Changes in the Household-Level Demand for Postal Delivery Services from 1986 to 1994

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Motivation—Over the past decade there has been an dramatic increase in

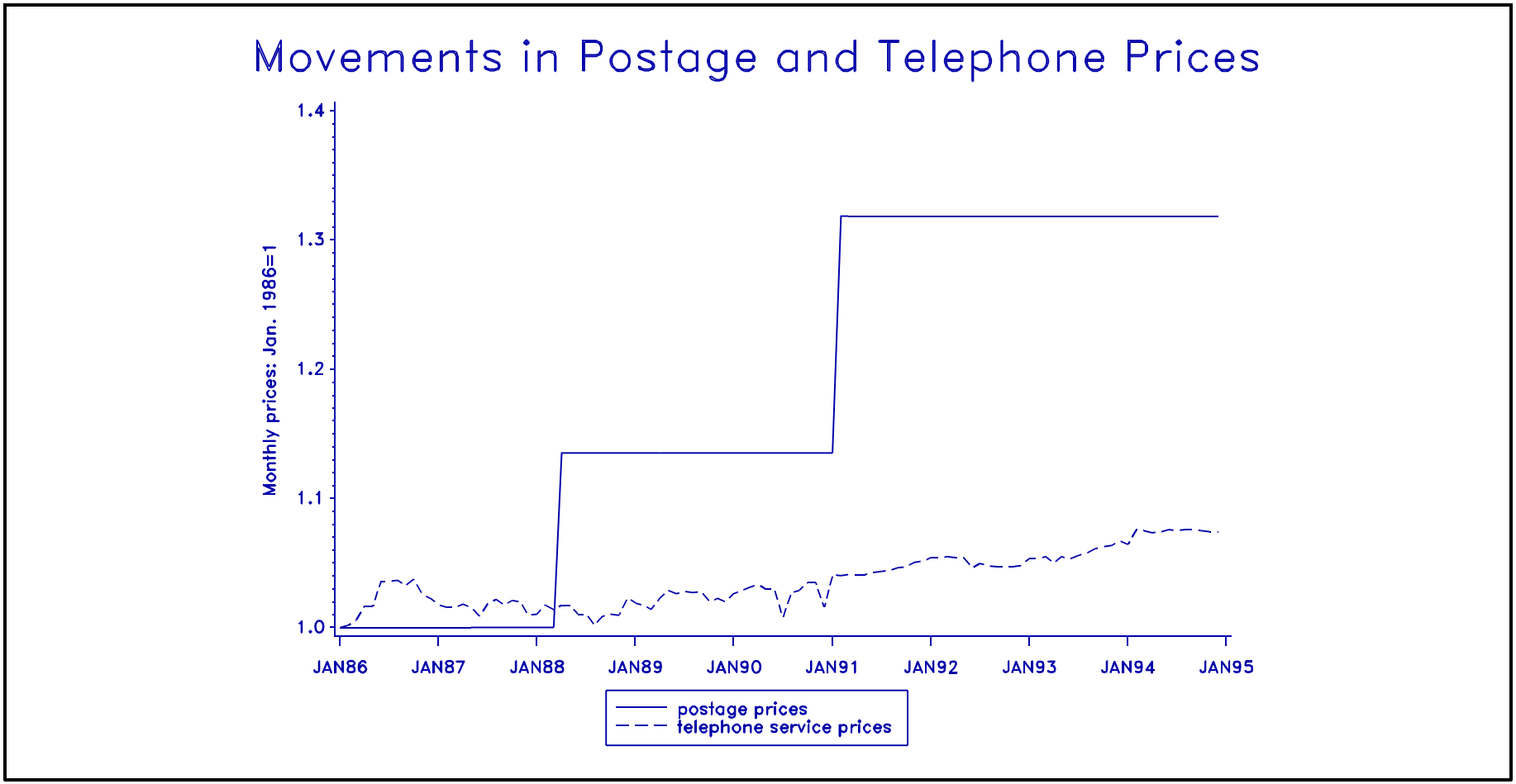
1) Available modes of interpersonal communication and the range in quality of these modes of communication in terms speed, reliability, and flexibility
2) Reductions in the price of these modes of communication—long-distance telephone service, FAX machines, on-line information services CompuServe and America Online (zero price for incremental messages)

Many of these modes of communication are very attractive alternatives to traditional postal delivery services supplied by the United States Postal Service (USPS).

Particularly true for household sector—E-mail, Electronic bill paying, FAX, long-distance call

This relative attractiveness is compounded by the increasing price of postal delivery services over the past decade.

From January 1, 1986 to January 1, 1995 the price of a one-ounce First-Class letter increased from $0.22 to $0.32, more than 45% in nine years.



Total pieces delivered and mail revenues have continued to increase

Annual Pieces Delivered and Mail Revenues (in Billions)				
Year	Pieces Delivered	Annual Growth	Mail Revenue	Annual Growth
1992	166.4	0.4%	$44.7	5.2%
1993	171.2	2.9%	$45.9	2.7%
1994	178.0	4.0%	$47.7	4.0%
1995	180.7	1.5%	$52.5	10.1%
1996	182.7	1.1%	$54.5	3.8%

Percentages by volume in 1996: First-Class--53%, Standard Mail A (Formerly Third Class)--39%, Periodicals--6%, All others--2%.

Standard Mail A—Primarily advertising circulars and mail-order catalogues—comprises an increasing share of pieces delivered

37.5% of pieces delivered 1992 versus 39% of pieces delivered in 1996

From 1993 to 1994, single-piece First-Class volume fell by 0.2 percent, but a 6.8 percent increase in pre-sorted First Class volume resulted in a net 2.4 percent increase in First-Class volume. From 1994 to 1995, single-piece fell by 1.0 percent and from 1995-1996 it fell by 1.5%.

This event appears to signal a leveling-off or decline in household-level use of USPS postal delivery services

Purpose of Talk

Reconcile growth in aggregate pieces delivered and mail revenues with increasing relative price of postal delivery services and growing number of substitutes at household level

- Are household sector trends consistent with aggregate trends?
- Quantify decline in aggregate household sector postage consumption.

Determine the relative extent to which the decline in household sector consumption over time can be attributed to

1) Increasing penetration of alternative modes of communication
2) Increasing relative price of USPS postal delivery services

Specific Questions Addressed

1) What has happened to the average household-level consumption and aggregate (US Population) household consumption of postal delivery services over the past decade?

2) What are own-price, cross-price and expenditure elasticities of the household-level demand for postal delivery services and how have they changed over time?

3) What is the impact of home computing technology on postal demand?

4) What household characteristics predict differences in household-level postal demand?

Aggregate Household Consumption of Postal Delivery Services

Bureau of Labor Statistics (BLS) Consumer Expenditure Survey (CES). A national probability sample of households. Sampling frame generated from the 1980 Census 100-percent detail file.

Two surveys administered to different samples of households: (1) Quarterly Interview Survey and (2) Diary Survey

Diary Survey—Each selected household is requested to keep two one-week diaries of all expenditures over consecutive weeks. Source for household-level postage expenditures and other non-durable goods expenditures.

Interview Survey—Household is interviewed every three months over a 15-month period. Questions about durables holdings--cars, housing, and personal computers.

Both surveys collect information on household characteristics—hours of work of the head and spouse, occupation of head and spouse, age and race of head and spouse, marital status, number of children, dwelling type, income, and census region of residence.

For each household in Diary Survey from 1986 to 1994, BLS computes a sampling weight giving the representativeness of that household in the population of US households during the year it is sampled

1) How many US households represented by a household with these demographic characteristics

Using these weights and BLS-recommended procedure, can compute estimate of US population aggregate expenditures on postal delivery services or aggregate expenditures any other category of goods

Estimated Annual Household Expenditures and USPS Mail Revenue						
Year	Aggregate Household Postage Exp. ($ Billion)	Household-Level Postage Exp. ($)	Aggregate Household Telephone Exp. ($ Billion)	Household-Level Telephone Exp. ($)	Total USPS Mail Revenues ($ Billion)	Percent of USPS Mail Revenues from Households
1986	5.07	58.19	36.70	421.67	29.12	17.39
1987	5.83	66.89	41.32	474.22	30.50	19.11
1988	5.85	65.87	42.64	480.38	33.92	17.23
1989	6.69	74.26	45.63	506.51	36.67	18.24
1990	6.38	69.88	50.11	549.16	37.89	16.83
1991	5.80	62.71	52.16	563.45	41.92	13.85
1992	6.06	64.20	59.79	633.04	44.72	13.56
1993	5.90	62.75	60.82	647.07	45.91	12.85
1994	5.05	54.35	64.19	690.65	47.74	10.58
1995	5.90*	60.10*	68.12*	701.03*	52.25	11.29*

*Preliminary figures.

Nominal declines aggregate household postage expenditures. In constant

dollars, decline would be steeper due to real postage price increases

Decline from $74.26 per household in 1989 to $54.35 in 1994

Almost double nominal increase in aggregate household telephones services expenditures from 1986 to 1994.

Increase from $421.67 per household in 1986 to $690.65 in 1994

Shift away from consumption of postal delivery services to telephone services for household sector

From 1987 to 1994 share of USPS mail revenues from US household fell

From a little less than 20 percent to a little more than 10 percent

Significant shift way from consumption of postal delivery services for household sector relative US economy at large

Second research question: What are the sources of these shifts in the consumption of postal delivery services?

Digression on Economic Model of Household Behavior

Each household is assumed to have a demand function for each good which depends on the prices of all goods, the household's budgeted total expenditure and observable and unobservable characteristics of the household

Let $p_1,p_2,...,p_K$ be the prices for goods household purchases, M be the household's budgeted total expenditure and $A_1,A_2,...,A_N$ are the attributes (observable and unobservable characteristics) of the household.

Define the household's demand function for the ith (i=1,...,K) good

$$x_i^* = D_i(p_1,p_2,...,p_K,M,A_1,A_2,...,A_N)$$

the amount each good, x_i, the household consumes. There are K goods and N characteristics.

One household characteristic we focus on is an indicator variable of whether or not the household owns a personal computer. This is our measure of the potential for electronic substitution.

This will allow us to determine extent to which decline is household-level demand is due to

1) Increasing relative price of postage
2) Increasing penetration of personal computing technology

Annual Sample Percentages of Personal Computer Ownership for Interview Survey Sample	
Year	Percent Owning Personal Computer
1988	7.0
1989	14.5
1990	16.2
1991	17.4
1992	19.1
1993	22.3
1994	24.9

Using econometric modeling techniques applied to our sample of households, we are able recover an estimate of the demand function

$$x_i^* = D_i(p_1,p_2,...,p_K,M,A_1,A_2,...,A_N)$$

for each household in the sample.

Demand functions differ across household depending on observable and unobservable characteristics of the household

Using our econometric model, we can compute an estimate of any US household's demand for postal delivery services given its M and $A_1,A_2,...,A_N$

Quantifying Demand Responses at Household-Level

Price Elasticity of Demand = One percent increase in the price of the ith good, p_i, brings about what percentage change in the household's demand for good j, D_j

If i = j, then it is the own-price elasticity of demand, otherwise magnitude is called the cross-price elasticity of demand.

Elasticity concept can be extended to any other variable in household's demand function

Expenditure elasticity of Demand = One percent increase in the household's total expenditure, M, brings about what percentage change in household-level demand for good j, D_j

For each US household can compute an estimate of its own-price and cross-price elasticities of demand and the expenditure elasticity of demand.

One of observable attributes that is assumed to shift the household's demand for postage is whether or not is owns a personal computer.

Model yields an estimate of the percentage change in a household's demand for postage as a result of owning a computer

Aggregate Demand Function for the Household Sector

Using BLS weights, can compute an estimate of the aggregate US population demand function for postage from the household sector as the weighted sum of sample household level-demand functions

Can compute own-price and cross-price elasticities of aggregate household demand for postage using this aggregate demand function.

Estimated Aggregate U.S. Household Postage Demand Elasticity Estimates

Year	Postage Price	Telephone Price	Total Expenditure	Computer Ownership
1986	-0.76	-0.12	0.36	0.12
1987	-0.82	-0.09	0.35	0.10
1988	-0.89	-0.06	0.33	0.07
1989	-0.95	-0.04	0.32	0.06
1990	-1.01	-0.01	0.31	0.03
1991	-1.08	0.02	0.29	0.01
1992	-1.14	0.05	0.28	-0.01
1993	-1.20	0.08	0.27	-0.10
1994	-1.27	0.11	0.25	-0.16

These magnitudes give the percent change in the demand from the household sector as result of a one percent change in any price, household's total expenditure or fraction of US households owning a personal computer.

Substantial increase in absolute value of own-price elasticity of aggregate household demand from 1986 to 1994, from -0.76 to -1.27.

Decline in total expenditure (income) elasticity of demand from 0.36 to 0.25 over same period.

Increasing degree of substitutability between postal delivery services and telephone services over past decade, from -0.12 in 1986 (complements) to 0.11 (substitutes) in 1994

Increased penetration of personal computing technology at household-level initially predicts increased demand for postal delivery services.

By 1994, predicts reduction in demand for postal delivery services, holding all other factors constant.

Estimated Aggregate Revenue Losses Based on 1994 Elasticity Estimates

In general, an X% own-price increase in a product with an own-price elasticity of ϵ increases revenues by $X(1 + \epsilon)\%$.

If ϵ is less than one in absolute value revenues increase. If it is greater than one revenues fall. In 1994, $\epsilon = -1.27$.

Note that before 1989, ϵ is less than one in absolute value, so that aggregate household revenues increase with price increases.

Consider January 1, 1995 price increase for a one ounce First-Class letter from $0.29 to 0.32, a little more than a 10% increase.

From estimated annual household postage expenditures in 1994 are approximately $5 billion, which implies a 2.7 percent reduction in annual aggregate expenditures or approximately a $135 million reduction in annual revenues from household sales, holding all else constant.

Impact of on household-level demand a 17 percent increase in penetration of computer ownership for all households.

In 1994, fraction of households owning a personal computer is 0.25.

A 17 percent increase in this number is 1.17(0.25) = 0.29, a plausible increase in the penetration of computer ownership by households over the course of a single year.

From estimate in above table US aggregate elasticity of demand with respect to computer ownership is -0.16. Therefore, 17% increase in purchase probability brings about a 0.16(17) = 2.7 percent reduction in aggregate demand.

Assuming no postal price change, this implies a 2.7 percent reduction in revenues from sales to household, or $135 million reduction in revenues, same as a 10 percent price increase.

Caveats

There is uncertainty associated with all of the numbers presented in this paper due to sampling error and estimation error in econometric estimation procedure used to recover household-level demand functions

Less confidence in exact magnitudes reported, more confidence in trends they illustrate

1) Decline in revenue share from household sector
2) Increasing, in absolute value, own-price elasticity
3) Increasing substitutability away from postage consumption with computer use
4) Increasing substitutability between postage and telephone consumption.

Economic and econometric theory underlying analysis available in technical paper by same title that can be downloaded from

http://www-leland.stanford.edu/~wolak

Future Research

1995 BLS data recently made available. It is source of preliminary numbers. 1996 data promised by end of summer.

Have the above trends continued for household-level demand in 1995 and 1996?

Sources of electronic substitution—USPS Postal Diary Survey provides detailed information telecommunications capital equipment holdings, on-line service member and electronic bill paying.