Fixed-mobile substitution

A simultaneous equation model with qualitative and limited dependent variables

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Background

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❏ Rapidly increasing mobile penetration

❏ Regulatory interest in understanding the relationship between fixed and mobile services:

　□ If complements: does not impact on fixed regulation

　□ If substitutes: fixed regulation could be relaxed as the mobile sector is often largely competitive

❏ Naïve interpretation of survey data suggest that fixed and mobile telephony are complements

Forms of substitution

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❏ Access level substitution:
  more mobile phones ➔ fewer fixed lines

❏ Call level substitution:
  higher mobile usage ➔ lower fixed usage

❏ The two forms of substitution are linked as access decision is based on expected usage

Empirical analysis

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❑ Time series analysis of macro data suggest access level substitution (Pita Barros and Cadima 2000, DotEcon 2001), but data tend to be poor

❑ Analysis presented here is based on survey data

  ☐ Repeated cross section (3 waves: 1999, 2000, 2001)

  ☐ Telephone survey

  ☐ >2000 observations per wave

Controlling for tastes

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❏ Statistics based on *observed fixed usage* might be misleading if there is *self selection* according to taste for telephony

❏ Need to establish fixed usage (expenditure) for the whole sample for *both* with and without mobile ownership, and then calculate statistics

❏ Fixed expenditure should be compared between the two scenarios across whole sample

❏ Endogenous switching models (Lee 1978, Maddala 1983, Trost 1981)

Endogenous switching model ●econ

❏ Individual buys a phone if expected reduction in fixed bill is sufficiently large

❏ We cannot observe the fixed bill a mobile user would have if he/she did not have a mobile phone

❏ Comparing observed fixed bills of mobile and non-mobile users is misleading as it does not take account of self-selection

❏ Consistent estimation of fixed bill requires the introduction of a selectivity term

Theoretical background I

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Individual *i* buys a mobile phone if:

$$Y_{ni} - Y_{mi} > h_i$$ (Y$_m$: fixed bill with mobile, Y$_n$: fixed bill without mobile)

$$h_i = aX_i + e_i$$ (X: individual characteristics)

Therefore for those who buy a mobile phone:

$$(Y_{ni} - Y_{mi}) - a X_i - e_i > 0$$

Which can be rewritten as a probit equation:

$$I_i^* = l_0 + l_1 (Y_{ni} - Y_{mi}) + l_2 X_i - e_i$$

Theoretical background II

Fixed bill can be estimated as:

$$Y_{mi} = d_{m0} + d_{m1} X_{mi} + e_{mi}$$

$$Y_{nj} = d_{n0} + d_{n1} X_{nj} + e_{nj}$$

However, we can only observe fixed bill for special cases:

$$Y_{mi} \quad \text{when} \quad I_i = 1 \quad \text{and}$$

$$Y_{ni} \quad \text{when} \quad I_i = 0.$$

Theoretical background III

Consistent estimation of the fixed bill equations requires the introduction of a selectivity term:

$$Y_{mi} = d_{m0} + d_{m1} X_{mi} + s_{me} \frac{f(\Psi_i{}^*)}{1 - \Phi(\Psi_i{}^*)} + V_{mi} \quad \text{for} \quad I_i = 1$$

$$Y_{ni} = d_{n0} + d_{n1} X_{ni} - s_{ne} \frac{f(\Psi_i{}^*)}{\Phi(\Psi_i{}^*)} + V_{ni} \quad \text{for} \quad I_i = 0$$

Where $?_i^*$ is the consistent estimate of the probability of having a mobile

Estimation

1. Reduced form probit ➔ calculate predicted probabilities

2. Fixed spending equations ➔ calculate predicted spending for both scenarios

3. Structural probit

We use the following variables:

- ❏ Internet and fax usage
- ❏ Homeworker
- ❏ Gender, age, income, social class and household size dummies

Results I

Reduced form probit (3rd survey)

Variable	Coefficient	z-value
WWW	0.59	5.47
FAX	0.11	0.71
GENDER	0.26	2.75
HOMEW	-0.00	-0.02
Constant	0.97	1.94
Wald Chi2 (df=29)	213.68	
Observations	1048	

Z-values are calculated using robust standard errors. Jointly significant social class, age, household size and income dummies are included

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Fixed telephony spending (selectivity adjusted for mobile phone owners, 3rd survey)

Variable	Coefficient	z-value
WWW	7.36	1.54
FAX	23.53	5.65
HOMEW	13.81	3.14
Constant	-6.89	-0.17
Selectivity parameter	51.75	1.87
Wald Chi2 (df=22)	265.00	
Observations	751	

Z-values are calculated using robust standard errors. Jointly significant social class, age, and household dummies are included

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Fixed telephony spending (selectivity adjusted for non-mobile users, 3rd survey)

Variable	Coefficient	z-value
WWW	10.80	1.81
HOMEW	12.90	1.50
Constant	67.41	5.43
Selectivity parameter	33.23	1.64
Wald Chi2 (df=8)	68.87	
Observations	297	

Z-values are calculated using robust standard errors. Jointly significant household size dummies are included

Results IV

Structural probit estimates (3rd survey)

Variable	Coefficient (probit)	Coefficient (dprobit)	z-value
Yn-Ym	0.01	0.003	1.70
WWW	0.53	0.16	4.95
FAX	0.40	0.11	1.86
GENDER	0.26	0.08	2.76
HOMEW	-0.01	0.00	0.04
Constant	-0.05		-0.09
Wald Chi2 (df=20)	210.43		
Observations	1048		

Z-values are calculated using robust standard errors. Jointly significant age and income dummies are included.

Conclusions

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❏ Strong evidence for call level substitution between fixed and mobile telephony as people decrease their fixed line usage as a result in mobile ownership

❏ Indirect evidence for access level substitution as the fall in fixed line expenditure creates an incentive to buy mobile phones