Discriminacion de Precios en Aerolineas usando Contratos de Reembolso

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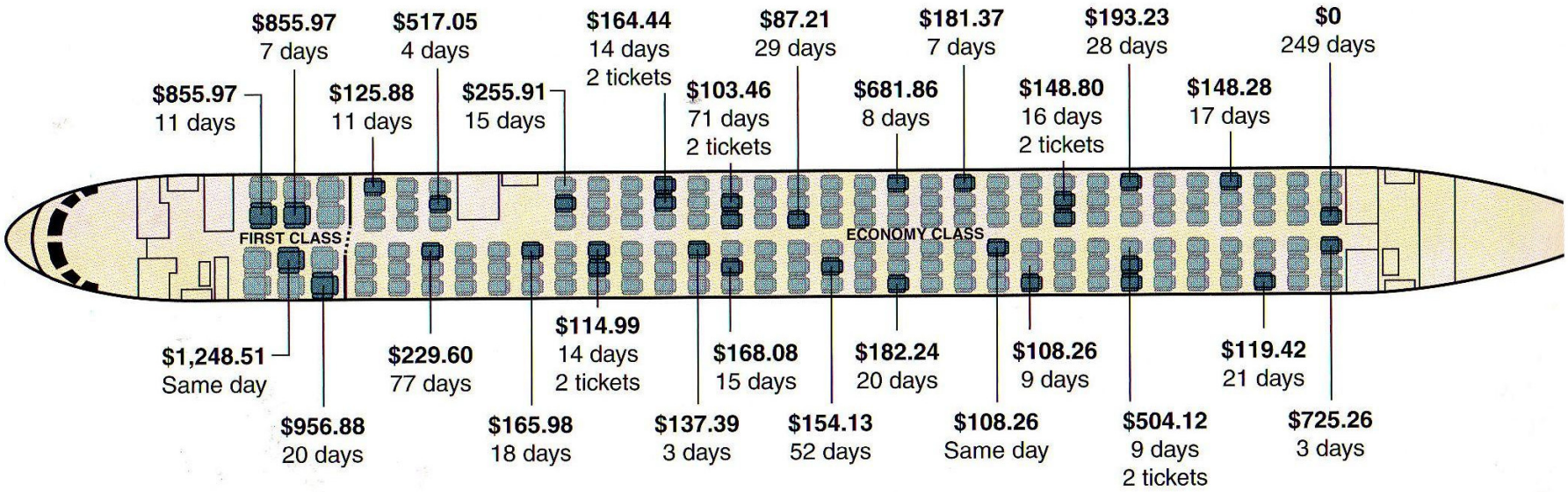
Outline

Motivacion: Dispersion de precios en aerolineas

Figure: Dispersion de precios en aerolineas



33 pasajeros pagaron 27 precios diferentes *(New York Times)*

- Borenstein and Rose (JPE, 1994): diferencia del 36%.
- Las aerolineas tienen uno de los sistemas de precios mas sofisticados del mundo.

Motivacion: Precios dinamicos en aerolineas (dynamic pricing)

- Caracteristicas clave:
  - Capacidad es fija y solo puede ser aumentada a un costo marginal alto.
  - Una vez que el vuelo parte, ya no se pueden vender tickets.
  - Hay incertidumbre en la demanda agregada.
- Las empresas utilizan 'restricciones/caracteristicas' como:
  - Estadia del sabado en la noche.
  - Estadia maxima y minima.
  - Tickets reembolsables.
  - Millas de viajeros frecuentes.
  - Blackouts.
  - Descuentos de volumen.
  - Cabinas (e.g. economica, primera clase)

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+ Identify the different components of price dispersion.
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- Implement seat inventory control to deal with costly capacity and demand uncertainty [Escobari and Gan (NBER)]
  First paper to provide an empirical test of the PED models: $P = MC/Prob$.
- Implement peak-load pricing.
  - *Systematic* peak-load pricing [Escobari (2009, EL)]
  First empirical paper that empirically shows the existance of peak load pricing in airlines. Measures a congestion premia and provides empirical support to Gale and Holmes (AER, 1993).
  - *Stochastic* peak-load pricing [Escobari (2008)]
  First paper to provide formal evidence of stochastic peak load pricing and to show that airlines learn about the aggregate demand, respond to early sales and reduce the cost of demand uncertainty.
- Implement price discrimination. [Escobari and Jindapon *(Today)*]
  Theory/empirical paper that shows why carriers offer refundable/nonrefundable tickets and also showns how consumers learn about their individual demand uncertainty.

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Contribucion e Intuicion del Presente Trabajo

- Considera un modelo donde los consumidores pueden ser adversos al riesgo [Courty and Li (REStud, 2000), Akan *et at.* (2008) neutros al riesgo].
- Explica como se puede ofrecer tickets reembolsables/no-rembolsables por adelantado para separar a los compradores.
- La diferencia en precios = valor de reembolso + discriminacion en precios.
- Primer trabajo que controla costos observados y no observados.
- Primer trabajo empirico que explica la diferencia en pricios y la dinamica de esta diferencia.
- Muestra como la estrategia de precios implica que los consumidores aprenden sobre su demanda.

La Disposicion a Pagar ex-ante

Periodo 1:

- Cada consumidor decide si compra o no.

Periodo 2:

- Los consumidores aprenden su demanda.
- Functiones de utilidad estado-dependientes:
- Estado a:
  Demanda $= 1$, funcion de utilidad $u_a(w)$.
- Estado b
  Demanda $= 0$, funcion de utilidad $u_b(w)$.

La Disposicion a Pagar (WTP) ex-ante

En el estado a:

- Con probabilidad π.
- Demanda $= 1$: quiere volar.
- El bien esta disponible: $u_a(w)$.
- El bien no esta disponible: $u_a^0(w)$.
- Excedente (S): $u_a(w - S) = u_a^0(w)$
- Variacion compensadora (compensating variation): Dado el estado a, la disposicion a pagar es S.

En el estado b:

- Con probabilidad $1 - \pi$.
- Demanda $= 0$: no quiere volar.
- $u_b(w) = u_b^0(w)$.
- Dado el estado b, la disposicion a pagar es 0.

Precio de opcion (option price): Disposicion a pagar ex-ante θ.

Compradores Homogeneos

- La firma ofrece dos tipos de tickets: reembolsable y no-reembolsable a precios R y D.
- La utilidad esperada de comprar un reembolsable es:

$$U_r(R) = \pi u_a(w - R) + (1 - \pi)u_b(w)$$

  - Su maxima disposicion a pagar por un ticket reembolsable es S.
  - Su utilidad esperada seria $U_r(S)$.

- La utilidad esperada de comprar un ticket no-reembolsable es:

$$U_d(D) = \pi u_a(w - D) + (1 - \pi)u_b(w - D)$$

  - Su maxima disposicion a pagar por un ticket no-reembolsable es θ.
  - θ es obtenido de $U_d(\theta) = U_r(S)$.

Compradores Homogeneos

- Con funciones de utilidad lineales, i.e., $u_a(w) = aw + c$ y $u_b(w) = bw + d$ con $a, b > 0$ encontramos que:

$$\theta = mS$$

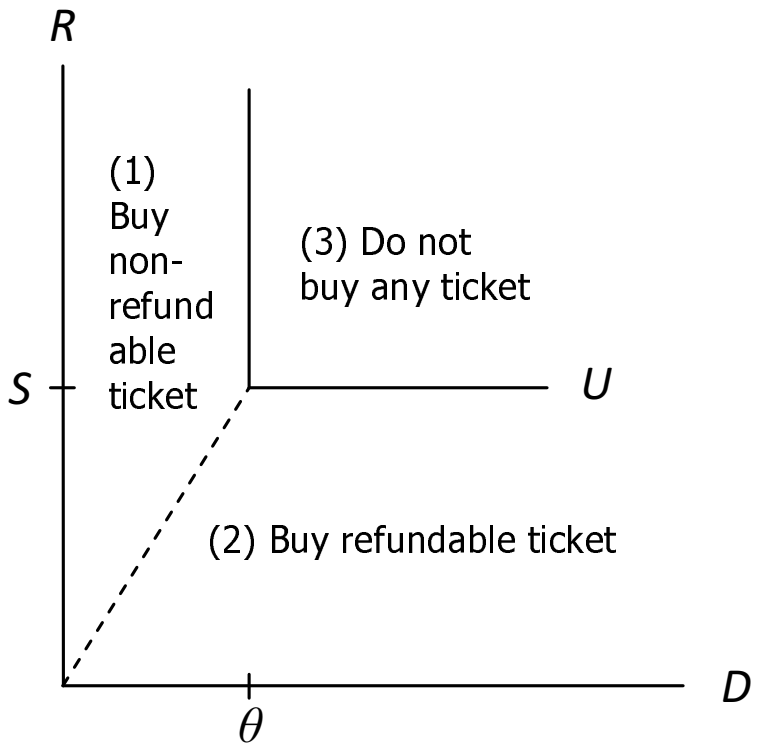
- Donde:

$$m = \frac{\pi a}{\pi a + (1 - \pi)b}$$

- $m \in [0, 1]$: factor de descuento no-reembolsable.
- $1 - m$: la proporcion de S dedicada al valor de reembolso.

Compradores Homogeneos

Figure: Tipo de ticket a comprar en el espacio (D,R)



$$U \equiv max\{U_d(D), U_r(S)\}$$

Compradores Homogeneos

Ejemplo 1

- $u_a(w) = 2w$ y $u_b(w) = w$.
- $w = 2000$, $S = 800$, y $\pi = 0.5$.
- Su precio de reserva por un ticket reembolsable $= 800$.
- $m = 2/3$
- Su disponibilidad a pagar por un ticket no-reembolsable $= 533.33$.
- Valor del reembolso 266.67.

Implicaciones:

- La disponibilidad a pagar por un ticket no-reembolsable (533.33) es mas alta que el excedente esperado (400).
- Para la firma, el beneficio esperado es mas alto cuando ofrece tickets no-reembolsables por adelantado.
- Explica ventas por adelantado.
- Explica venta de tickets no-reembolsables.

Compradores Heterogeneos

- Existen dos tipos de compradores:
  - Tipo alto, h.
  - Tipo bajo, l.
- Para el tipo $i = h, l$,
- Si compran reembolsable:

$$U_{ir}(R) = \pi u_{ia}(w_i - R) + (1 - \pi)u_{ib}(w_i)$$

- Si compran no-reembolsable:

$$U_{id}(D) = \pi u_{ia}(w_i - D) + (1 - \pi)u_{ib}(w_i - D)$$

Compradores Heterogeneos

- Con funciones de utilidad lineales, i.e., $u_{ia}(w_i) = a_i w_i + c_i$ y $u_{ib}(w_i) = b_i w_i + d_i$ con $a_i, b_i > 0$ encontramos que:

$$\theta_i = m_i S_i$$

- Donde:

$$m_i = \frac{\pi_i a_i}{\pi_i a_i + (1 - \pi_i) b_i}$$

- La disponibilidad a pagar del tipo i es S_i con $S_h > S_l$.
- En el periodo 1 existen N_h y N_l consumidores tipo h y tipo l, respectivamente.
- En el periodo 2: $n_h = \pi N_h$, and $n_l = \pi N_l$.

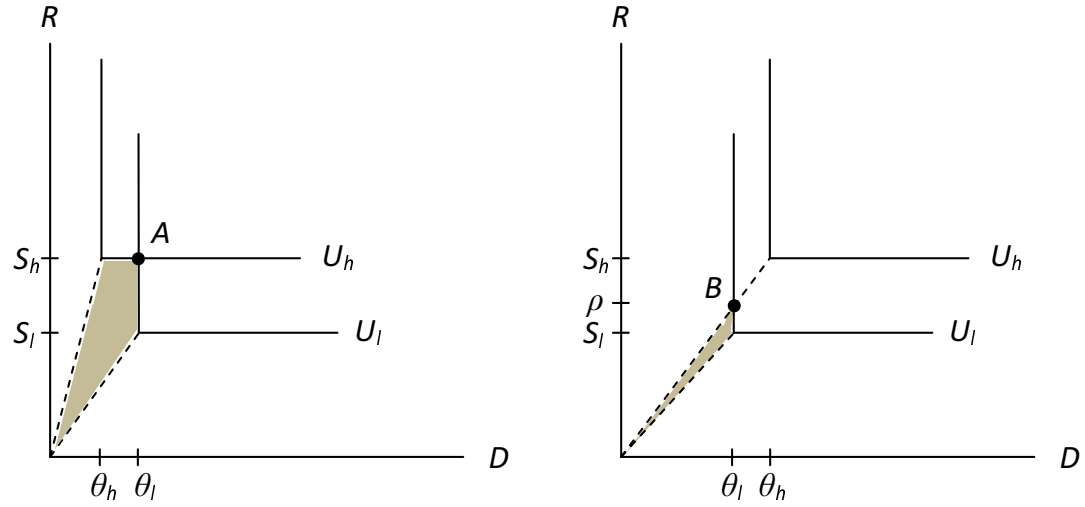
Discriminacion de Precios

El problema de la firma es:

$$\begin{aligned} \max_{D,R} \quad & N_l D + n_h R \\ & \text{s.t.} \\ & U_{hr}(R) \geq U_{hd}(D), \\ & U_{ld}(D) \geq U_{lr}(R), \\ & U_{hr}(R) \geq U_{hr}(S_h), \\ & U_{ld}(D) \geq U_{ld}(\theta_l). \end{aligned}$$

- Primeras dos son las restricciones de compatibilidad de incentivos.
- Ultimas dos son las restricciones de participacion.

Figure: Soluciones del problema de optimizacion en el espacio (D,R)



Discriminacion de Precios

- (c) y (d): La firma no puede separar a los consumidores.
- (a): Trivial; (b): De interes.

Ejemplo 2

- $\pi_h = \pi_l = \pi$

Compradores tipo h:

- $u_{ha}(w) = w$, $u_{hb}(w) = 2w$, $S_h = 800$.

Compradores tipo l:

- $u_{la}(w) = 2w$, $u_{lb}(w) = w$, $S_l = 500$.

Contrato Optimo:

- $\pi = 0.5$, $(D, R) = (333.33, 800)$; $\pi = 0.8$, $(D, R) = (444.44, 666.67)$; $\pi = 1$, $(D, R) = (500, 500)$
- Conforme π se acerca a uno, la diferencia de precios desaparece.
- $R - S_l$: Valor de reembolso.
- $S_l - D$: Discriminacion.

Implicancias Empiricas

Ejemplo 3

- $\pi_l \geq \pi_h$; $u_{ha}(w) = u_{la}(w) = 2w, u_{hb}(w) = u_{lb}(w) = w$.

Compradores tipo h:

- $S_h = 800$.

Compradores tipo l:

- $S_l = 500$.

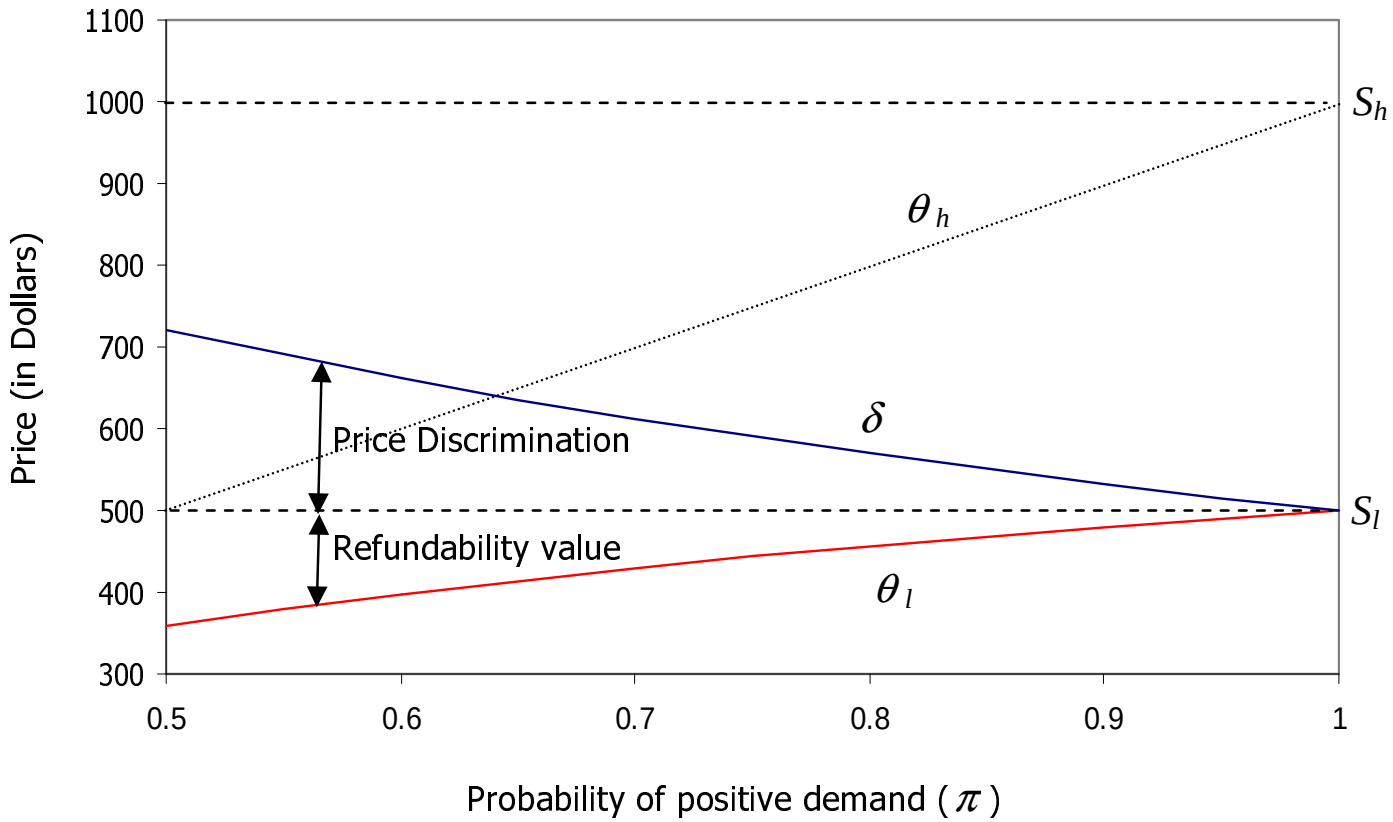
Contrato Optimo:

- Los dos precios convergen a S_l cuando π_h converge a 1.

Proposicion. Si $\theta_h > \theta_l$, entonces la firma fija $(D, R) = (\theta_l, \rho)$, donde $\rho \in [S_l, S_h)$. Dadas las sequencias crecientes $\{\pi_l^k\}$ y $\{\pi_h^k\}$ con $\pi_l^k \geq \pi_h^k$ para todo k. Conforme $\{\pi_l^k\}$ y $\{\pi_h^k\}$ convergen a 1, las sequancias correspondientes $\{D^k\}$ y $\{R^k\}$ convergen a S_l.

Multiple Periods

Figure: Optimal refundable and non-refundable prices



Empirical Implications

- Firms will offer two types of tickets in advance.
- On any day t, the difference between $R(t)$ and $D(t)$ includes:
  - Quality difference: $S_l - \theta_l(t)$.
  - Price discrimination: $\delta(t) - S_l$.
- As travelers learn about their demand, the difference in fares will converge to 0.
- The speed of convergence should tell us when travelers learn about their demand.

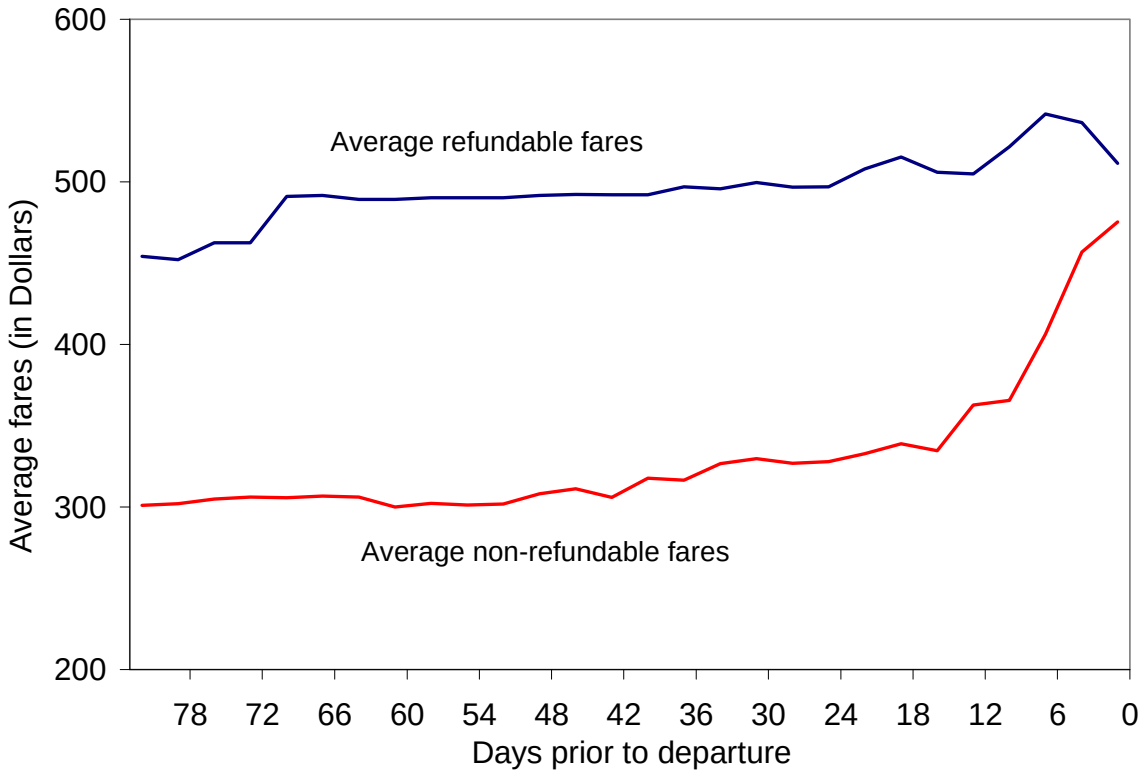
Construction of the Data

- Refundable and non-refundable fares from expedia.com
- Pick a single day: Thursday, June 22, 2006.
  - Controls for systematic peak load pricing.
- One-way, non-stop, economy-class.
  - Connecting passengers / sophisticated itineraries / legs.
  - Uncertainty in the return portion of the ticket.
  - Saturday-night-stayover / min- and max-stay.
  - Fare classes.
- Monopoly routes.
- A panel with 96 cross section observations (city pairs).
- Collected every 3 days with 28 observations in time.
- American, Alaska, Continental, Delta, United, and US Airways.

Expedia

Data

Figure: Average refundable and non-refundable fares



Controlling for Costs

Costs change at the seat level:

- Borenstein and Rose (JPE, 1994)
  - Systematic peak-load pricing.
  - Stochastic peak-load pricing.
- Dana (RAND, 1999)
  - Operational marginal cost.
  - Effective costs of capacity.

Both fares are posted for the same seat.

Dynamic Panel Model

$$\begin{aligned}\ln(REF)_{ijt} - \ln(NONREF)_{ijt} = & \\ \alpha[\ln(REF)_{ij,t-1} - \ln(NONREF)_{ij,t-1}] & \\ +\beta_1 DAYADV_{ijt} + \beta_2 \Delta LOAD_{ijt} & \\ +\nu_{ij} + \varepsilon_{ijt} &\end{aligned}$$

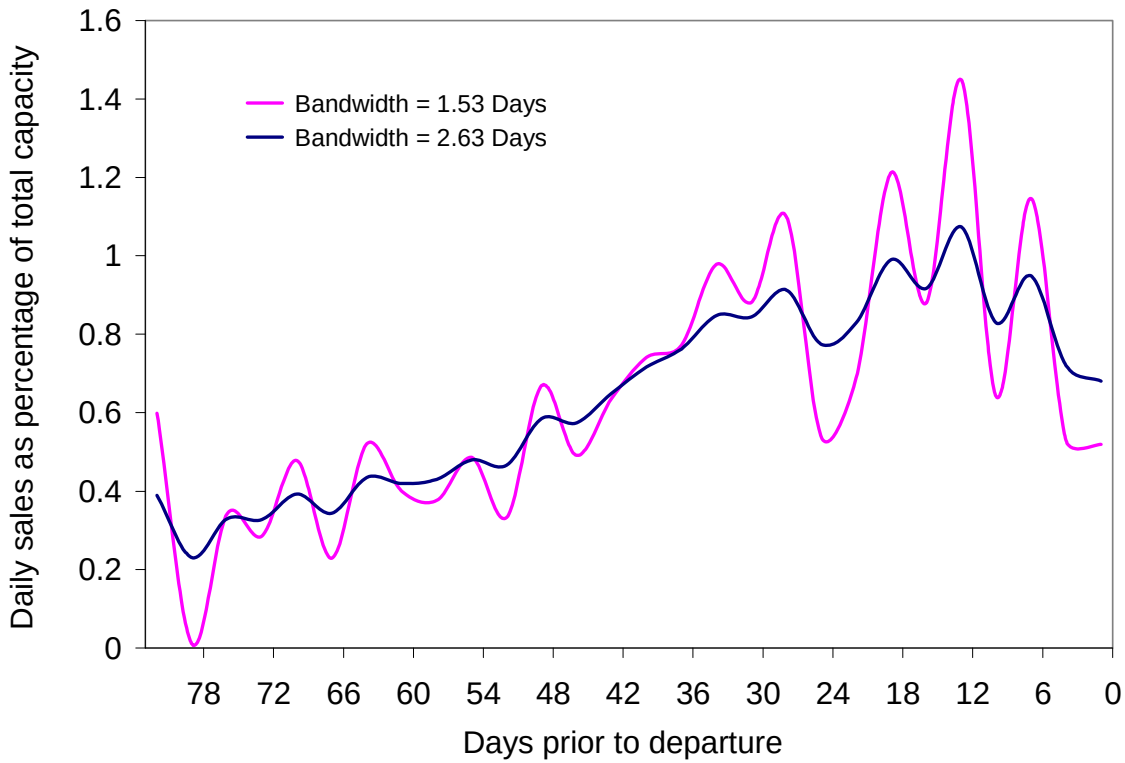
Controls for:

- Time-invariant flight-, route-, and carrier-specific characteristics.
- Time-variant seat-specific characteristics.

Estimated using GMM dynamic panels to assume only weak exogeneity of $\Delta LOAD$.

Estimated Daily Sales

Figure: Nonparametric regression of daily sales on days to departure



Summary Statistics

Table: Summary statistics

Variables	Mean	Std. Dev.	Min.	Max.	Obs.
REF					
overall	494.486	169.181	144.000	1715.310	2628
between		156.974	144.000	735.497	96
within		64.167	141.262	1474.299	27.375[a]
NONREF					
overall	327.749	171.588	64.000	914.000	2628
between		156.654	74.107	665.786	96
within		70.204	164.642	852.249	27.375[a]
DAYADV	41.500	24.238	1.000	82.000	2688
LOAD	0.591	0.241	0.038	1.000	2688

Notes: [a] Number of observations in time $= \bar{T}$, with one observation every three days.

Regression Estimates

Table: Regression estimates (prices in logs)

	OLS levels	Within groups	GMM *difference* $t-2$	GMM *difference* $t-3$	GMM *system* $t-2$	GMM *system* $t-3$
$\ln(REF)_{ij,t-1} - \ln(NONREF)_{ij,t-1}$	0.944	0.697	0.879	0.868	0.788	0.790
	(120.459)	(19.049)	(8.904)	(9.357)	(10.663)	(11.193)
$DAYADV_{ijt}/10^3$	1.086	1.664	0.998	1.040	1.629	1.571
	(0.536)	(11.326)	(2.541)	(2.873)	(4.971)	(4.979)
$\Delta LOAD_{ijt}$	−0.001	0.180	0.232	0.138	−0.160	−0.112
	(−0.006)	(2.016)	(0.713)	(0.567)	(−0.545)	(−0.484)
Serial correlation test[a] (p-value)			0.032	0.037	0.035	0.035
Sargan test[b] (p-value)			0.133	0.178	0.691	0.988
Difference Sargan test[c] (p-value)				0.463		1.000

Notes: The dependent variable is $[\ln(REF)_{ijt} - \ln(NONREF)_{ijt}]$ and the number of observations is 2519. t-statistics in parentheses based on White heteroskedasticity robust standard errors for the first and second columns. t-statistics in parentheses based on Windmeijer WC-robust estimator for the GMM specifications. [a] The null hypothesis is that the errors in the first-difference regression exhibit no second-order serial correlation (valid specification). [b] The null hypothesis is that the instruments are not correlated with the residuals (valid specification). [c] The null hypothesis is that the additional instruments $t-3$ are not correlated with the residuals (valid specification).

Regression Estimates

Table: Regression estimates (prices in levels)

	OLS levels	Within groups	GMM *difference* $t-2$	GMM *difference* $t-3$	GMM *system* $t-2$	GMM *system* $t-3$
$REF_{ij,t-1} - NONREF_{ij,t-1}$	0.940	0.648	0.906	0.908	0.757	0.760
	(92.828)	(10.131)	(3.658)	(3.817)	(7.106)	(7.128)
$DAYADV_{ijt}$	0.387	0.488	0.290	0.311	0.479	0.456
	(5.459)	(9.361)	(1.585)	(1.695)	(5.054)	(4.881)
$\Delta LOAD_{ijt}$	17.537	67.696	195.139	124.231	7.859	11.439
	(0.581)	(2.467)	(1.840)	(1.194)	(0.086)	(0.152)
Serial correlation test[a] (p-value)			0.410	0.411	0.410	0.410
Sargan test[b] (p-value)			0.084	0.155	0.691	0.988
Difference Sargan test[c] (p-value)				0.566		1.000

Notes: The dependent variable is $[REF_{ijt} - NONREF_{ijt}]$. See notes on Table 2.

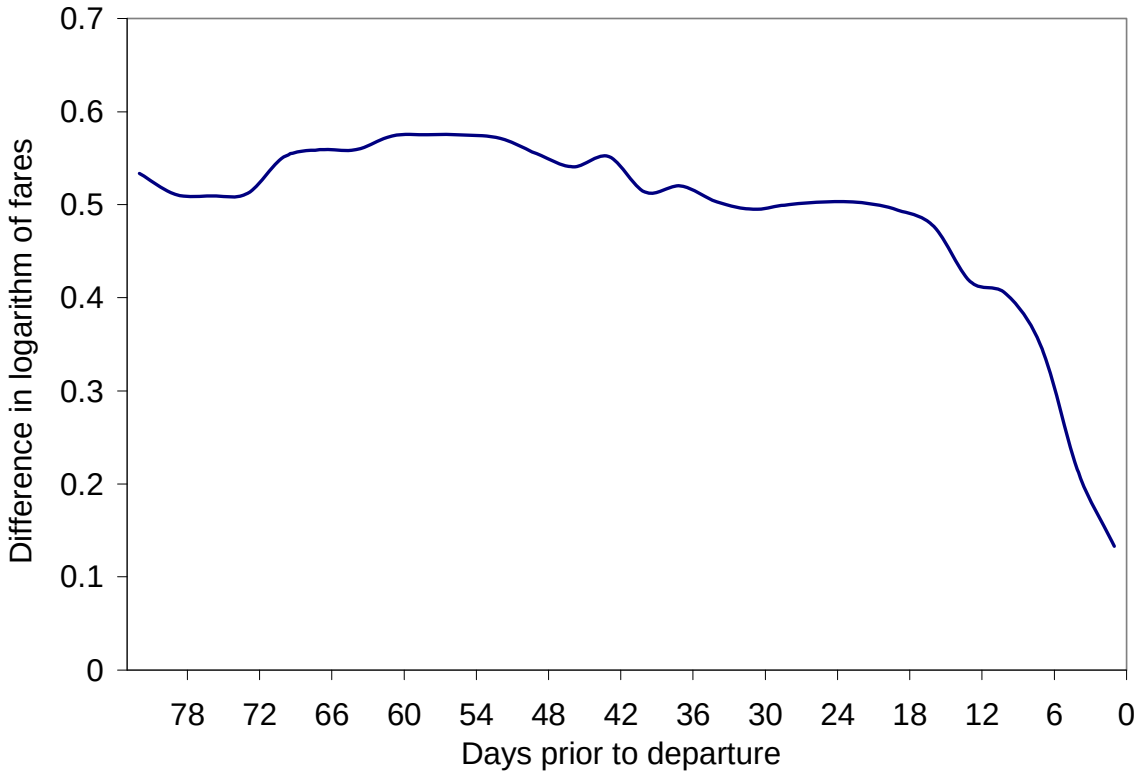
Nonparametric Panel Regression

$$\ln(REF)_{ijt} - \ln(NONREF)_{ijt} = g(DAYADV_{ijt}, \Delta LOAD_{ijt}) + \nu_{ij} + \varepsilon_{ijt}$$

- $g(\cdot)$: Unknown smooth function.
- Flight-specific effects are outside to avoid the curse of dimensionality.
- Estimated using kernel methods for mixed data types [Racine and Li (J. Econometrics, 2004) and Li and Racine (2007)].

Nonparametric Estimation

Figure: Average refundable and non-refundable fares



- Bandwidth obtained by least squares cross-validation.

Conclusions

- Importance of offering a menu of prices.
- A seller can price discriminate when buyers with heterogeneous willingness to pay are uncertain about their demand for travel.
- Buyers can use refund contracts to insure againts uncertainty in consumption.
- The gap between fares is a function of individual's demand uncertainty.
- Nonparametric regression shows that most of the individual demand uncertainty is resolved during the last two weeks.
- The opportunity to price discriminate decreases closer to departure.

Work in progress

+ Work in progress.

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  - On the Efficiency of Thin and Thick Markets in Airlines [with Vivek Pai]

    Estimates a matching function and finds that capacity utilization rates are higher in thicker markets.
  - Flight Departure Time Differentiation and Spatial Competition [with Sang-Yeob Lee]

    Uses a Spatial Autoregresive models to analyze dynamic competition and demand shifting across own and competitors' flights. Estimates price reaction functions.

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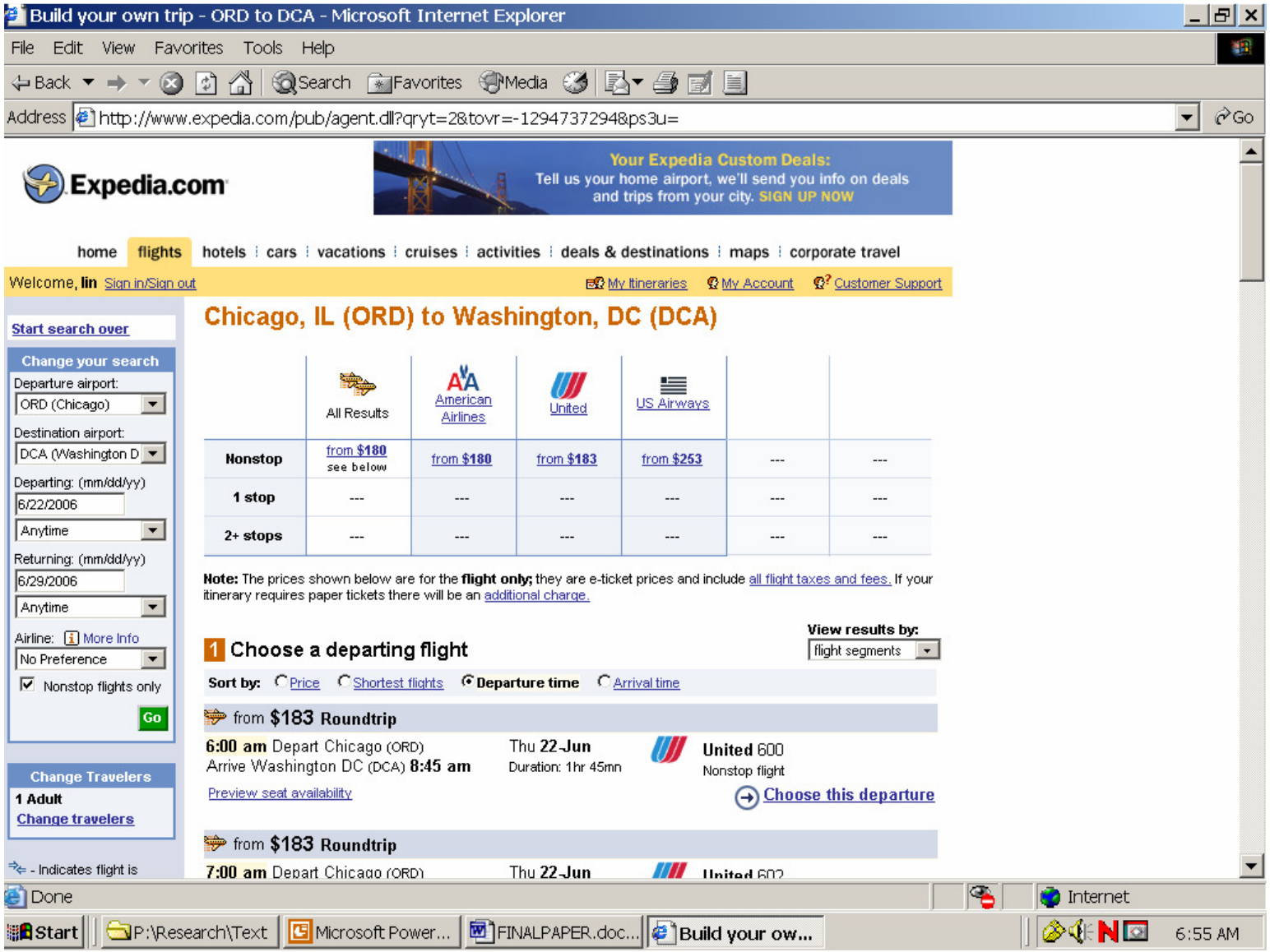
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Start search over
Change your search
Departure airport:
ORD (Chicago)
Destination airport:
DCA (Washington D
Departing: (mm/dd/yy)
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Anytime
Returning: (mm/dd/yy)
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Nonstop flights only
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1 Adult
Change travelers
- Indicates flight is
Chicago, IL (ORD) to Washington, DC (DCA)
All Results
American Airlines
United
US Airways
Nonstop
from $180
see below
from $180
from $183
from $253
1 stop
2+ stops
Note: The prices shown below are for the flight only; they are e-ticket prices and include all flight taxes and fees. If your itinerary requires paper tickets there will be an additional charge.
View results by:
flight segments
1 Choose a departing flight
Sort by: Price Shortest flights Departure time Arrival time
from $183 Roundtrip
6:00 am Depart Chicago (ORD)
Arrive Washington DC (DCA) 8:45 am
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Duration: 1hr 45mn
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Nonstop flight
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7:00 am Depart Chicago (ORD)
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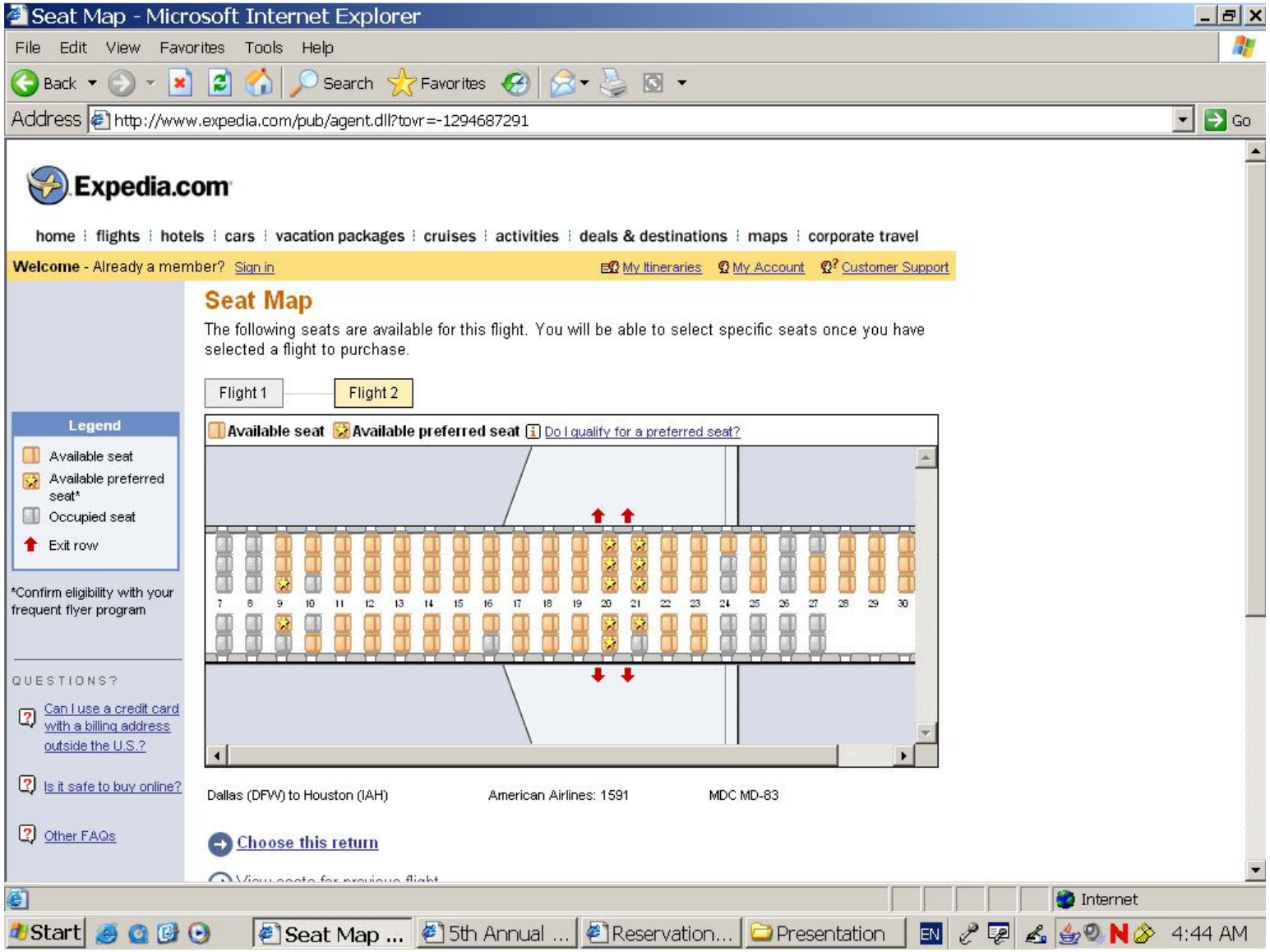
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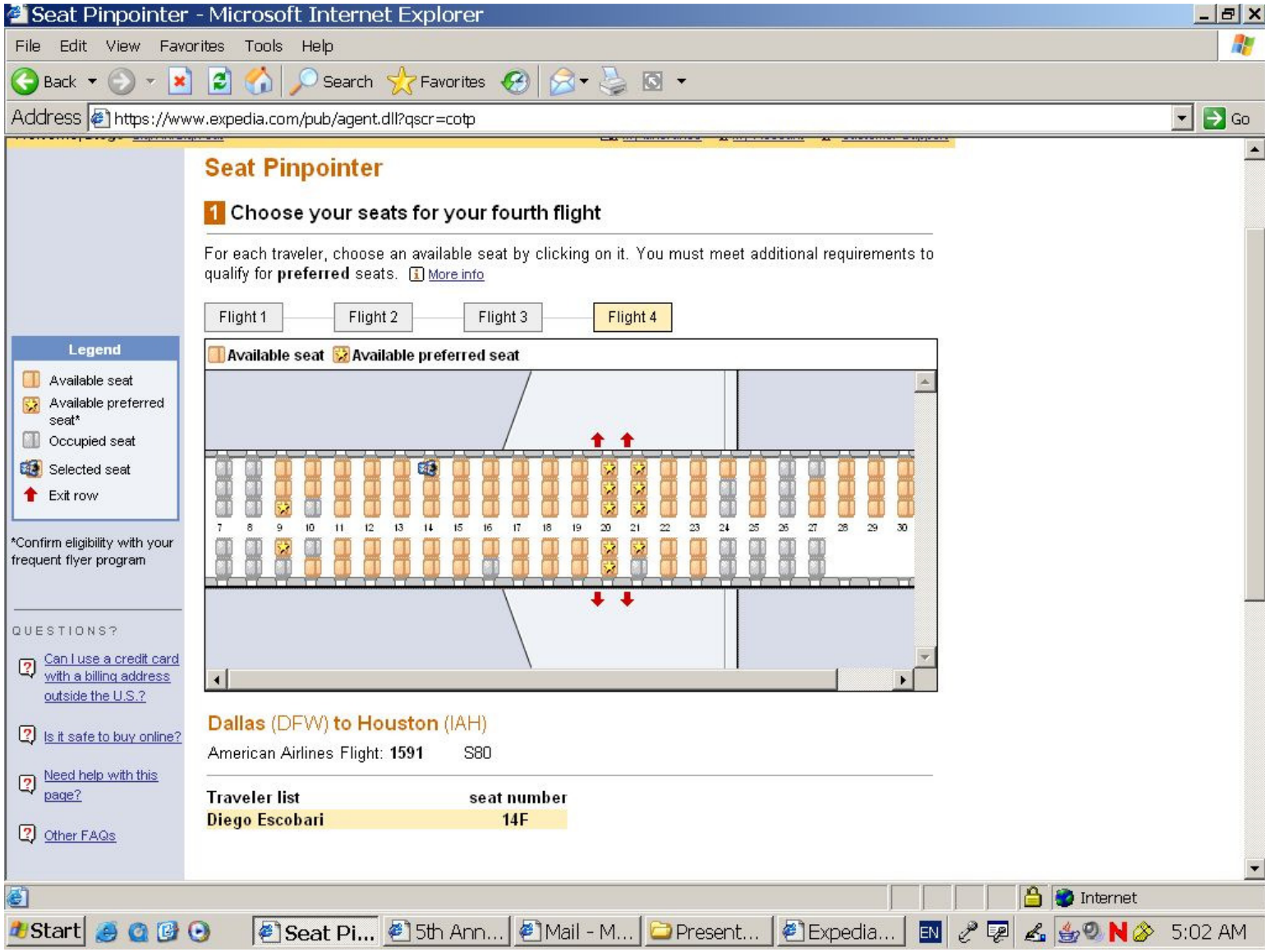
Welcome - Already a member? Sign in
My Itineraries My Account Customer Support
Seat Map
The following seats are available for this flight. You will be able to select specific seats once you have selected a flight to purchase.
Flight 1
Flight 2
Legend
Available seat
Available preferred seat*
Occupied seat
Exit row
*Confirm eligibility with your frequent flyer program
Available seat
Available preferred seat
Do I qualify for a preferred seat?
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
QUESTIONS?
Can I use a credit card with a billing address outside the U.S.?
Is it safe to buy online?
Other FAQs
Dallas (DFW) to Houston (IAH)
American Airlines: 1591
MDC MD-83
Choose this return
Internet
Start
Seat Map ...
5th Annual ...
Reservation...
Presentation
EN
4:44 AM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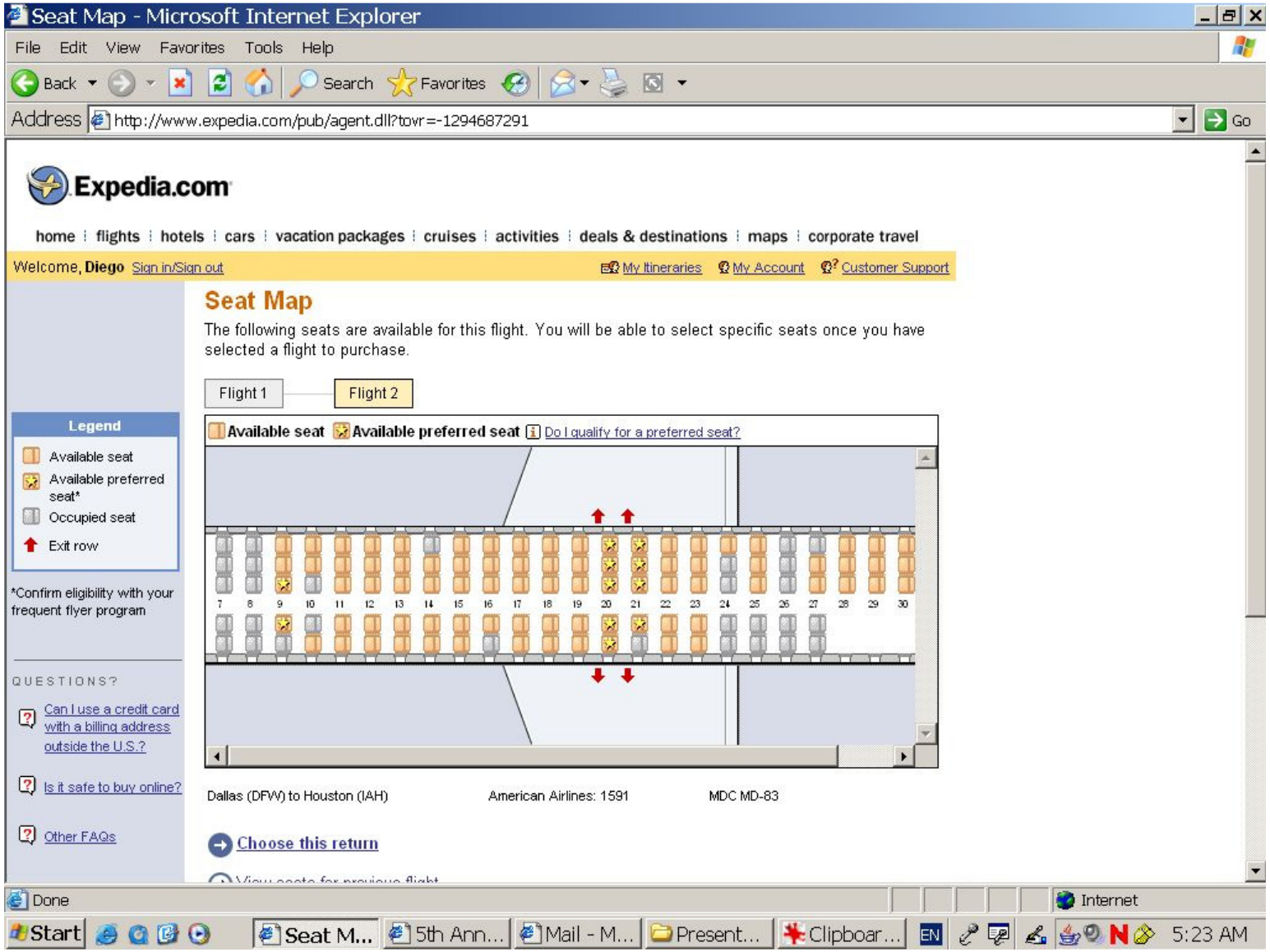
Go
Seat Pinpointer
1 Choose your seats for your fourth flight
For each traveler, choose an available seat by clicking on it. You must meet additional requirements to qualify for preferred seats. More info
Flight 1
Flight 2
Flight 3
Flight 4
Legend
Available seat
Available preferred seat*
Occupied seat
Selected seat
Exit row
Available seat
Available preferred seat
*Confirm eligibility with your frequent flyer program
QUESTIONS?
Can I use a credit card with a billing address outside the U.S.?
Is it safe to buy online?
Need help with this page?
Other FAQs
Dallas (DFW) to Houston (IAH)
American Airlines Flight: 1591 S80
Traveler list
seat number
Diego Escobari
14F
Internet
Start
Seat Pi...
5th Ann...
Mail - M...
Present...
Expedia...
EN
5:02 AM


Seat Map - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://www.expedia.com/pub/agent.dll?tovr=-1294687291
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Expedia.com
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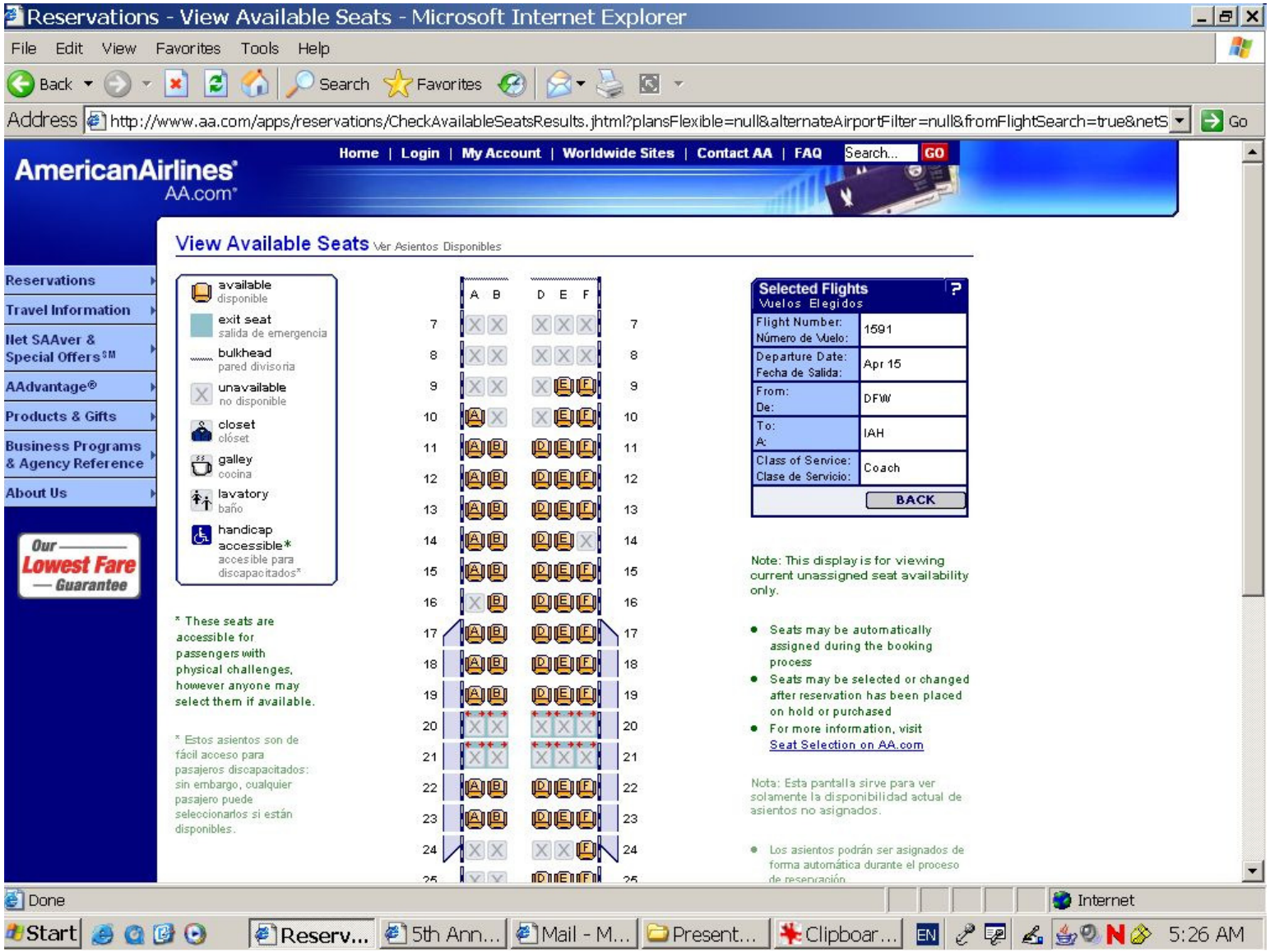
Welcome, Diego Sign in/Sign out
My Itineraries My Account Customer Support
Seat Map
The following seats are available for this flight. You will be able to select specific seats once you have selected a flight to purchase.
Flight 1
Flight 2
Legend
Available seat
Available preferred seat*
Occupied seat
Exit row
*Confirm eligibility with your frequent flyer program
Available seat
Available preferred seat
Do I qualify for a preferred seat?
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
QUESTIONS?
Can I use a credit card with a billing address outside the U.S.?
Is it safe to buy online?
Other FAQs
Dallas (DFW) to Houston (IAH)
American Airlines: 1591
MDC MD-83
Choose this return
Done
Internet
Start
Seat M...
5th Ann...
Mail - M...
Present...
Clipboar...
EN
5:23 AM


Reservations - View Available Seats - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://www.aa.com/apps/reservations/CheckAvailableSeatsResults.jhtml?plansFlexible=null&alternateAirportFilter=null&fromFlightSearch=true&netS
Go
AmericanAirlines
AA.com
Home | Login | My Account | Worldwide Sites | Contact AA | FAQ
Search... GO
View Available Seats Ver Asientos Disponibles
Reservations
Travel Information
Net SAAver & Special Offers SM
AAdvantage®
Products & Gifts
Business Programs & Agency Reference
About Us
Our Lowest Fare Guarantee
available disponible
exit seat salida de emergencia
bulkhead pared divisoria
unavailable no disponible
closet clóset
galley cocina
lavatory baño
handicap accessible* accesible para discapacitados*
* These seats are accessible for passengers with physical challenges, however anyone may select them if available.
* Estos asientos son de fácil acceso para pasajeros discapacitados: sin embargo, cualquier pasajero puede seleccionarlos si están disponibles.
A B D E F
Selected Flights Vuelos Elegidos
Flight Number: Número de Vuelo: 1591
Departure Date: Fecha de Salida: Apr 15
From: De: DFW
To: A: IAH
Class of Service: Clase de Servicio: Coach
BACK
Note: This display is for viewing current unassigned seat availability only.
Seats may be automatically assigned during the booking process
Seats may be selected or changed after reservation has been placed on hold or purchased
For more information, visit Seat Selection on AA.com
Nota: Esta pantalla sirve para ver solamente la disponibilidad actual de asientos no asignados.
Los asientos podrán ser asignados de forma automática durante el proceso de reservación
Done
Internet
Start
Reserv...
5th Ann...
Mail - M...
Present...
Clipboar...
EN
5:26 AM

Data