Online appendix for
Sticky price for declining risk? Business strategies with "behavioral" customers in the hotel industry

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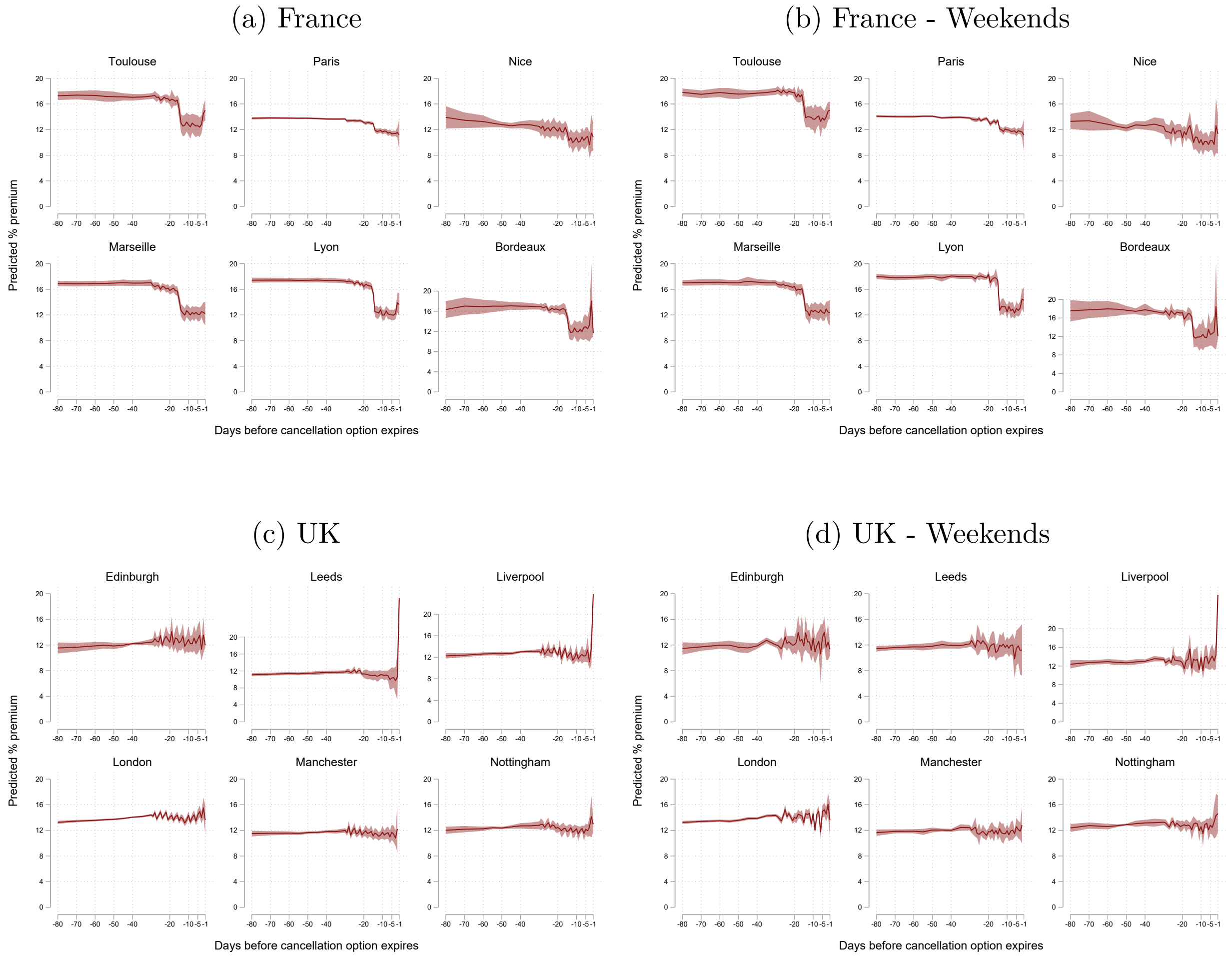
A Sample Statistics

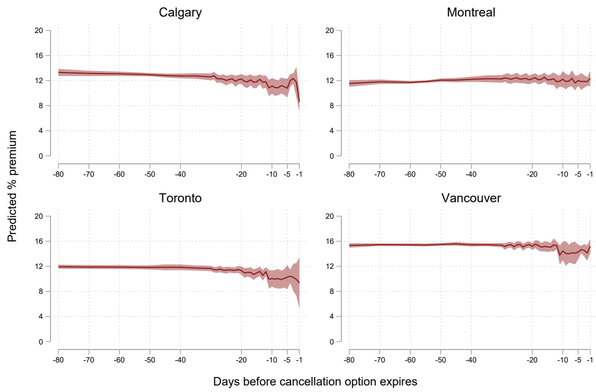
Figure A.1: Predicted Percentage Cancellation Premia, by city and country: Europe



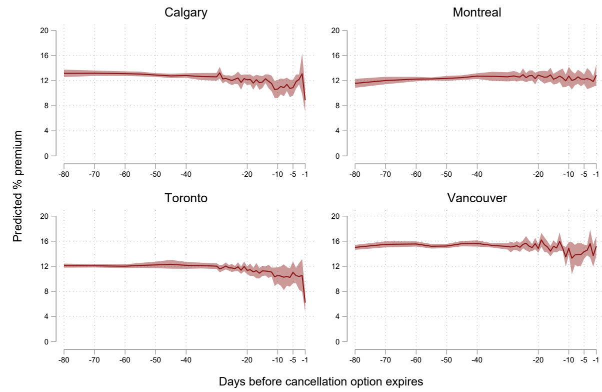
Notes: Four and Five-star hotels combined. All hotels affiliated with a chain.

Figure A.2: Predicted Percentage Cancellation Premia, by city and country: North America

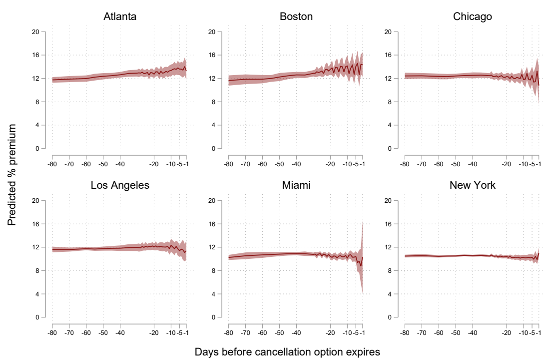
(a) Canada



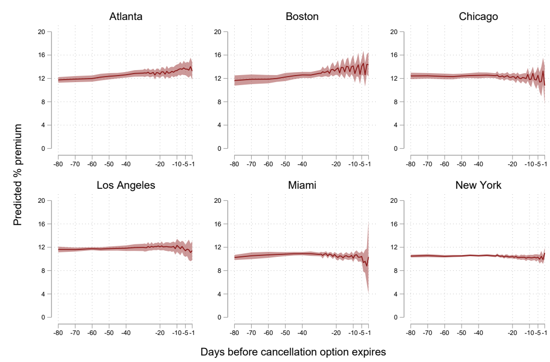
(b) Canada - Weekend



(c) USA



(d) USA - Weekend



Notes: Four and Five star hotels combined. All hotels affiliated with a chain.

Table A.1: Number of observations by combination of prices retrieved before the stay date

Country:	FRANCE				UK			
Price:	NR and R	Only R	Only NR	All	NR and R	Only R	Only NR	All
Days from stay:								
0-2	18,093	51,800	6,805	76,698	11,759	43,288	46,959	102,006
3-4	66,515	23,414	5,006	94,935	44,936	32,838	3,814	81,588
5-6	78,395	18,946	3,978	101,319	57,475	26,594	1,965	86,034
7-9	119,142	21,882	7,096	148,120	93,521	26,718	3,004	123,243
10-13	144,860	24,175	8,782	177,817	117,757	31,329	3,512	152,598
14-20	262,027	33,525	12,578	308,130	199,371	44,305	4,537	248,213
21-29	312,682	30,645	23,948	367,275	253,968	40,598	4,792	299,358
30-39	300,520	24,475	52,194	377,189	304,843	40,245	5,354	350,442
40-49	253,915	21,834	73,913	349,662	300,670	36,197	5,015	341,882
50-59	261,833	22,138	111,183	395,154	346,296	38,789	5,358	390,443
60+	589,455	61,127	513,260	1,163,842	1,009,415	128,931	17,907	1,156,253
Total	2,407,437	333,961	818,743	3,560,141	2,740,011	489,832	102,217	3,332,060

Country:	CANADA				USA			
Price:	NR and R	Only R	Only NR	All	NR and R	Only R	Only NR	All
Days from stay:								
0-2	8,971	29,450	44,529	82,950	8,894	67,804	129,459	206,157
3-4	28,279	50,688	4,291	83,258	77,404	170,598	14,510	262,512
5-6	31,711	47,852	3,094	82,657	113,793	154,126	6,724	274,643
7-9	84,129	73,450	5,008	162,587	270,510	261,886	11,224	543,620
10-13	116,807	101,622	6,440	224,869	392,225	363,713	14,310	770,248
14-20	204,568	158,541	10,422	373,531	695,410	555,439	22,209	1,273,058
21-29	269,265	203,056	14,025	486,346	889,878	687,479	27,158	1,604,515
30-39	285,084	205,746	15,471	506,301	900,157	685,149	26,671	1,611,977
40-49	250,942	178,212	13,807	442,961	773,777	587,711	23,125	1,384,613
50-59	226,444	160,609	12,850	399,903	706,031	527,535	21,026	1,254,592
60+	1,062,271	760,036	62,183	1,884,490	3,518,388	2,516,279	107,167	6,141,834
Total	2,568,471	1,969,262	192,120	4,729,853	8,346,467	6,577,719	403,583	15,327,769

Table A.2: Mean price of rooms with cancellation, by stars and country

Country:	FRANCE			UK		
Stars:	3	4	5	3	4	5
Days from stay:						
0-2	96.5	186.4	485.3	87.2	154.9	425.3
3-4	104.5	205.7	524.1	90.4	169.0	453.1
5-6	109.9	212.3	530.1	91.7	172.7	458.3
7-9	111.9	212.3	530.4	92.8	173.8	458.1
10-13	111.0	212.9	534.4	93.3	174.2	451.9
14-20	112.1	214.3	519.0	95.9	181.1	452.4
21-29	112.5	214.8	520.5	97.5	184.3	450.5
30-39	113.0	214.7	523.3	96.9	181.9	448.8
40-49	114.9	217.4	532.4	98.0	183.9	452.3
50-59	115.8	223.2	541.6	98.6	185.3	454.0
60+	119.4	234.8	557.3	97.3	178.1	445.4

Country:	CANADA			USA		
Stars:	3	4	5	3	4	5
Days from stay:						
0-2	174.1	257.7	565.1	158.8	284.0	751.5
3-4	182.0	299.0	529.9	185.0	315.2	731.6
5-6	186.2	309.5	534.9	195.8	328.8	742.0
7-9	184.6	301.4	529.3	195.5	323.4	754.8
10-13	184.5	301.5	529.1	197.8	325.2	774.8
14-20	188.0	307.0	530.6	203.3	333.4	789.8
21-29	189.7	307.2	533.2	205.1	331.9	781.4
30-39	192.1	312.4	540.6	212.0	340.4	790.8
40-49	190.8	309.9	535.9	211.6	335.4	786.6
50-59	190.0	308.1	536.0	214.5	336.9	783.9
60+	196.1	315.2	554.6	217.5	333.1	762.6

Notes: Two-star hotels in France and UK not included to save space, but available on request. Prices expressed in local currency.

Table A.3: Mean percentage cancellation premia by stars, days of the week and country

Country:	FRANCE						UK					
Stars:	3		4		5		3		4		5	
Weekend:	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Days from stay:												
0-2	14.0	15.0	11.5	11.4	10.7	11.3	12.4	12.4	15.6	16.5	12.6	11.9
3-4	13.1	14.2	13.1	13.3	11.1	11.6	12.6	12.6	13.8	14.4	12.2	11.8
5-6	12.9	13.2	13.2	13.4	11.2	11.5	12.3	12.3	13.4	13.8	12.1	11.7
7-9	12.5	13.4	13.0	13.4	11.8	12.2	12.1	12.9	13.2	13.6	12.6	12.0
10-13	12.8	13.4	13.2	13.4	11.9	12.0	12.2	12.7	13.0	13.6	12.5	12.4
14-20	13.8	14.4	14.9	15.6	13.3	13.4	12.3	12.6	12.9	13.2	12.8	12.8
21-29	14.5	15.2	15.5	16.5	13.3	13.7	12.5	12.8	13.1	13.2	12.9	13.1
30-39	15.6	16.6	15.5	16.6	13.2	13.6	12.6	13.2	12.9	13.5	12.8	13.1
40-49	15.6	16.1	15.6	16.2	13.0	13.4	12.5	12.8	12.7	12.9	12.7	12.5
50-59	15.0	16.0	15.2	16.2	12.9	13.3	12.4	12.9	12.4	12.6	12.4	12.2
60 plus	14.3	14.7	14.8	15.2	12.6	13.1	12.5	12.8	12.4	12.4	12.5	12.1

Country:	CANADA						USA					
Stars:	3		4		5		3		4		5	
Weekend:	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Days from stay:												
0-2	12.9	13.4	13.2	14.7	15.9	16.0	13.0	14.1	12.9	12.8	15.0	16.7
3-4	12.6	13.2	11.7	12.2	14.4	14.0	12.5	12.8	12.3	13.3	13.8	13.9
5-6	12.2	12.8	11.1	11.9	14.3	14.0	12.0	11.9	11.6	12.4	13.8	13.0
7-9	11.8	11.9	11.4	11.6	14.2	14.1	11.2	11.4	11.8	12.5	13.1	13.0
10-13	11.9	12.2	11.5	11.6	13.9	13.8	11.1	11.3	11.6	12.5	13.4	13.6
14-20	12.0	12.3	12.0	12.3	13.8	13.9	11.2	11.5	11.2	12.0	13.6	13.7
21-29	11.9	12.1	12.0	12.4	13.9	14.1	11.2	11.4	11.3	11.9	13.7	13.9
30-39	12.0	12.2	12.1	12.4	14.1	13.9	11.2	11.6	11.4	12.2	13.7	14.2
40-49	11.9	12.3	12.1	12.6	14.0	14.2	11.3	11.6	11.4	12.0	13.6	14.1
50-59	11.8	12.1	12.1	12.3	14.0	13.9	11.2	11.5	11.2	11.9	13.5	13.9
60 plus	11.8	12.2	12.0	12.0	13.9	14.0	11.0	11.3	10.9	11.6	13.9	14.2

Notes: Two-star hotels in France and UK not included to save space, but available on request.

Table A.4: Mean percentage cancellation premia by stars, days of the week and city

Country:	FRANCE	
Chain:	Yes	
Weekend:	No	Yes
City:		
Toulouse	16.4	17.6
St.Etienne	16.6	17.2
Paris	13.0	13.4
Nice	12.6	12.3
Marseille	15.7	16.0
Lyon	15.6	16.5
Lille	16.9	17.6
Lens	16.0	15.4
Bordeaux	15.5	16.0

Country:	CANADA			
Chain:	No		Yes	
Weekend:	No	Yes	No	Yes
City:				
Calgary	11.9	12.0	11.9	12.1
Montreal	11.6	11.5	12.0	12.3
Toronto	12.2	12.2	11.7	12.1
Vancouver	14.7	14.7	15.1	15.1
Winnipeg	13.0	13.9	11.2	11.7

Country:	UK	
Chain:	Yes	
Weekend:	No	Yes
City:		
Birmingham	11.2	11.7
Cambridge	11.9	12.3
Cardiff	12.6	12.6
Edinburgh	12.3	12.4
Leeds	12.0	12.5
Liverpool	12.9	13.2
London	13.6	13.7
Manchester	11.9	12.0
Nottingham	12.1	12.6
Oxford	12.6	12.3
Sheffield	12.7	12.9

Country:	US			
Chain:	No		Yes	
Weekend:	No	Yes	No	Yes
City:				
Atlanta	13.9	13.5	11.4	11.6
Boston	10.7	10.7	11.5	11.8
Chicago	13.2	13.1	12.3	12.5
Houston	12.4	12.2	12.3	12.8
Los Angeles	12.4	12.4	11.5	12.5
Minneapolis	10.7	10.7	12.0	12.4
Miami	13.6	13.9	10.5	10.4
New York	12.1	12.2	10.2	11.3
Portland	12.6	12.3	12.6	13.4
Seattle	13.0	13.1	10.4	11.1

Notes: Hotels in France and UK are all chain affiliated. Statistics for some UK cities not included to save space, but available on request.

B Solving the model

In this section, we report the results and corresponding proofs that lead to Proposition 1.

B.1 The optimal tariff menu: the general case

The following lemmas simplify the firm's profit maximization problem:

Lemma B.1 *Suppose that PC_ω is satisfied for a type ω selecting p_{NR}. Then $IC_{\omega'}$ implies $PC_{\omega'}$ for all types ω displaying $c_{\omega'} > c_\omega$.*
Proof *If $U_\omega^{NR} \geq 0$, then $c_\omega \geq p_{NR}$. It follows that $U_{\omega'}^{NR} \geq 0$ because $c_{\omega'} > c_\omega \geq p_{NR}$. If type ω' selects p_R, then $U_{\omega'}^{R} \geq U_{\omega'}^{NR} \geq 0$.* ■

Lemma B.2 *Suppose that type θS ($\theta = L, H$) selects p_R. Then type θN selects p_R as well, as long as $\pi_\theta < 1$.*

Proof *The proof is by contradiction. Suppose that $U_{\theta S}^{R} \geq U_{\theta S}^{NR}$ and $U_{\theta N}^{NR} \geq U_{\theta N}^{R}$. The two conditions can be re-written as:*

$$\pi_\theta \left[u(v_\theta - p_{NR}) - u(v_\theta - p_R) - u(-p_{NR})\right] \leq -u(-p_{NR});$$

$$g(\pi_\theta) \left[u(v_L - p_{NR}) - u(v_\theta - p_R) - u(-p_{NR})\right] \geq -u(-p_{NR}).$$

Because $\pi_\theta > g(\pi_\theta)$, the two inequalities are incompatible. ■

Lemma B.3 *Suppose that type LS (LN) selects p_R. Then type HS (HN) selects p_R as well.*
Proof *Let us consider the case of sophisticated types first. The proof is by contradiction. Suppose that $U_{LS}^{R} \geq U_{LS}^{NR}$ and $U_{HS}^{NR} \geq U_{HS}^{R}$. The two conditions can be re-written as*

$$\pi_L \left[u(v_\theta - p_{NR}) - u(v_L - p_R)\right] \leq -(1 - \pi_L)u(-p_{NR}) < -(1 - \pi_H)u(-p_{NR});$$

$$\pi_H \left[u(v_H - p_{NR}) - u(v_H - p_R)\right] \geq -(1 - \pi_H)u(-p_{NR}).$$

Due to the concavity of $u(\circ)$, $u(v_H - p_{NR}) - u(v_H - p_R) < u(v_L - p_{NR}) - u(v_L - p_R)$. Therefore, the two inequalities are incompatible. The proof for naive types is obtained substituting $g(\pi_\theta)$ to π_θ. ■

Lemma B.1 shows that the reservation price for a non-refundable tariff identifies an ordering over type exclusion when such a tariff is part of the equilibrium menu: if type ω is served in equilibrium, then all types ω' for which $c_{\omega'} > c_\omega$ must also be served. Lemmas B.2 and B.3 derive from the fact the attractiveness of refundable tariffs is higher for those customers who have more to gain from being insured, because they have a higher subjective probability of not enjoying the service (Lemma B.2) or they have a higher valuation for it and a higher objective probability of not enjoying the service (Lemma B.3).

In the first group of equilibrium configurations, where each tariff is chosen by at least one type, Lemmas B.1-B.3 implies that there are six configurations to consider. For each configuration, we can determine the candidate equilibrium tariffs by setting p_{NR}^* equal to the lowest reservation price for types selecting such a tariff, and p_R^* such that the incentive compatibility constraints of types selecting in equilibrium such a tariff hold, with at least one of them with an equality sign. We also observe that configurations thatdiscriminate between naive and sophisticated consumers of type θ require $\pi_\theta < 1$.

We summarize the candidate equilibrium tariffs in the following propositions:

Proposition B.1 *Suppose HS, HL and LN select the refundable tariff and LS selects the non-refundable tariff (configuration 1). Then* $p^*_{NR} = c_{LS}$ *and* $p^*_R = v_L$*. The firm's expected profit is* $v_L(\pi_H N_H + \pi_L N_L(1-\beta)) + c_{LS}\beta N_L$.

Proof *The eight constraints for expected profit maximization problem are:*

$$\pi_H u(v_H - p_R) \geq \pi_H u(v_H - p_{NR}) + (1-\pi_H)u(-p_{NR}) \qquad (IC_{HS})$$
$$g(\pi_H)u(v_H - p_R) \geq g(\pi_H)u(v_H - p_{NR}) + (1-g(\pi_H))u(-p_{NR}) \qquad (IC_{HN})$$
$$g(\pi_L)u(v_L - p_R) \geq g(\pi_L)u(v_L - p_{NR}) + (1-g(\pi_L))u(-p_{NR}) \qquad (IC_{LN})$$
$$\pi_L u(v_L - p_{NR}) + (1-\pi_L)u(-p_{NR}) \geq \pi_L u(v_L - p_R) \qquad (IC_{LS})$$
$$\pi_H u(v_H - p_R) \geq 0 \qquad (PC_{HS})$$
$$g(\pi_H)u(v_H - p_R) \geq 0 \qquad (PC_{HN})$$
$$g(\pi_L)u(v_L - p_R) \geq 0 \qquad (PC_{LN})$$
$$\pi_L u(v_L - p_{NR}) + (1-\pi_L)u(-p_{NR}) \geq 0 \qquad (PC_{LS})$$

PC_{LN} implies PC_{HS}, PC_{HN} and PC_{LS} as from Lemma B.1, whereas IC_{HS} implies IC_{HN} following B.2. PC_{LN} is binding when $p_R = v_L$. We ignore IC_{HS} for now. $p_R = v_L$ implies that IC_{LS} is satisfied if $p^*_{NR} \leq c_{LS}$. If this constraint is binding, then IC_{LN} holds because $c_{LS} \geq c_{LN}$. Finally, if we substitute $p_R = v_L$ and $p_{NR} = c_{LS}$ into IC_{HS}, we obtain

$$\pi_H u(v_H - v_L) \geq \pi_H u(v_H - c_{LS}) + (1-\pi_H)u(-c_{LS}),$$

which always holds because $c_{LS} \leq v_L$. ■

Proposition B.2 *Suppose HS and HN select the refundable tariff and LS and LN select the non-refundable tariff (configuration 2). Then* $p^*_{NR} = c_{LN}$ *and* $p^*_R = m_2$ *where* m_2 *is the solution of* $\pi_H u(v_H - m_2) = \pi_H u(v_H - c_{LN}) + (1-\pi_H)u(-c_{LN})$*. The firm's expected profit is* $m_2\pi_H N_H + c_{LN}N_L$.

Proof *The eight constraints of the expected profit maximization program are:*

$$\pi_H u(v_H - p_R) \geq \pi_H u(v_H - p_{NR}) + (1-\pi_H)u(-p_{NR}) \qquad (IC_{HS})$$
$$g(\pi_H)u(v_H - p_R) \geq g(\pi_H)u(v_H - p_{NR}) + (1-g(\pi_H))u(-p_{NR}) \qquad (IC_{HN})$$
$$g(\pi_L)u(v_L - p_{NR}) + (1-g(\pi_L))u(-p_{NR}) \geq g(\pi_L)u(v_L - p_R) \qquad (IC_{LN})$$
$$\pi_L u(v_L - p_{NR}) + (1-\pi_L)u(-p_{NR}) \geq \pi_L u(v_L - p_R) \qquad (IC_{LS})$$
$$\pi_H u(v_H - p_R) \geq 0 \qquad (PC_{HS})$$
$$g(\pi_H)u(v_H - p_R) \geq 0 \qquad (PC_{HN})$$
$$g(\pi_L)u(v_L - p_{NR}) + (1-g(\pi_L))u(-p_{NR}) \geq 0 \qquad (PC_{LN})$$
$$\pi_L u(v_L - p_{NR}) + (1-\pi_L)u(-p_{NR}) \geq 0 \qquad (PC_{LS})$$

PC_{LN} implies PC_{HS}, PC_{HN} and PC_{LS} following Lemma B.1; IC_{HS} implies IC_{HN} as per Lemma B.2. PC_{LN} is binding for $p_{NR} = c_{LN}$. For $p_R = m_2$, IC_{HS} is binding. Because

$$\pi_H u(v_H - v_L) \geq \pi_H u(v_H - c_{LN}) + (1-\pi_H)u(-c_{LN}),$$

it follows that $m_2 \geq v_L$, which implies that IC_{LS} and IC_{LN} hold. ■

Proposition B.3 *Suppose HS and HN select the refundable tariff, LS selects the non-refundable tariff, and LN does not buy (configuration 3). Then $p^*_{NR} = c_{LS}$ and $p^*_R = m_3$ where m_3 is the solution of $\pi_H u(v_H - m_3) = \pi_H u(v_H - c_{LS}) + (1 - g(\pi_H))u(-c_{LS})$. The firm's expected profit is $m_3\pi_H N_H + c_{LS}\beta N_L$.*
Proof *These are the six constraints for the expected profit maximization problem in this case:*

$$\pi_H u(v_H - p_R) \geq \pi_H u(v_H - p_{NR}) + (1 - \pi_H)u(-p_{NR}) \quad (IC_{HS})$$
$$g(\pi_H)u(v_H - p_R) \geq g(\pi_H)u(v_H - p_{NR}) + (1 - g(\pi_H))u(-p_{NR}) \quad (IC_{HN})$$
$$\pi_L u(v_L - p_{NR}) + (1 - \pi_L)u(-p_{NR}) \geq \pi_L u(v_L - p_R) \quad (IC_{LS})$$
$$\pi_H u(v_H - p_R) \geq 0 \quad (PC_{HS})$$
$$g(\pi_H)u(v_H - p_R) \geq 0 \quad (PC_{HN})$$
$$\pi_L u(v_L - p_{NR}) + (1 - \pi_L)u(-p_{NR}) \geq 0 \quad (PC_{LS})$$

PC_{LS} implies PC_{HS} and PC_{HN} (Lemma B.1), and IC_{HS} implies IC_{HN} as per Lemma B.2. PC_{LS} is binding for $p_{NR} = c_{LS}$. For $p_R = m_3$, IC_{HS} is binding. Moreover, because the following inequality holds:

$$\pi_H u(v_H - v_L) \geq \pi_H u(v_H - c_{LN}) + (1 - \pi_H)u(-c_{LN}),$$

it follows that $m_3 \geq v_L$, and therefore IC_{LS} is verified. Finally, we observe that LN types would obtain a negative expected utility both from the refundable tariff (since $m_3 > v_L$) and the non-refundable tariff (since $c_{LS} > c_{LN}$) as long as $\pi_L < 1$. ■

Proposition B.4 *Suppose HN selects the refundable tariff and HS, LS and LN select the non-refundable tariff (configuration 4). Then, $p^*_{NR} = c_{LN}$ and $p^*_R = m_4$ where m_4 is the solution of $g(\pi_H)u(v_H - m_4) = g(\pi_H)u(v_H - c_{LN}) + (1 - g(\pi_H))u(-c_{LN})$. The expected profit is $m_4\pi_H(1 - \beta)N_H + c_{LN}(\beta N_H + N_L)$.*
Proof *The eight constraints for expected profit maximization are the following;*

$$\pi_H u(v_H - p_{NR}) + (1 - \pi_H)u(-p_{NR}) \geq \pi_H u(v_H - p_R) \quad (IC_{HS})$$
$$g(\pi_H)u(v_H - p_R) \geq g(\pi_H)u(v_H - p_{NR}) + (1 - g(\pi_H))u(-p_{NR}) \quad (IC_{HN})$$
$$\pi_L u(v_L - p_{NR}) + (1 - \pi_L)u(-p_{NR}) \geq \pi_L u(v_L - p_R) \quad (IC_{LS})$$
$$g(\pi_L)u(v_L - p_{NR}) + (1 - g(\pi_L))u(-p_{NR}) \geq g(\pi_L)u(v_L - p_R) \quad (IC_{LN})$$
$$\pi_H u(v_H - p_R \geq 0 \quad (PC_{HS})$$
$$g(\pi_H)u(v_H - p_{NR}) + (1 - g(\pi_H))u(-p_{NR}) \geq 0 \quad (PC_{HN})$$
$$\pi_L u(v_L - p_{NR}) + (1 - \pi_L)u(-p_{NR}) \geq 0 \quad (PC_{LS})$$
$$g(\pi_L)u(v_L - p_{NR}) + (1 - g(\pi_L))u(-p_{NR}) \geq 0 \quad (PC_{LN})$$

PC_{LN} implies that all the other participation constraints hold, as per Lemma B.1. PC_{LN} is binding for $p_{NR} = c_{LN}$. For $p_R = m_4$, IC_{HL} is binding. IC_{HL} can be re-written as

$$g(\pi_H)\left[u(v_H - c_{LN}) - u(v_H - m_4) - u(-c_{LN})\right] = -u(-c_{LN}),$$

which for $\pi_H < 1$ *implies:*

$$\pi_H \left[u(v_H - c_{LN}) - u(v_H - m_4) - u(-c_{LN}) \right] < -u(-c_{LN}),$$

from which IC_{HS} *follows. Because*

$$g(\pi) u(v_H - v_L) > \pi u(v_H - c_{LN}) + (1 - \pi) u(-c_{LN}),$$

then $m_4 > v_L$*. It follows that* IC_{LS} *and* IC_{LN} *are verified, too.* ■

Proposition B.5 *Suppose* HN *selects the refundable tariff,* HS *and* LS *select the non-refundable tariff and* LN *does not buy (configuration 5). Then,* $p^*_{NR} = c_{LS}$ *and* $p^*_R = m_5$ *where* m_5 *is the solution of* $g(\pi_H) u(v_H - m_5) = g(\pi_H) u(v_H - c_{LS}) + (1 - g(\pi_H)) u(-c_{LS})$*. The firm's expected profit is* $m_5 \pi_H (N_H (1 - \beta)) + c_{LS} \beta (N_H + N_L)$*.*
Proof *The six constraints for expected profit maximization are:*

$$\begin{aligned}
&\pi_H u(v_H - p_{NR}) + (1 - \pi_H) u(-p_{NR}) \geq \pi_H u(v_H - p_R) && (IC_{HS}) \\
&g(\pi_H) u(v_H - p_R) \geq g(\pi_H) u(v_H - p_{NR}) + (1 - g(\pi_H)) u(-p_{NR}) && (IC_{HN}) \\
&\pi_L u(v_L - p_{NR}) + (1 - \pi_L) u(-p_{NR}) \geq \pi_L u(v_L - p_R) && (IC_{LS}) \\
&\pi_H u(v_H - p_{NR}) + (1 - \pi_H) u(-p_{NR}) \geq 0 && (PC_{HS}) \\
&g(\pi_H) u(v_H - p_R) \geq 0 && (PC_{HN}) \\
&\pi_L u(v_L - p_{NR}) + (1 - \pi_L) u(-p_{NR}) \geq 0 && (PC_{LS})
\end{aligned}$$

From Lemma B.1, PC_{LS} *implies* PC_{HS}*.* PC_{LS} *is binding for* $p_{NR} = c_{LS}$*. For* $p_R = m_5$*,* IC_{HL} *is binding. We can rewrite* IC_{HL} *as*

$$g(\pi_H) \left[u(v_H - c_{LS}) - u(v_H - m_5) - u(-c_{LS}) \right] = -u(-c_{LS}),$$

which for $\pi_H < 1$ *implies:*

$$\pi_H \left[u(v_H - c_{LN}) - u(v_H - m_h) - u(-c_{LN}) \right] > -u(-c_{LN}),$$

from which IC_{HS} *follows. Moreover because the following inequality holds:*

$$g(\pi_H) u(v_H - v_L) > g(\pi_H) u(v_H - c_{LN}) + (1 - g(\pi_H)) u(-c_{LN}),$$

then $m_5 > v_L$*, so* IC_{LS} *is verified. Finally, note that* LN *would derive a negative expected utility both from the refundable tariff (*$m_5 > v_L$*) and from the non-refundable tariff because* $c_{LS} > c_{LN}$ *when* $\pi_L < 1$*.* ■

Proposition B.6 *Suppose* HN *selects a refundable tariff,* HS *selects a non-refundable tariff and* LS *and* LN *do not buy (configuration 6). Then* $p^*_{NR} = c_{HS}$ *and* $p^*_R = v_H$*, and the firm's expected profit is* $v_H \pi_H (1 - \beta) N_H + c_{HS} \beta N_H$*.*
Proof *The four constraints for expected profit maximization are the following:*

$$\begin{aligned}
&\pi_H u(v_H - p_{NR}) + (1 - \pi) u(-p_{NR}) \geq \pi u(v_H - p_R) && (IC_{HS}) \\
&g(\pi_H) u(v_H - p_R) \geq g(\pi_H) u(v_H - p_{NR}) + (1 - g(\pi_H)) u(-p_{NR}) && (IC_{HS}) \\
&\pi_H u(v_H - p_R) \geq 0 && (PC_{HS}) \\
&g(\pi_H) u(v_H - p_{NR}) + (1 - g(\pi_H)) u(-p_{NR}) \geq 0 && (PC_{HN})
\end{aligned}$$

Suppose that both participation constraints are binding. Then IC_{HS} is also binding and IC_{HN} is satisfied. Finally, note that both LN and LS would derive a negative expected utility both from the refundable tariff (because $v_H > v_L$) and the non-refundable tariff because $c_{HS} > c_{LS} > c_{LN}$. ■

In the second group of configurations, customers choose only the refundable tariff. In this case, the participation constraints do not depend on the degree of sophistication (because $U_\theta^{S,R} \geq 0$ implies $U_\theta^{N,R} \geq 0$ and vice versa). It follows that the candidate equilibrium tariffs are determined by fixing the refundable tariff equal to the lowest valuation among the customers served by the firm. This leads to the following Propositions.

Proposition B.7 *Suppose HS, HL, LS and LN select the refundable tariff (configuration 7). Then, $p^*_{NR} = p > c_{HS}$ and $p^*_R = v_L$. The firm's expected profit is $v_L(\pi_H N_H + \pi_L N_L)$.*

Proposition B.8 *Suppose HS and HN select the refundable tariff and LS and LN do not buy (configuration 8). Then, $p^*_{NR} = p > c_{LS}$ and $p^*_R = v_H$. The firm's expected profit is $\pi_H v_H N_H$.*

Finally, in the third group of configurations, only the non-refundable tariff is chosen. In this case, given Lemma B.1 above, the candidate equilibrium tariffs are determined by fixing to non-refundable tariff equal to the lowest reservation price among the customers served by the firm. Therefore, we can derive the following Propositions:

Proposition B.9 *Suppose HS, HL, LS and LN select the non-refundable tariff (configuration 9). Then $p^*_{NR} = c_{LN}$ and $p^*_R = p > v^H$.The firm's expected profit is $c_{LS}(N_H + N_L)$.*

Proposition B.10 *Suppose HS, HL and LS select the non-refundable tariff and LS does not buy (configuration 10). Then $p^*_{NR} = c_{LS}$ and $p^*_R = p > v^H$. The expected profit is $c_{LS}(N_H + \beta N_L)$.*

Proposition B.11 *Suppose HS and HN select the non-refundable tariff and LS and LN do not buy (configuration 11). Then $p^*_{NR} = c_{HN}$ and $p^*_R = p > v^H$. The expected profit is $c_{HN} N_H$.*

Proposition B.12 *Suppose HS selects the non-refundable tariff and HL, LS and LN do not buy. (configuration 12). Then $p^*_{NR} = c_{HS}$ and $p^*_R = p > v^H$. The firm's expected profit is*

$c_{HS}\beta N_H$.

Based on expected profit comparison, the following Proposition shows that we can restrict our attention to seven candidate equilibria.

Proposition B.13 *The candidate equilibrium 7 always guarantees higher expected profits than candidate equilibria 9 and 10. The candidate equilibrium 8 always guarantees higher expected profits than candidate equilibria 6, 11 and 12.*

Proof *Equilibrium 8 dominates 6 because $v_H \geq c_{HS}$. Equilibrium 7 dominates 9 and 10 and 8 dominates 11 and 12 because $\pi_\theta v_\theta \geq c_{\theta S}$. (**??**) can be re-written as $\pi_\theta = \frac{-u(-c_{\theta S})}{u(v_\theta - c_{\theta S}) - u(-c_{\theta S})}$. Multiplying both sides by $\frac{v_\theta}{c_{\theta S}}$, we obtain $\frac{\pi_\theta v_\theta}{c_{\theta S}} = \frac{-u(-c_{\theta S})/c_{\theta S}}{[u(v_\theta - c_{\theta S}) - u(-c_{\theta S})]/v_\theta}$. The right-hand term is greater than or equal to 1 because $u''(\circ) < 0$. $\pi_\theta v_\theta \geq c_{\theta S}$ then follows.* ■

B.2 The optimal tariff menu: the case of $\pi_L \to 1$ and $\pi_L \to \overline{\pi}$

In this Section we provide the characterization of the equilibrium for $\pi_L \to 1$ and $\pi_H \to \overline{\pi}$. We observe that $\lim_{\pi_L \to 1} c_{LN} = \lim_{\pi_L \to 1} c_{LS} = v_L$. which implies $m_2 = m_3$ and $m_4 = m_5$. The expected profits are summarized Table B.1 below.

Table B.1: Expected profits for each equilibrium configuration

Equilibrium candidate:	**Expected profits:**
1	$v_L\overline{\pi}N_H + v_L N_L$
2	$m_2\overline{\pi}N_H + v_L N_L$
3	$m_3\overline{\pi}N_H + v_L\beta N_L$
4	$m_4\overline{\pi}(1-\beta)N_H + v_L(\beta N_H + N_L)$
5	$m_5\overline{\pi}(N_H(1-\beta)) + v_L\beta(N_H + N_L)$
7	$v_L\overline{\pi}N_H + v_L N_L$
8	$\overline{\pi}v_H N_H$

The following Proposition shows that in this case we can further restrict our attention to three candidate equilibria only.

Proposition B.14 *The candidate equilibria* 2 *always guarantee higher expected profits than candidate equilibria* 1, 7 *and* 3*. The candidate equilibrium* 4 *always guarantees a higher expected profit than* 5*.*
Proof 2 *dominates* 1 *and* 7 *because* $m_2 > v_L$*, and* 3 *because* $\beta < 1$. 4 *dominates* 5 *because* $\beta < 1$. ■

Candidate equilibria 4, 2 and 8 correspond to Configuration I, II and III respectively. The condition that makes Configuration I the optimal menu based on expected profit comparison is described in the main text.

B.3 Proof of Lemma 1

Suppose that $\overline{\pi}v_H N_H > \overline{\pi}\ m_{II}N_H + v_L N_L$. This condition implies that configuration *III* yields higher profits than Configuration *II* for $\pi_L \to 1$ and $\pi_H \to \overline{\pi}$. Therefore, if the menu choice is restricted to cases without naiveté-based discrimination (Configuration II and III), in the optimal menu only high-valuation types are served, and pay a price equal to v_H. In this case, the market is not fully covered, and the utility of low-valuation types is zero. With naiveté-based discrimination, i.e. if Configuration I is feasible and profitable, the naive high-valuation types pay m_I, lower than v_H, and the same is for the sophisticated types, since $v_L < v_H$. Low-valuation types are indifferent under Configuration I and III.

Now consider $\overline{\pi}v_H N_H < \overline{\pi}\ m_{II}N_H + v_L N_L$. Absent naiveté-based discrimination, the market is fully covered in equilibrium. If naiveté-based discrimination is considered (and profitable), a NH type ends up paying m_I, which is higher than m_{II}: therefore, he is worse off. The HS type is better off, since $v_L < m_I$. As in the previous case, low types are indifferent.

C A model with competition

We sketch a tractable model of competitive price discrimination, following Stole (1995) and Valletti (2002). We assume that consumers are located along a line of unit length, with point x being a consumer's position, while two firms are located at the extremes of the line (points 0 and 1). The distribution of consumers' "augmented" type (ω) does not depend on x. If θ is the consumer willingness to pay and x her position, then the utility function $u(\circ)$ when she buys from the firm located in 0 is given by $v_\theta - p - tx$, while it is $v_\theta - p - t(1-x)$ if she buys from the firm located in 1. As in Stole (1995) and Valletti (2002), we assume that the "horizontal" parameter x is observable, so that firms can offer refundable and non-refundable tariffs contingent on x. In equilibrium, each firm serves the half of the market which is the closest to it, while the other firm fixes the lowest possible tariffs (in our setting, both equal to zero) at these locations. From now on we focus on the case of small cancellation probability ($\pi_L \to 1$ and $\pi_H \to \overline{\pi} < 1$) and Configuration I, corresponding to naiveté-based discrimination. Since firms are symmetric, we consider the firm located at the left extreme (point 0) only. In addition to meeting the constraints for the monopoly case, the firm must guarantee each consumer a utility which is at least the utility provided by other firm, so that both the refundable and non-refundable price must be lower than $t(1-2x)$. We define these conditions as the competition constraints.

Ignoring competition constraints, Configuration I now entails $p^*_{NR} = v_L - tx$ and $p^*_R = m_I$ where m_I is the solution to $g(\pi_H)u(v_H - m_I) = g(\pi_H)u(v_H - v_L) + (1 - g(\pi_H))u(-v_L + tx)$. If competition is mild, i.e. if x is low and/or t is high, competition constraints are not binding, so that the monopoly case is unaffected. If competition is intense, i.e. if x is high and/or t is low, both constraints are binding. It follows that the cancellation premium is zero. For an intermediate level of competition intensity, the competition constraint is binding for the high type only. It follows that $p^*_{NR} = v_L - tx$ and $p^*_R = t(1-2x)$. This requires $v_L - tx < t(1-2x)$, i.e. $v_L < t(1-x)$. In this case, the cancellation premium is given by $p^*_R - p^*_{NR} = t(1-x) - v_L > 0$.

D A model with a capacity constraint

In this section, we outline an extension of the model that includes a capacity constraint. We assume that the firm can serve up to K customers; K therefore represents the available capacity at the beginning of the period. Consistently with the set-up of the basic model, the firm is myopic and maximizes expected profits in each period; for this reason, we omit the time index for capacity just as we did for the other variables. In addition, we focus on the case of $\pi_L \to 1$ and $\pi_H \to \overline{\pi}$, and further restrict the analysis to $\beta \geq 1/2$. By assuming that the fraction of sophisticated consumers is "large", we consider the area of the parameter space for which the conditions for the existence of naiveté-based discrimination are less likely to be met. *A fortiori*, our conclusions should hold for lower values of β. Finally, we assume that the firm adopts a quantity-based revenue management approach, by allocating capacity to each tariff. Because there is no uncertainty in demand, the firm serves fully the group of customers purchasing the tariff associated with higher expected profits; they then use the residual capacity to sell the other tariff. For $K \geq N_H + N_L$, the analysis is just the same as the one presented in Section 4 in the main text. Here we consider $K < N_H + N_L$.

To solve the model, we first observe that, in each of the twelve configurations considered as candidate equilibria in Appendix Section B, the tariffs that maximize expected profits are unrelated to the number of consumers of each type served; in contrast, expected profits do, of course, depend on the number of consumers per type. To determine the equilibrium, we therefore proceed as follows:

- For each configuration, we determine i) the condition on K that makes a configuration *admissible*, i.e., such that the firm can serve (at least partially) the consumer types that are supposed to be served under that configuration; and ii) the corresponding expected profits, as a function of K.
- For each value of K, we compare the expected profits of all the admissible configurations to identify the optimal menu.

For each configuration, the condition for admissibility and the corresponding expected profits are as follows:

(Configuration 1) In this case, consumer types HS, HL and LN select the refundable tariff, whereas LS customers select the non-refundable tariff. The condition for this configuration to be admissible is $K > N_H + N_L(1-\beta)$. The firm's expected profit is $v_L K \pi^*_{R1} + v_L \beta N_L$, where $\pi^*_R = \overline{\pi}\frac{N_H}{N_H+N_L(1-\beta)} + \frac{N_L(1-\beta)}{N_H+N_L(1-\beta)}$ is the average cancellation probability for the consumers choosing the refundable tariff.

(Configuration 2) In this case, HS and HN select the refundable tariff and LS and LN choose the non-refundable tariff. The condition for admissibility of this configuration is $K > N_H$. The expected profit is $m_2 \overline{\pi} N_H + v_L(K - N_H)$. Note that with $\pi_L \to 1$ and $\pi_H \to \overline{\pi}$, configuration 3 is equivalent to configuration 2.

(Configuration 4) HN customers select the refundable tariff while HS, LS and LN opt for the non-refundable tariff. The condition for this configuration to be admissible is $K > N_H(1-\beta)$. The expected profit is $m_4 \overline{\pi}(1-\beta)N_H + v_L(K - (1-\beta)N_H)$. In the case of $\pi_L \to 1$ and $\pi_H \to \overline{\pi}$ on which we focus in this extension, configuration 5 is equivalent to configuration 4.

(Configuration 6) Customers of type HN select a refundable tariff, HS selects a non-refundable tariff, and LS and LN do not buy. This case requires $K > N_H(1-\beta)$ to be admissible. The expected profit is $v_H \overline{\pi}(1-\beta)N_H + c_{HS} \min\{\beta N_H; K - (1-\beta)N_H)\}$.

(Configuration 7) In this case, all consumer types select the refundable tariff. This requires $K > N_H$. The firm's profit is $v_L K \pi^*_{R2}$, with $\pi^*_{R2} = \overline{\pi}\frac{N_H}{N_H+N_L} + \frac{N_L}{N_H+N_L}$.

(Configuration 8) HS and HN types select the refundable tariff and LS and LN types do not buy. This configuration is always admissible. The expected profit is $\overline{\pi} v_H \min\{K; N_H\}$.

(Configuration 9) In this case, all four types choose the non-refundable tariff. This configuration requires $K > N_H + N_L\beta$ t be admissible. The expected profit is $v_L K$.

(Configuration 10) HS, HL and LS types select the non-refundable tariff, whereas LN types do not buy. The admissibility condition is $K > N_H$, and the expected profit is $v_L \min\{K; N_H + \beta\ N_L\}$.

(Configuration 11) In this case, HS and HN customers select the non-refundable tariff, whereas LS and LN do not buy. The condition for this configuration to be admissible is $K > \beta N_H$. The expected profit is $c_{HN} \min\{K; N_H\}$.

(Configuration 12) HS customers buy the non-refundable tariff while HL, LS and LN do not buy. This configuration is always admissible, and will lead to an expected profit of $c_{HS} \min\{K; \beta N_H\}$.

Expected profit comparisons for each value of K lead to the following results.

1. If $K \leq (1-\beta)N_H$, the only admissible configurations are (8) and (12). Configuration (8) always guarantees higher expected profits than (12) because $\overline{\pi} v_H > c_{HS}$.

2. If $(1-\beta)N_H < K \leq \beta N_H$, the admissible configurations are (4), (6), (8) and (12), with configuration (8) dominating the others because the condition for (8) yielding higher expected profits than (6) is $K > (1-\beta)N_H$, and the condition for (8) to be superior to (4) is $K > \frac{\overline{\pi} m_4 - v_L}{\overline{\pi} v_H - v_L}(1-\beta)N_H$. This condition always holds because $\frac{\overline{\pi} m_4 - v_L}{\overline{\pi} v_H - v_L} < 1$ is implied by $\overline{\pi} v_H > \overline{\pi} m_4 > v_L$ (the second inequality is demonstrated in Escobari and Jindapon (2014).

3. If $\beta N_H < K \leq N_H$, the admissible configurations are (4), (6), (8), (11) and (12), with configuration (8) being again the dominating one. This occurs because (8) is preferred to (11) under $\overline{\pi} v_H > c_{HN}$.

4. If $N_H < K \leq N_H + (1-\beta)N_L$, the admissible configurations are (2), (4), (6), (7), (8), (10), (11) and (12). Configuration (8) dominates (10) because $\overline{\pi} v_H > v_L$. In turn, (10) yields higher expected profits than (7) because $\pi^*_{R2} < 1$. For configuration (4) to be the one yielding the highest expected profits, the requirement is that $K > N_H(1-\beta) + N_H \frac{\overline{\pi}}{v_L}(v_H - m_4(1-\beta)$ and $\overline{\pi}\left[m_4(1-\beta) - m_2\right] + v_L\beta > 0. If \mathrm{N}_H + (1-\beta) < K \leq N_H + \beta N_L$, the admissible configurations are (1), (2), (4), (6), (7), (8), (10), (11) and (12). (1) is dominated by (10) because $\pi^*_{R1} < 1$. The conditions for Configuration (4) to the one with the highest expected profits are the same as before.

6. If $\beta N_L + N_H < K \leq N_H + N_L$, all configurations are admissible. Configuration (9) is dominated by (2) since $\overline{\pi} m_2 > v_L$. The conditions for configuration (4) to be the one with the highest expected profit are the same as before.

The following Proposition describes the condition under which configuration 4, the one that exhibits naiveté-based discrimination, is the optimal one.

Proposition D.1 *If $K < N_H$, Configuration (4) is never the optimal configuration. If $K > N_H$, configuration (4) is optimal if $K > N_H(1-\beta) + N_H \frac{\overline{\pi}}{v_L}(v_H - m_4(1-\beta))$ and $\overline{\pi}\left[m_4(1-\beta) - m_2\right] + v_L\beta > 0$.*

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