Online Appendix to "Memory and Reference Prices: an Application to Rental Choices"

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A. Supplementary Material

Table A.1 presents descriptive statistics of our samples' demographics, measured the year prior to their move. The samples are comparable in all the dimensions we control for. Households are equally likely to move "up" (to more expensive cities) as to move "down" (to cheaper cities), and face significant changes in rent levels ($152.6 on average, with $156.8 if moving up and $148.9 if moving down).

	Head's Age (yrs)	Head's Education	Household Income ($)	Nr. Adults	Nr. Children	Median city rent ($)
Movers (N=2773)	34.6 (14.3)	14.1 (2.4)	41,765 (37,117)	1.64 (0.64)	0.82 (1.19)	652.38 (190.74)
Movers moving up (N=1,333)	34.5 (13.2)	14.15 (2.3)	40,369 (32,225)	1.61 (0.60)	0.79 (1.14)	570.34 (150.65)
Movers moving down (N=1,440)	34.04 (12.67)	14.09 (2.46)	41,699 (31,646)	1.64 (0.64)	0.77 (1.15)	739.30 (198.54)
Multiple Moves (N=504)	33.81 (11.03)	14.18 (2.27)	41,101 (27,609)	1.63 (0.61)	0.91 (1.25)	468.82 (338.73)

Table A.1: Descriptive Statistics for Renters prior to move, at time $t-1$.

Table A.2 presents the results in the paper but shows several controls.

	Backward looking reference	Adaptation through recency	Adaptation through price similarity		Asymmetry	
			Dissimilar	Similar	Moving up	Moving down
Log(income)	0.253*** (0.0367)	0.483*** (0.0346)	0.339*** (0.0486)	0.223*** (0.0590)	0.416*** (0.0256)	0.385*** (0.0229)
Nr. Children	0.0475*** (0.0109)	0.0566** (0.0177)	0.0518* (0.0221)	0.0815** (0.0298)	0.0511*** (0.0120)	0.0481*** (0.0110)
Nr. Adults	0.174*** (0.0240)	0.152*** (0.0360)	0.171*** (0.0375)	0.187*** (0.0506)	0.188*** (0.0254)	0.167*** (0.0224)
$log(p_d)$	0.499*** (0.0499)	0.583*** (0.0744)	0.627*** (0.0983)	0.589*** (0.137)	0.524*** (0.0760)	0.525*** (0.0783)
$log(p_o)$	**0.163***** (0.0458)	**0.0723** (0.0557)	**0.221*** (0.106)	**0.173** (0.141)	**0.0703** (0.0797)	**0.243***** (0.0744)
$p_{i,t-1}/p_0$	0.0560*** (0.0124)	0.0607** (0.0202)	0.0300* (0.0128)	0.194* (0.0684)	0.0264** (0.00989)	0.0645*** (0.0101)
Constant	-2.094*** (0.365)	-2.798*** (0.558)	-3.114* (0.877)	-0.807 (1.012)	-1.999*** (0.439)	-3.065*** (0.403)
N	2773	719	257	247	1333	1440

Table A.2: Results from regression (3), estimated at MSA level. Not shown: age of head of household, (age squared)/100, female head, attended college, year fixed effects, inverse Mills ratio. Standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001.

B. Proof of Predictions 1-4.

We start by documenting some general properties of willingness to pay (WTP) in our model, which is the largest solution p to the following equation:

$$V^n(q,p) = q - p - \sigma(p,p^n)[p - p^n] = 0 \qquad (A.1)$$

By the implicit function theorem, it is immediate to find that (A.1) decreases in p, so there is a unique willingness to pay p_{WTP} and that such willingness to pay increases in the city of origin price:

$$\frac{\partial p_{WTP}}{\partial p_o} = -\frac{\frac{\partial V^n(q,p)}{\partial p^n}}{\frac{\partial V^n(q,p)}{\partial p}}[1 - w(p_d)] > 0.$$

This proves Prediction 1. An analogous calculation proves Prediction 3, noting that the norm $p^n(p_d)$ is closer to p_d when p_d is in the memory database (even if in the more distant past).

Moreover, by increasing the mover's experience with the destination price p_d we find:

$$\frac{\partial p_{WTP}}{\partial \pi_t} = -\frac{\frac{\partial V^n(q,p)}{\partial p^n}}{\frac{\partial V^n(q,p)}{\partial p}} \frac{S(0)S(|p_d - p_o|)}{[S(0)\pi_t + S(|p_d - p_o|)(1-\pi_t)]}(p_d - p_o),$$

which is increasing for those moving up $(p_d - p_o) > 0$, decreasing for those moving down $(p_d - p_o) < 0$. This proves Prediction 2.

Finally, to show Prediction 4, rewrite the utility function as:

$$V^n(q,p) = q - p^n\left(\frac{p}{p^n} - \sigma\left(\frac{p}{p^n},1\right)\left[\frac{p}{p^n} - 1\right]\right)$$

Setting $V^n(q, p_{wtp}) = 0$ implicitly defines a function $x(p^n) = \frac{p_{wtp}(p^n)}{p^n}$ that satisfies:

$$\frac{dx(p^n)}{dp^n} = -\frac{1}{p^n}\frac{x + \sigma(x,1)(x-1)}{1 + \sigma'(x,1)(x-1) + \sigma(x,1)} < 0$$

So p_{wtp} grows with p^n but less than linearly. In fact we find

$$\frac{dp_{wtp}}{dp^n} = \frac{x + \sigma(x-1)}{1 + \sigma'(x-1) + \sigma}$$

where $\sigma' = \sigma'(x,1)$ and $\sigma = \sigma(x,1)$. Also,

$$\frac{d^2 p_{wtp}}{d(p^n)^2} \propto \sigma'' x'(x-1) + 2\sigma' x'$$

Because $x' < 0$, we conclude p_{wtp} is concave if and only if σ is not too concave:

$$\sigma'' > -2\frac{\sigma'}{x-1}$$

which is satisfied by our specifications.