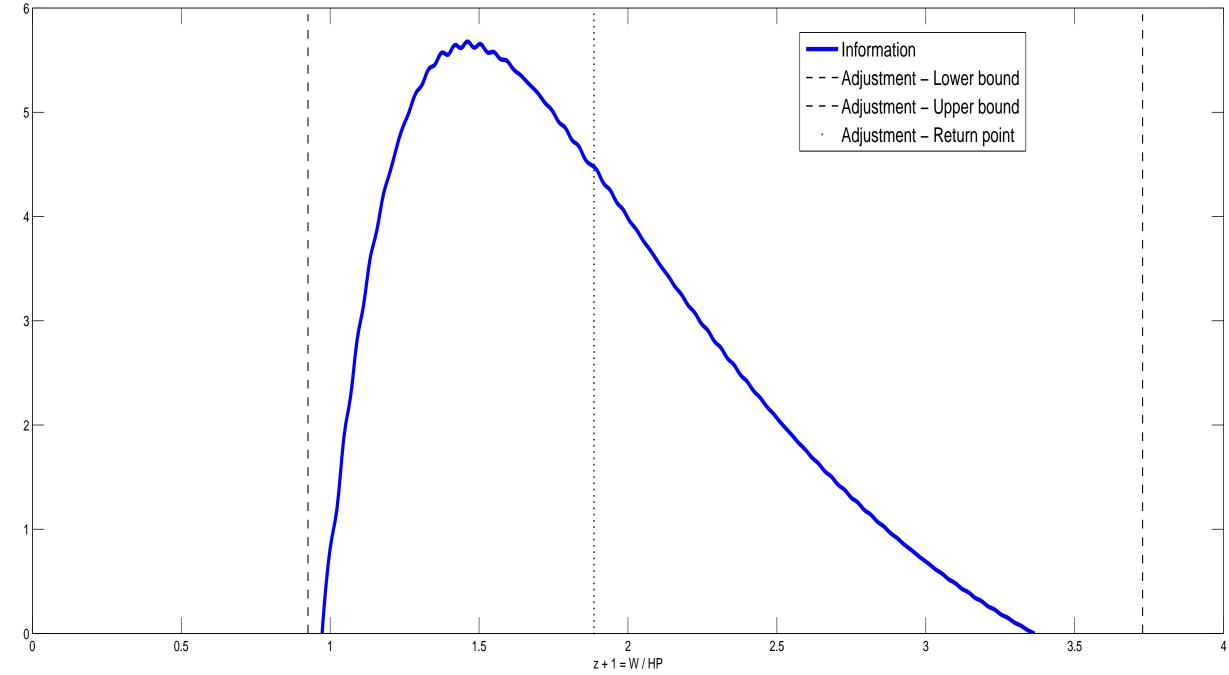
Curvature of the utility function House flow services Time preference Risk free rate Housing stock depreciation Transaction cost information cost Risky asset drift Standard deviation risky asset Correlation house price - risky ass Standard deviation house price House price drift Overvaluation Undervaluation Probability

	Symbol	Value
	γ	2
	$1-\beta$	0.4
	ho	0.025
	r	0.015
	δ	0.02
	ϕ_a	0.06
	ϕ_o	0.06
	$lpha_S$	0.077
	σ_S	0.1655
set	$ ho_{PS}$	0.25
	σ_P	0.14
	μ_P	0.03
	m_H	20%
	m_L	-20%
	π	0.5



Graphical Solution

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Table 1: Acquisition of information, housing adjustments, and misperception. Model outcomes for the information acquisition boundaries, the housing adjustment boundaries, and the return points under different parameterizations.

	Adjust LB	Info. LB	Return Point	Info. UB	Adjust UB
GL (no misperception)	-0.025		0.955		2.311
Benchmark (+5%/-5%)	-0.074	-0.070	0.885	2.432	2.867
Increase misperception	0.120	0.138	0.773	2.160	2.542
Overvaluation - $ abla\pi$	0.022	0.023	0.709	4.855	5.111
Undervaluation - $\Delta\pi$	0.127	0.134	0.948	1.807	1.902

with respect to GL, inaction region is lower and smaller



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- with respect to GL, inaction region is lower and smaller
- wider misperception, lowers inaction region even more



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- with respect to GL, inaction region is lower and smaller
- wider misperception, lowers inaction region even more
- more undervaluation, widens inaction region for information



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- with respect to GL, inaction region is lower and smaller
- wider misperception, lowers inaction region even more
- more undervaluation, widens inaction region for information
- more overvaluation, narrows inaction region for information



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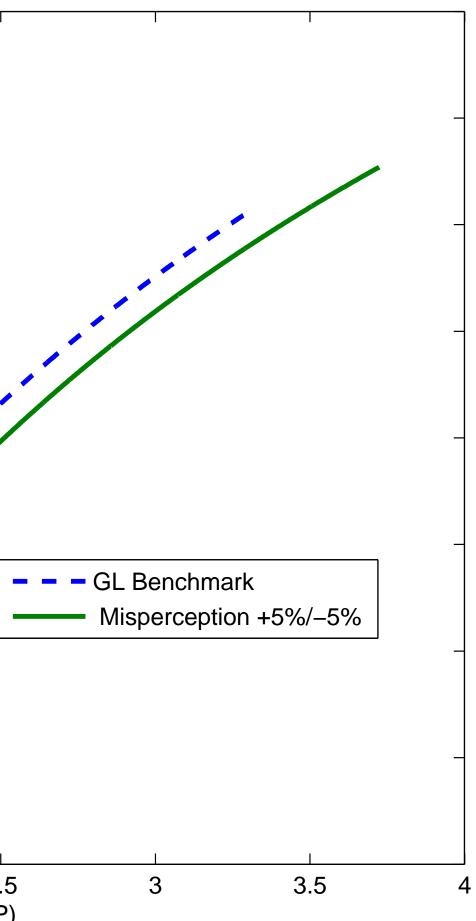
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Risky assets and misperception

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$\frac{RESULTS}{\Delta m \text{ and } \theta}$	1.15	_				
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Δm and C Over/Under and C						
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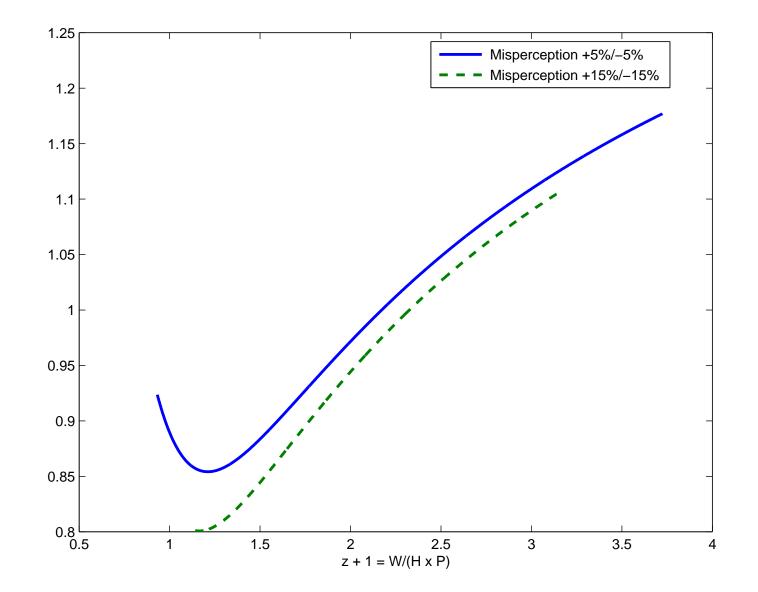
 $z + 1 = W/(H \times P)$





Risky assets and probabilities of over/undervaluation

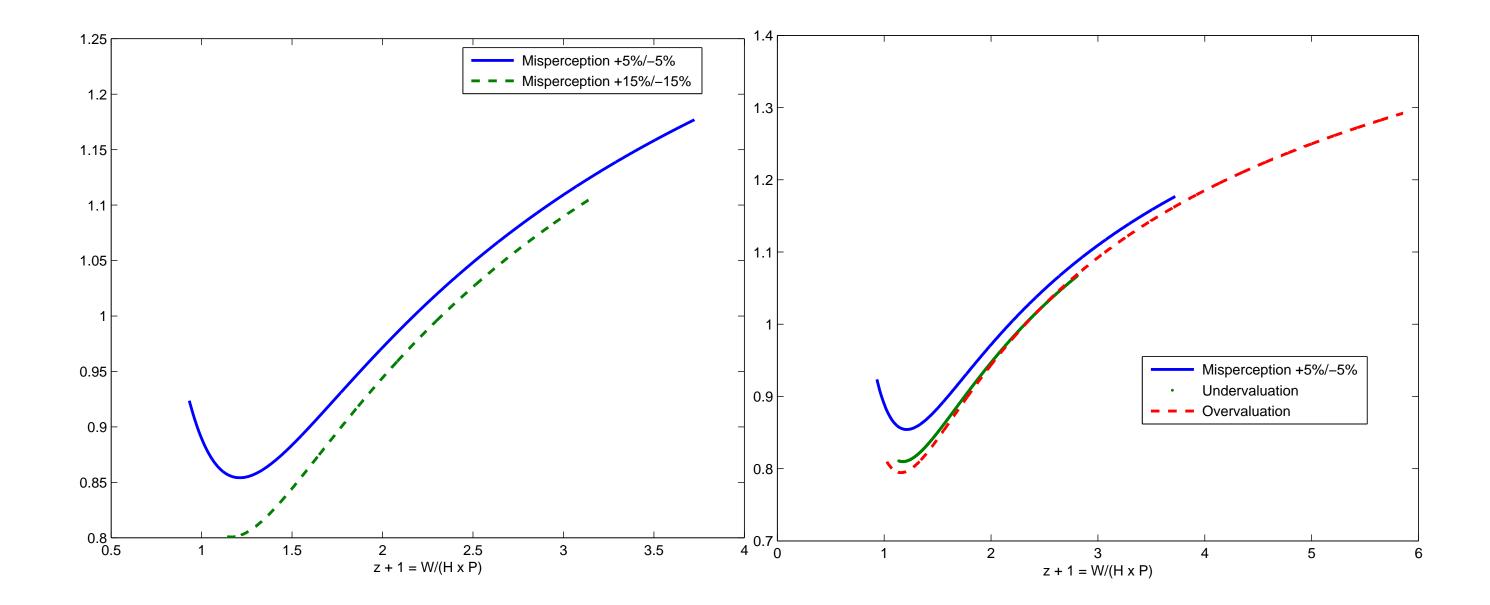
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Risky assets and probabilities of over/undervaluation

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$$\frac{\theta_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} + \gamma_4 \cdot z_{it} \cdot m_{it} \cdot z_{it} \cdot m_{it} + \gamma_4 \cdot m_{it} \cdot m_{it} + \gamma_$$

Panel A: Misperception (dispersion)						
[1]	[2]	[3]				
-0.006968^{**}	-0.010731^{***}	-0.010729^{*}				
[-2.11]	[-2.77]	[-1.88]				
		0.000775				
с ј	L J	$[1.15] \\ 0.002869$				
		[1.39]				
0.04553	-0.077445	-0.076793				
[0.1]	[-0.51]	[-0.33]				
5.83%	57.36%	57.14%				
	\overline{D}					
		$FE\ Zip$				
4,225	4,225	2ip 4, 198				
	$\begin{bmatrix} 1 \end{bmatrix}$ $-0.006968^{**} \\ \begin{bmatrix} -2.11 \end{bmatrix} \\ 0.001718^{***} \\ \begin{bmatrix} 5.10 \end{bmatrix} \\ 0.001859 \\ \begin{bmatrix} 1.43 \end{bmatrix} \\ 0.04553 \\ \begin{bmatrix} 0.1 \end{bmatrix} \\ 5.83\%$ $RE \\ No$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				

 $+\Gamma \cdot X_{it} + u_{it},$

$$\frac{\theta_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} + \gamma_4 \cdot z_{it} \cdot m_{it} \cdot z_{it} \cdot m_{it} + \gamma_4 \cdot m_{it} \cdot m_{it} + \gamma_$$

Panel A: Misperception (dispersion)						
	[1]	[2]	[3]			
m_{it}	-0.006968**	-0.010731^{***}	-0.010729^{*}			
z_{it}	[-2.11] 0.001718^{***}	[-2.77] 0.000773^*	[-1.88] 0.000775			
$m_{it} * z$	$[5.10] \\ 0.001859$	$[1.79] \\ 0.002865^*$	$[1.15] \\ 0.002869$			
constant	$[1.43] \\ 0.04553$	[1.93] -0.077445	$[1.39] \\ -0.076793$			
R^2	$[0.1]\ 5.83\%$	$[-0.51]\ 57.36\%$	$[-0.33]\ 57.14\%$			
FE/RE	RE	FE	FE			
Cluster	No	No	Zip			
Obs.	4,225	4,225	4,198			

 $-\Gamma \cdot X_{it} + u_{it},$

$$\frac{\theta_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} + \Gamma \cdot X_{it} + u_{it},$$

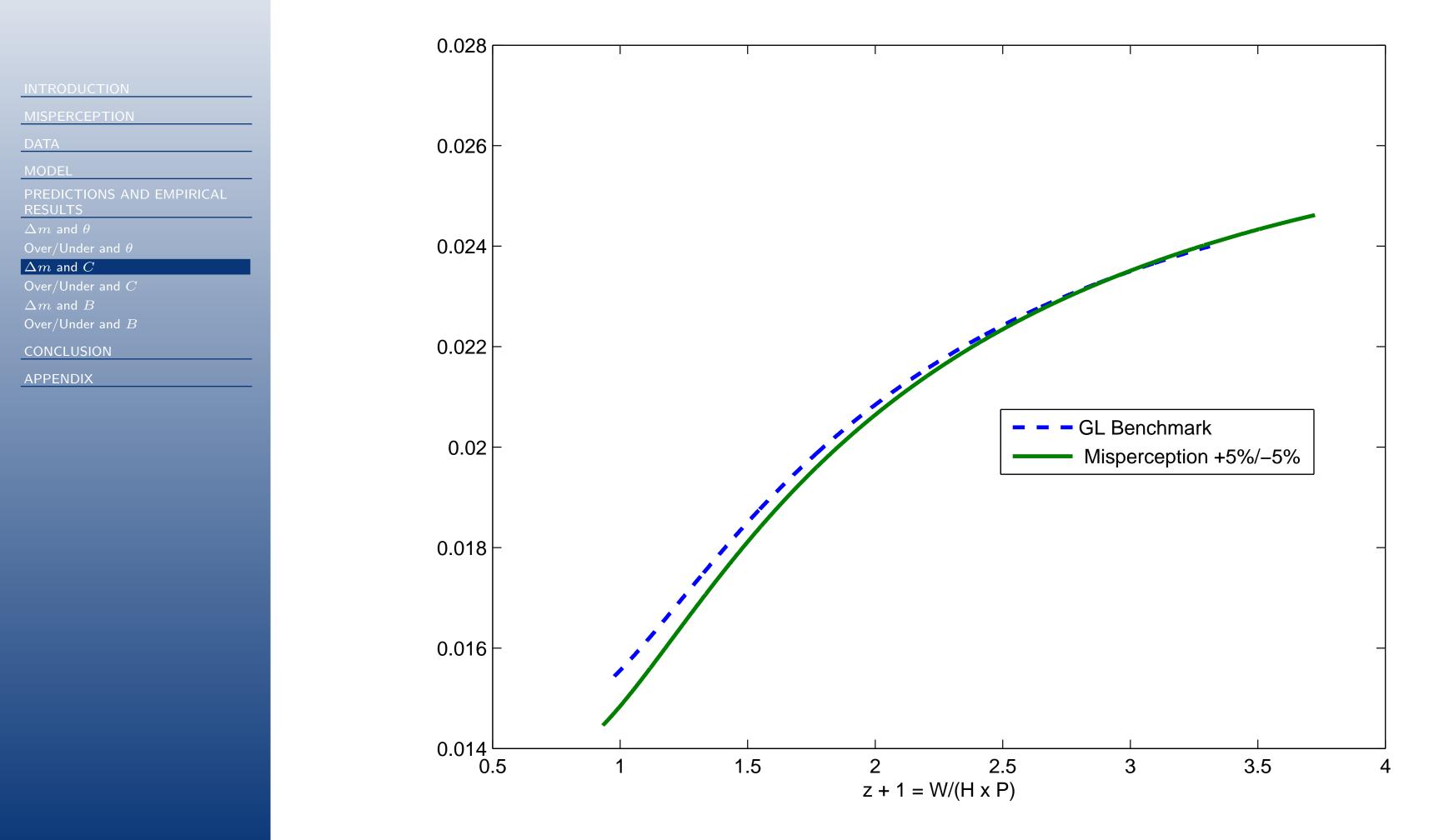
	Panel A: Misperception (dispersion)			Panel B: Misperception (overvaluation)		uation)	
	[1]	[2]	[3]		[1]	[2]	[3]
m_{it}	-0.006968^{**}	-0.010731^{***}	-0.010729^{*}	m_{it}	-0.005282^{**}	-0.007952^{***}	-0.007951^{***}
	[-2.11]	[-2.77]	[-1.88]		[-2.55]	[-3.29]	[-1.99]
z_{it}	0.001718^{***}	0.000773^{*}	0.000775	z_{it}	0.001893^{***}	0.001120^{***}	0.001122^{*}
	[5.10]	[1.79]	[1.15]		[6.34]	[2.84]	[1.82]
$m_{it} * z$	0.001859	0.002865^{*}	0.002869	$m_{it} * z$	0.001076	0.002380**	0.002379
	[1.43]	[1.93]	[1.39]		[1.28]	[2.45]	[1.62]
constant	0.04553	-0.077445	-0.076793	constant	0.063773	-0.034879	-0.034326
	$\left[0.1\right]$	[-0.51]	[-0.33]		[0.72]	[-0.23]	[-0.15]
R^2	5.83%	57.36%	57.14%	R^2	6.09%	57.4%	57.18%
FE/RE	RE	FE	FE	FE/RE	RE	FE	FE
Cluster	No	No	Zip	Cluster	No	No	Zip
Obs.	4,225	4,225	4,198	Obs.	4,225	4,225	4,198

$$\frac{\theta_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} + \Gamma \cdot X_{it} + u_{it},$$

	Panel A: Misperception (dispersion)			Panel B: Misperception (overvaluation)		uation)	
	[1]	[2]	[3]		[1]	[2]	[3]
m_{it}	-0.006968^{**}	-0.010731^{***}	-0.010729^{*}	m_{it}	-0.005282^{**}	-0.007952^{***}	-0.007951^{***}
	[-2.11]	[-2.77]	[-1.88]		[-2.55]	[-3.29]	[-1.99]
z_{it}	0.001718^{***}	0.000773^{*}	0.000775	z_{it}	0.001893^{***}	0.001120^{***}	0.001122^{*}
	[5.10]	[1.79]	[1.15]		[6.34]	[2.84]	[1.82]
$m_{it} * z$	0.001859	0.002865^{*}	0.002869	$m_{it} * z$	0.001076	0.002380**	0.002379
	[1.43]	[1.93]	[1.39]		[1.28]	[2.45]	[1.62]
constant	0.04553	-0.077445	-0.076793	constan	0.063773	-0.034879	-0.034326
	$\left[0.1\right]$	[-0.51]	[-0.33]		[0.72]	[-0.23]	[-0.15]
R^2	5.83%	57.36%	57.14%	R^2	6.09%	57.4%	57.18%
FE/RE	RE	FE	FE	FE/RE	RE	FE	FE
Cluster	No	No	Zip	Cluster	No	No	Zip
Obs.	4,225	4,225	4,198	Obs.	4,225	4,225	4,198



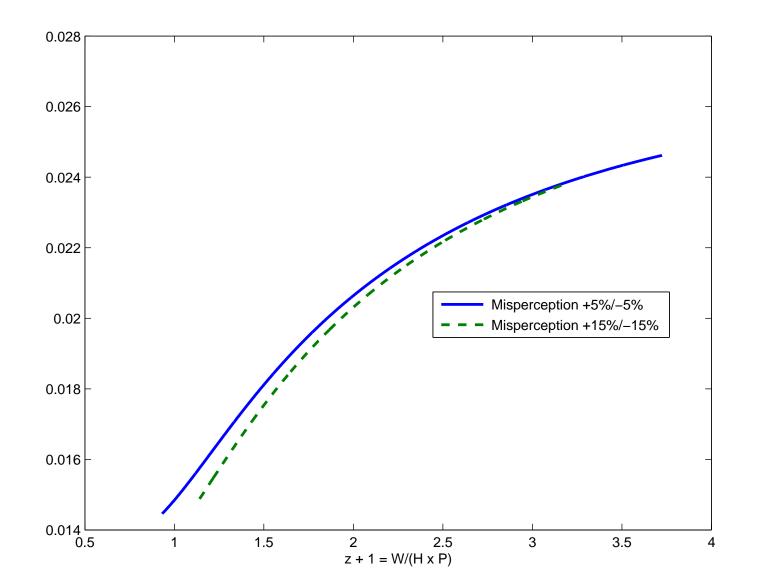
Misperception and Consumption





Probabilities of Over/Undervaluation and Consumption

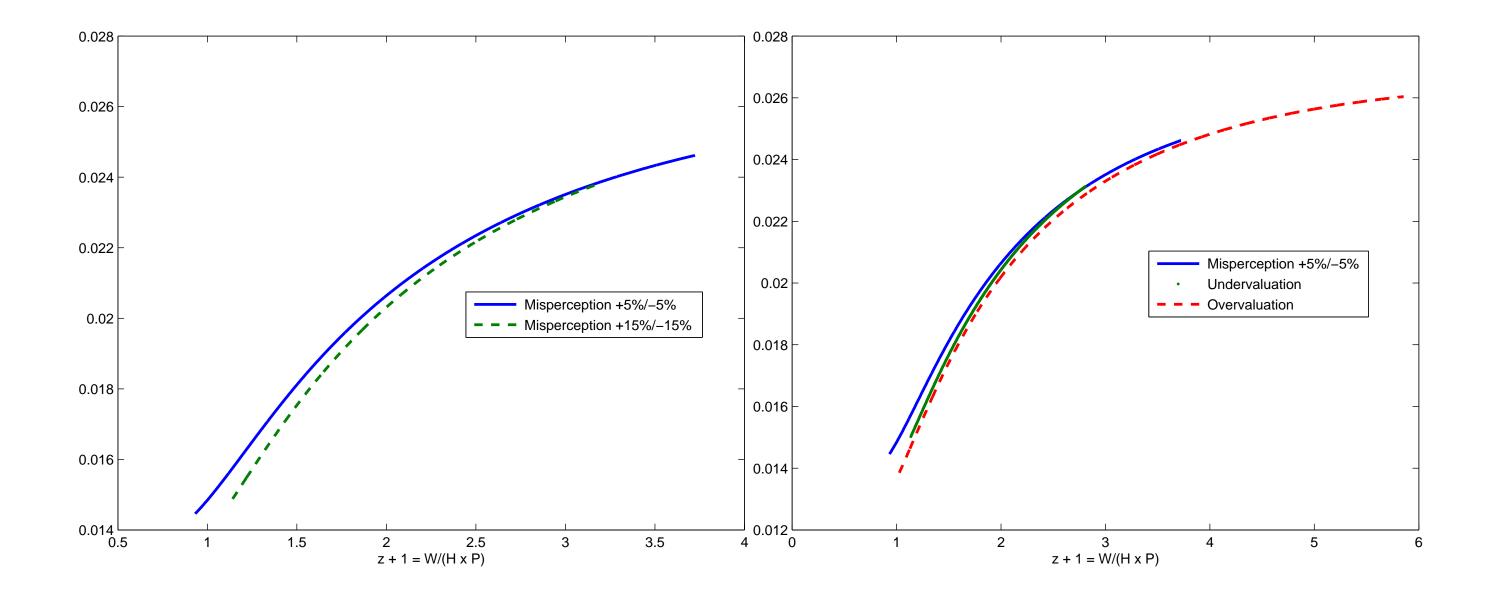
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$$\frac{C_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it$$

	Panel A: Misperception (dispersion)					
	[1]	[2]	[3]			
m_{it}	-0.008014^{***}	-0.012556^{***}	-0.01260^{***}			
	[-2.99]	[-4.45]	[-3.64]			
z_{it}	-0.010316^{***} [-27.55]	-0.010356^{***} [-25.67]	-0.010337^{***} [-17.73]			
$m_{it} * z_{it}$	0.003647^{***}	0.003913^{***}	0.003884***			
	[3.12]	[3.25]	[3.20]			
constant	1.712719***	1.467278***	1.437393***			
R^2	$[10.62] \\ 15.15\%$	$[8.08] \\ 81.85\%$	$[5.26] \\ 81.76\%$			
FE/RE	RE	FE	FE			
Cluster	No	No	Zip			
Obs.	8,192	8,192	8,028			

 $+\Gamma \cdot X_{it} + u_{it},$

$$\frac{C_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it$$

Panel A: Misperception (dispersion)					
	[1]	[2]	[3]		
m_{it}	-0.008014^{***}	-0.012556^{***}	-0.01260^{***}		
	[-2.99]	[-4.45]	[-3.64]		
z_{it}	-0.010316^{***}	-0.010356^{***}	-0.010337^{***}		
	[-27.55]	[-25.67]	[-17.73]		
$m_{it} * z_{it}$	0.003647^{***}	0.003913^{***}	0.003884^{***}		
	[3.12]	[3.25]	[3.20]		
constant	1.712719^{***}	1.467278^{***}	1.437393^{***}		
	[10.62]	[8.08]	[5.26]		
R^2	15.15%	81.85%	81.76%		
FE/RE	RE	FE	FE		
Cluster	No	No	Zip		
Obs.	8,192	8,192	8,028		

 $+\Gamma \cdot X_{it} + u_{it},$

$$\frac{C_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} + \gamma_4 \cdot z_{it} \cdot m_{it} \cdot z_{it} \cdot m_{it} + \gamma_4 \cdot m_{it} \cdot m_{it} + \gamma_$$

	Panel A: Mispe	rception (dispers	sion)		Panel B: Misperception (overvaluation)			
	[1]	[2]	[3]		[1]	[2]	[3]	
m_{it}	-0.008014^{***} [-2.99]	-0.012556^{***} [-4.45]	-0.01260^{***} [-3.64]	m_{it}	-0.024522^{***} [-15.18]	-0.024224^{***} [-14.29]	-0.024275^{***} [-8.73]	
z_{it}	-0.010316^{***} [-27.55]	-0.010356^{***} [-25.67]	-0.010337^{***} [-17.73]	z_{it}	-0.009922^{***} [-31.03]	-0.009890^{***} [-28.49]	-0.009876^{***} [-19.52]	
$m_{it} * z_{it}$	0.003647^{***}	0.003913***	0.003884***	$m_{it} * z_{it}$	0.003667^{***}	0.004058***	0.004065^{***}	
constant	[3.12] 1.712719^{***}	[3.25] 1.467278^{***}	[3.20] 1.437393^{***}	constant	[5.03] 1.318664^{***}	[5.38] 1.213028^{***}	[4.22] 1.183237^{***}	
R^2	$[10.62]\ 15.15\%$	$[8.08] \\ 81.85\%$	$[5.26] \\ 81.76\%$	R^2	$[8.40] \\ 17.90\%$	$[6.88] \\ 82.67\%$	$[4.40] \\ 82.58\%$	
FE/RE Cluster Obs.	$RE \\ No \\ 8, 192$	FE No 8,192	$FE \\ Zip \\ 8,028$	FE/RE Cluster Obs.	$RE \\ No \\ 8,192$	FE No 8,192	$FE \\ Zip \\ 8,028$	
ODS.	0,192	0,192	0,020	Obs.	0,192	0,192	0,020	

$$\Gamma \cdot X_{it} + u_{it},$$

$$\frac{C_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} + \gamma_4 \cdot z_{it} \cdot m_{it} \cdot z_{it} \cdot m_{it} + \gamma_4 \cdot m_{it} \cdot m_{it} + \gamma_$$

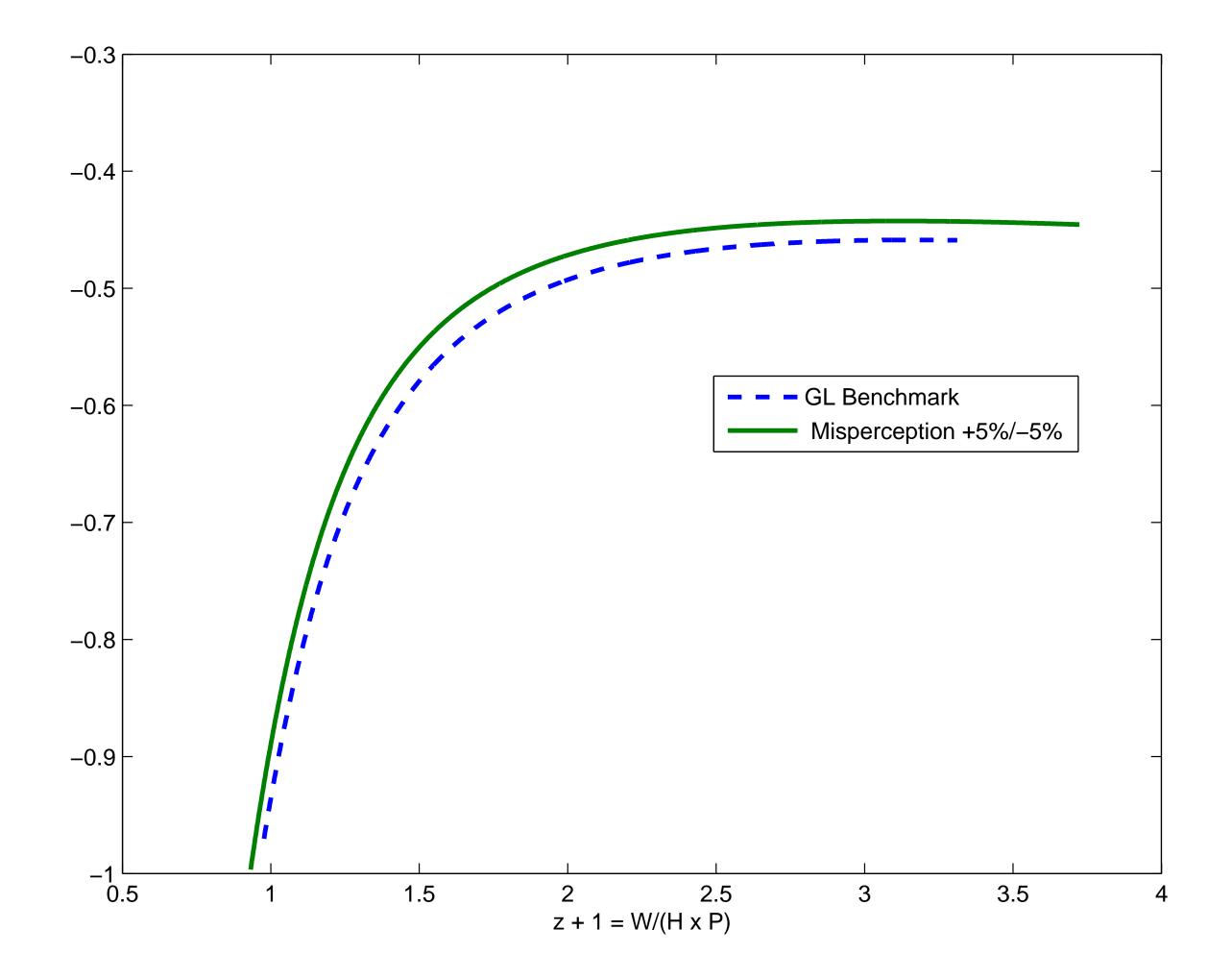
	Panel A: Mispe	rception (dispers	sion)	F	Panel B: Misperc	eption (overvalu	ation)
	[1]	[2]	[3]		[1]	[2]	[3]
m_{it}	-0.008014^{***} [-2.99]	-0.012556^{***} [-4.45]	-0.01260^{***} [-3.64]	m_{it}	-0.024522^{***} [-15.18]	-0.024224^{***} [-14.29]	-0.024275^{***} [-8.73]
z_{it}	-0.010316^{***} [-27.55]	-0.010356^{***} [-25.67]	-0.010337^{***} [-17.73]	z_{it}	-0.009922^{***} [-31.03]	-0.009890^{***} [-28.49]	-0.009876^{***} [-19.52]
$m_{it} * z_{it}$	0.003647^{***} [3.12]	0.003913*** [3.25]	0.003884*** [3.20]	$m_{it} * z_{it}$	0.003667^{***} [5.03]	0.004058*** [5.38]	0.004065^{***} $[4.22]$
constant	[5.12] 1.712719^{***} [10.62]	[5.26] 1.467278^{***} [8.08]	[5.26] 1.437393^{***} [5.26]	constant	[5.05] 1.318664^{***} [8.40]	1.213028^{***} [6.88]	1.183237^{***} [4.40]
R^2	15.15%	[8.08] 81.85%	[3.20] 81.76%	R^2	[8.40] 17.90%	[0.88] 82.67%	[4.40] 82.58%
FE/RE Cluster Obs.	$\begin{matrix} RE\\ No\\ 8,192 \end{matrix}$	$FE \\ No \\ 8,192$	$FE\\Zip\\8,028$	FE/RE Cluster Obs.	$\begin{matrix} RE\\ No\\ 8,192 \end{matrix}$	$FE\\No\\8,192$	$FE\ Zip\ 8,028$

$$\Gamma \cdot X_{it} + u_{it},$$



Misperception and Leverage

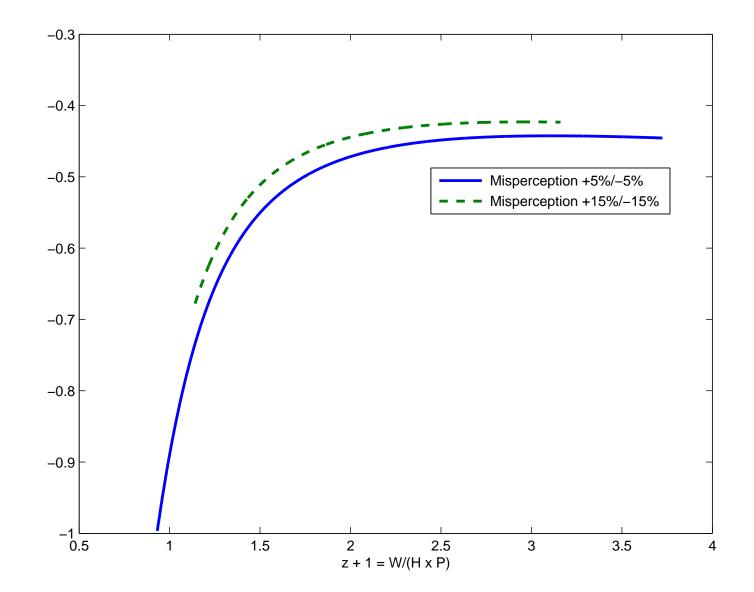
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Probabilities of Over/Undervaluation and leverage

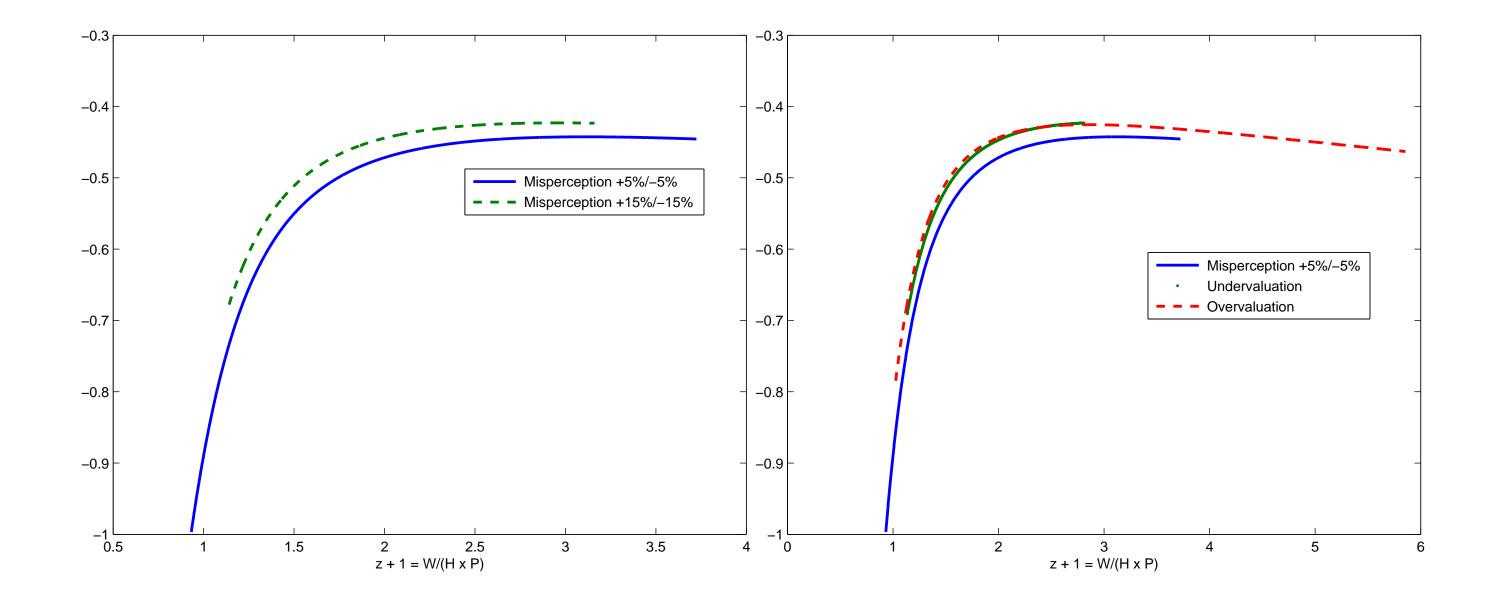
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Misperception and Leverage - Empirics

$$\frac{B_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} - \gamma_3 \cdot z_{it} - \gamma_5 \cdot m_{it} -$$

	Panel A: Misperception (dispersion)					
	[1]	[2]	[3]			
m_{it}	-0.139381***	-0.170331^{***}	-0.171242***			
~	[-7.11] -0.039793^{***}	[-6.92] -0.051349^{***}	[-3.90] -0.051589^{***}			
z	[-14.24]	[-13.98]	[-9.14]			
$m_{it} * z$	0.084761^{***}	0.098550^{***}	0.099200***			
	[7.91]	[7.70]	[4.03]			
constant	1.894726^{***} [2.78]	$1.549514 \\ [1.57]$	$1.383134 \\ [0.85]$			
R^2	6.93%	71.16%	71.01%			
FE/RE	RE	FE	FE			
Cluster	No	No	Zip			
Obs.	3,828	3,828	3,857			

 $+\Gamma \cdot X_{it} + u_{it},$

(3)

Misperception and Leverage - Empirics

$$\frac{B_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} - \gamma_3 \cdot z_{it} - \gamma_5 \cdot m_{it} -$$

	Panel A: Misperception (dispersion)				
	[1]	[2]	[3]		
m_{it}	-0.139381^{***}	-0.170331^{***}	-0.171242^{***}		
	[-7.11]	[-6.92]	[-3.90]		
\mathcal{Z}	-0.039793^{***}	-0.051349^{***}	-0.051589^{***}		
	[-14.24]	[-13.98]	[-9.14]		
$m_{it} * z$	0.084761^{***}	0.098550^{***}	0.099200^{***}		
	[7.91]	[7.70]	[4.03]		
constant	1.894726^{***}	1.549514	1.383134		
	[2.78]	[1.57]	[0.85]		
R^2	6.93%	71.16%	71.01%		
FE/RE	RE	FE	FE		
Cluster	No	No	Zip		
Obs.	3,828	3,828	3,857		

 $+\Gamma \cdot X_{it} + u_{it},$

(3)

Misperception and Leverage - Empirics

$$\frac{B_{it}}{z_{it}} = \gamma_0 + \gamma_1 \cdot z_{it} + \gamma_2 \cdot m_{it} + \gamma_3 \cdot z_{it} \cdot m_{it} + \beta_3 \cdot z_{it} \cdot m_{it} \cdot$$

	Panel A: Mispe	rception (dispers	sion)		Panel B: Misperception (overvaluation)			
	[1]	[2]	[3]			[1]	[2]	[3]
m_{it}	-0.139381^{***}	-0.170331^{***}	-0.171242^{***}	η	n_{it}	0.006325	-0.009512	-0.008998
	[-7.11]	[-6.92]	[-3.90]			[0.46]	[-0.54]	[-0.31]
z	-0.039793^{***}	-0.051349^{***}	-0.051589^{***}	\mathcal{Z}		-0.030290^{***}	-0.037645^{***}	-0.037771^{***}
	[-14.24]	[-13.98]	[-9.14]			[-12.81]	[-12.14]	[-6.05]
$m_{it} * z$	0.084761^{***}	0.098550^{***}	0.099200^{***}	m	$n_{it} * z$	-0.038122^{***}	-0.025783^{**}	-0.026115
	[7.91]	[7.70]	[4.03]			[-4.47]	[-2.41]	[-1.44]
constant	1.894726***	1.549514	1.383134	CC	onstant	1.817843***	1.696728*	1.517266
	[2.78]	[1.57]	[0.85]			[2.70]	[1.71]	[0.90]
R^2	6.93%	71.16%	71.01%	R	2^2	7.52%	70.68%	70.51%
FE/RE	RE	FE	FE	F	E/RE	RE	FE	FE
Cluster	No	No	Zip	С	luster	No	No	Zip
Obs.	3,828	3,828	3,857	0	bs.	3,828	3,828	3,857

$$\Gamma \cdot X_{it} + u_{it},$$

(3)



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Conclusions

- House price misperception affects the optimal behavior of households (via risk aversion). The more misperception,
 - less investment in risky assets
 - larger housing wealth relative to total wealth
 - acquire information more frequently
- Overvaluation \Rightarrow less risky asset near downsizing
- Overvaluation \Rightarrow narrower bands of inaction

In this paper

- Showed evidence of misperception
- Build misperception into a portfolio choice model
- Tested implications with household level data (PSID)



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Next Steps

On the model:

Extend to a richer model for misperception as a function of tenure (to match data)

On the empirical implications:

- Extend the analysis to include tenure. •
- Robustness: Census Data.
- Better understanding of the drivers behind misperception and implication on other markets.



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v(z) satisfies

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 $\widetilde{\rho}v(z) = \sup_{c,\theta} \left\{ u(c) + \mathcal{D}v(z) \right\}, \quad z \in (\underline{z}_o, \overline{z}_o),$



v(z) satisfies

$$\widetilde{\rho}v(z) = \sup_{c,\theta} \left\{ u(c) + \mathcal{D}v(z) \right\}, \quad z \in (\underline{z}_o, \overline{z}_o),$$

where

$$\begin{aligned} \mathcal{D}v(z) =& (z(r+\delta-\mu_P+\sigma_P^2(1+\beta(\gamma-1)))) \\ &+\theta(\alpha_S-r-(1+\beta(\gamma-1))\rho_{PS}\ \sigma_S\sigma_P)-c)v_z(z) \\ &+\frac{1}{2}(z^2\sigma_P^2-2z\hat{\theta}\ \rho_{PS}\ \sigma_P\sigma_S+\theta^2\sigma_S^2)v_{zz}(z), \end{aligned}$$

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v(z) satisfies

$$\widetilde{\rho}v(z) = \sup_{c,\theta} \left\{ u(c) + \mathcal{D}v(z) \right\}, \quad z \in (\underline{z}_o, \overline{z}_o),$$

where

$$\begin{aligned} \mathcal{D}v(z) = & (z(r+\delta-\mu_P+\sigma_P^2(1+\beta(\gamma + \theta(\gamma + \theta(\gamma - 1)) + \theta(\alpha_S - r - (1+\beta(\gamma - 1)) + \frac{1}{2}(z^2\sigma_P^2 - 2z\hat{\theta}\ \rho_{PS}\ \sigma_P\sigma_S) \end{aligned}$$

$$v(z) = M \frac{(z+1-\phi_o)^{(1-\gamma)}}{1-\gamma}, \quad z \notin (\underline{z}_o, \overline{z}_o)$$

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$$egin{aligned} &\gamma-1)))\ &(1))
ho_{PS}\ \sigma_S\sigma_P)-c)v_z(z)\ &(2+ heta^2\sigma_S^2)v_{zz}(z), \end{aligned}$$



v(z) satisfies

$$\widetilde{\rho}v(z) = \sup_{c,\theta} \left\{ u(c) + \mathcal{D}v(z) \right\}, \quad z \in (\underline{z}_o, \overline{z}_o),$$

where

$$\begin{aligned} \mathcal{D}v(z) = & (z(r+\delta-\mu_P+\sigma_P^2(1+\beta(\gamma-1)))) \\ & +\theta(\alpha_S-r-(1+\beta(\gamma-1))\rho_{PS}\ \sigma_S\sigma_P)-c)v_z(z) \\ & +\frac{1}{2}(z^2\sigma_P^2-2z\hat{\theta}\ \rho_{PS}\ \sigma_P\sigma_S+\theta^2\sigma_S^2)v_{zz}(z), \end{aligned}$$

$$v(z) = M \frac{(z+1-\phi_o)^{(1-\gamma)}}{1-\gamma}, \quad z \notin (\underline{z}_o, \overline{z}_o)$$

$$\widetilde{v}(z) = \widetilde{M} \frac{(z+1-\phi_a-\phi_0)^{(1-\gamma)}}{1-\gamma}, \quad z \notin (\underline{z}_a, \overline{z}_a)$$

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Solution: Inaction Region

v(z) satisfies

$$\widetilde{\rho}v(z) = \sup_{c,\theta} \left\{ u(c) + \mathcal{D}v(z) \right\}, \quad z \in (\underline{z}_o, \overline{z}_o),$$

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$$v(z) = M \frac{(z+1-\phi_o)^{(1-\gamma)}}{1-\gamma}, \quad z \notin (\underline{z}_o, \overline{z}_o)$$

$$\widetilde{v}(z) = \widetilde{M} \frac{(z+1-\phi_a-\phi_0)^{(1-\gamma)}}{1-\gamma}, \quad z \notin (\underline{z}_a, \overline{z}_a)$$

and \widetilde{M} is defined as

 $\widetilde{M} = (1 - \gamma) \sup_{z \ge \epsilon} (z + 1)^{\gamma - 1} \widetilde{v}(z),$



Solution: Return Point

The return point \boldsymbol{z}_a^* attains the maximum in

$\widetilde{v}(z^*)$	 \widetilde{M}	$(z_a$	+	1)
$U(\mathcal{Z})$	 IVI		1	

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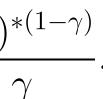
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Solution: Information Acquisition and Transaction Boundaries

Value matching and smooth pasting conditions hold at the two thresholds $(\underline{z}_a, \overline{z}_a)$

$$\widetilde{v}(z) = \widetilde{M} \frac{(\hat{z} + 1 - \phi_a - \phi_o)^{(1-\gamma)}}{1 - \gamma}$$
$$\widetilde{v}_z(z) = \widetilde{M}(\hat{z} - \phi_a - \phi_o)^{-\gamma}$$

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Solution: Information Acquisition and Transaction Boundaries

Value matching and smooth pasting conditions hold at the two thresholds $(\underline{z}_a, \overline{z}_a)$

$$\widetilde{v}(z) = \widetilde{M} \frac{(\hat{z} + 1 - \phi_a)}{1 - \tilde{v}_z(z)}$$
$$\widetilde{v}_z(z) = \widetilde{M}(\hat{z} - \phi_a - \phi_a)$$

for $\hat{z}_a = \underline{z}_a, \overline{z}_a$ and at the two thresholds $(\underline{z}_o, \overline{z}_o)$

$$v(z) = \pi v \left(\frac{\overline{z}_o}{1+m^h} + 1 - \phi_o\right) + (1-\pi)M\frac{(\overline{z}_o)}{1+m^h}$$
$$v(z) = (1-\pi)v \left(\frac{\underline{z}_o}{1+m^l} + 1 - \phi_o\right) + \pi M\frac{(\underline{z}_o)}{1+m^h}$$
$$v(z) = \pi v \left(\frac{\underline{z}_o}{1+m^h} + 1 - \phi_o\right) + (1-\pi)M\frac{(\underline{z}_o)}{1+m^h}$$

