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Estimating the Impact of Access Conditions on Service Quality in Post

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Abstract: Third party access to postal networks can be made subject to a range of access conditions. While the pricing of postal network access has received much research attention, the effects of access on quality of service have received less. Using data on international postal services in a large panel of European countries, we estimate an econometric model of average time-to-delivery for letter post, including a range of access conditions. We find that several access conditions have a significant association with service quality. Appropriate access conditions may improve service quality.

Keywords: postal services, service quality, network access

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1. Introduction

This paper studies the relationships between access and quality in the postal sector. Access and quality are of prime importance in the postal sector and in postal sector reform. A particular feature of postal sector reform and method of promoting competition has been allowing competitors access to postal delivery networks. A key idea is that, since studies have shown delivery to exhibit scale economies, the incumbent can maintain the delivery function (and so continue to exploit scale and/or density economies), while competitors offering (possibly) greater focus or higher value-added enter at different stages of the value chain. Improved quality is often seen as a key way to maintain postal demand and the value-for-money of postal products.

A *priori*, the impact of access on quality is probably ambiguous. For example, access might relieve volume/capacity constraints. Such constraints are significant and important determinants of quality for the main operator (Swinand 2004). Alternatively, access could potentially degrade quality, for example if the access mail volumes vary considerably (so the incumbent has a hard time matching resources to volumes), if the access mail is of a poorer address quality (by exacerbating existing problems with mis-sorting), or if the incumbent is not fully committed to the access product, etc.

In general, access conditions need to be considered carefully from a regulatory standpoint. On the one hand, poorly defined access conditions could allow the incumbent to engage in non-price discrimination; on the other hand, they could allow an entrant ways of engaging in cream-skimming or transferring costs onto the incumbent (for example if the access seeker provides mail that is not easily machinable).

In this paper, we use data on the speed of delivery for international letter post to estimate the impact of access conditions on quality.

2. Previous Research

In theory, access conditions[1] could affect the regulated outcome in a regulated sector such as post quite substantially. Similar to the price of access, access conditions can be mandated by the regulator, negotiated between the regulator and the incumbent, or determined via bilateral negotiation between the access provider and the access seeker.

In terms of access conditions, most regulator-mandated conditions have tended to be very general in scope, such as, "non-discriminatory", or "transparent".[2] Finger (2006)[3] considered some general principles of access conditions pertaining to the postal sector. Besides price control, he highlights the number of access points and interoperability standards. In bulk post, interoperability standards include rules pertaining to the quality of addresses and labelling and the machinability of the envelope, among others.

There has been much theoretical work on access and access pricing in general and in postal systems (e.g., Armstrong 2008, Crew and Kleindorfer 2006, 2008), and some significant empirical work on quality in the postal sector (e.g., Swinand 2004, Swinand and Scully 2006), but the interaction of the two is somewhat less developed—a notable exception is Calzada (2009), which develops an access pricing model which determines optimal quality and demand with first- and second-class mail.

There has been, however, more considerable work with respect to vertical integration, access and quality (and non-price/quality discrimination) in the telecoms sector, with particular focus on incentives to the incumbent, such as quality-based discrimination of the incumbent towards competitors. For example, Weisman and Kang (2001) find that in order for the incumbent to have an incentive not to discriminate against rivals, these rivals must have a pronounced efficiency advantage over the incumbent. According to Cave, Correa and Crocioni (2006), previous research suggests that "the incentives [of the incumbent] to [engage in non-price discrimination] increases: the tighter is price regulation of the upstream input and the less intense is upstream competition."

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1 Here, we are focusing on non-price terms of access.

2 See for example, the ERG common position documents on bitstream access: http://ec.europa.eu/information_society/policy/ecomm/doc/library/public_consult/nga/dr_recomm_nga.pdf

3 Finger, Matthias, "The postal network between competition and Universal Service provision," CDM Working Papers Series, 17 March 2006 MIR-REPORT-2006-002.

3. The Model

The model used in this paper to determine the impact of access conditions on postal service quality is derived from the basic assumption of a production function. Demand determines volume and must be served, so quality becomes the endogenous variable. We sketch the derivation of the model in the steps below[4].

1) $$q = F(L, K, V, A, t)$$

The above says that quality, q, is a function of inputs, labour (*L*) and capital or capacity (*K*), volume or demand (*V*), and a vector of attributes or conditions, including access conditions (***A***)

Developing the above into an estimating relationship is straightforward. It is common to estimate variables with arbitrary units in the natural logs. The attribute variables on access and other conditions are divided into zero-one (dummy) variables (*A* subscript *d*) and continuous variables (*A* subscript *i*). An assumed random error term is also added.

2) $$\ln q = \alpha + \beta_L \ln L + \beta_K \ln K + \beta_V \ln V + \sum_d \beta_d A_d + \sum_i \beta_i \ln A_i + \chi t + \varepsilon$$

The above equation represents our model for estimation. It says that quality of service will be the result of input quantities (*labour L and capacity/capital K*), volume/demand (*V*), attributes, (*A*), and a time index (*t*). The impact of the access conditions on the quality of service provision by postal operators enters the model through the attributes variables.

4. Data

The model for this paper requires data on the quality of service, the access conditions, input prices, demand, and a demand shift variable (e.g. GDP). Due to data constraints, no adequate proxy for capacity/capital could be obtained. Therefore production inputs are proxied by labour alone.

Information on postal quality of service has been collected by the International Post Corporation (IPC) and published via the UNEX monitoring system since 1994. In estimating this model, we are concerned with one particular measure of quality: the average number of

[4] A more detailed derivation is given in the Appendix.

days required for delivery. UNEX data are end-to-end actual and audited measurements. Swinand *et al.* (2009) note that quality might have further dimensions than speed of delivery, but, following their analysis, we assume this to be the most important determinant of quality of postal service provision.

Another issue (as in previous work) is whether international mail from UNEX is a good proxy for all mail quality by the delivering postal operator[5]. The work here, it should be noted has tracked "access for international conditions" against UNEX data. Naturally, only a small portion of mail is actually routed through access. However, we note that much of the concern over access conditions is whether providing access will degrade the general mail pipeline system. So while there are significant caveats to the data, we do believe the data are capable of measuring the correct things.

Of particular interest, and the main addition to our dataset, is the development of a number of key variables on access conditions. We are limited in our data to terms of access for termination of international mail. These are developed into summary data, such as minimum quantities, standardised address formats, etc. It should be noted that the data on access conditions matches our data on quality, that is to say, the quality data is for termination of international mail.

The following access variables are included in the model: price, pre sort min (a minimum number of item presorted), the number of entry points, minimum volumes, maximum weight and targets for number of days to reach the destination. Those access variables that are not in binary format are included in the estimations in log form as was outlined in the theoretical model above.

An additional issue in developing our dataset on access conditions is that we have focused on addressed mail only. There are naturally other conditions set on unaddressed mail, but to have included these would have significantly complicated the data collection and development. In addition, casual inspection and comparison of the unaddressed versus the addressed mail access conditions suggested only small variations between the two, and thus inclusion of the two would have led to significant collinearity problems. One limitation that arose in the development of our variables for access conditions was a lack of intertemporal

[5] Since there is no published data on the quality of other mail streams on an internationally-comparable basis, we must assume that this is a reasonable proxy.

variation. Since access conditions vary little (or not at all) over time in most jurisdictions, it is not possible to control for unobserved heterogeneity in the determinants of quality at country-pair level using fixed effects. Instead, we have included origin and destination fixed effects that are constant across counterparties.

Our proxy for input prices is annual real labour cost inputs for the telecommunications, storage and distributions sector taken from the OECD. This measure was selected due to the lack of data available in from the UPU database in regard to expenditure on wages and salaries. This measure is deemed to be a good proxy for the variability of input prices for the postal operators. Data on GDP was taken from Eurostat for the selection of countries in our panel. It represents real purchasing power standard adjusted GDP figures for all countries presented. We also included controls for population density in the destination country as this could potentially play a role in determining quality of service. Table 1 below lists the variables used in our analysis and provides some descriptive statistics on them.

Table 1: Key Variables and Descriptive Statistics

Variable	Description and Source	Mean	St. Dev.	Min.	Max.
Avg_days	The average number of days to deliver first class mail from country *i* to country *j* in year *t* as per UNEX monitoring results	2.63	0.758	1.5	8.3
presortmin	The min % that must be presorted	81.9%	38.5%	0%	100%
entrypoints	The number of entry-points for access	1.68	0.700	1	4
minvol	The minimum volume for access	1,010	1,230	50	4,000
maxwtgrams	The maximum weight of an item in grams	1,420	879	50	5,000
target_j+n	The service quality target j+n in days	2.46	1.56	1	5
$labcost_{jt}$	Index of Real Labour unit costs taken from OECD Annual Indicators (2005 = 100)	98.7	9.23	70.4	146
vol_{jt}	Total volume of letter post items (billions) delivered in country *j*, year *t*, taken from the UPU Postal Statistics Database	7.78	10.1	0.157	46.5
gdp_{jt}	Real GDP (€billions), for country *j*, year *t*, taken from Eurostat Annual National Accounts indicators.	577	644	14.7	2,410

The demand/volume data used in this paper was taken from the UPU database for all years in the sample.[6] We used data for all letter post items (domestic and inbound international), taking data only for countries and years when all of these components were reported. The reason for using all items is that it is most likely the total volume of letters that will have the most bearing on quality via the volume/capacity relationship.

Summary statistics for the origins and destinations in the sample are presented in Table 2 below.

Table 2 : List of countries in the sample and number of times each country appears as an origin or destination

Country	Origin	Destination	Country	Origin	Destination
Austria	150	217	Lithuania	39	
Belgium	169	84	Luxembourg	165	226
Cyprus	53		Malta	31	
Czech Republic	59	110	Netherlands	163	217
Denmark	166	238	Norway	164	204
Estonia	36	86	Poland	54	
Finland	164	214	Portugal	166	145
France	163	223	Romania	41	
Germany	163	225	Slovakia	42	99
Greece	163	212	Slovenia	45	
Hungary	54	78	Spain	162	236
Iceland	171		Sweden	170	33
Ireland	164	205	Switzerland	174	
Italy	162	237	UK	165	169
Latvia	40				

5. Estimation and Results

For the purpose of this analysis, the model as outlined above is log-linearised which allows the application of standard estimation techniques and the interpretation of the variables' coefficients as elasticities (% change per % change).

The dataset includes quality by country pair over time, while other variables are annual values for each destination country. As the data on quality and some other variables have components that are invariant over time but not across countries, we include fixed effects for origin and destination countries. The dependent variable is the average days to delivery for international mail. This metric has an inverse relationship to quality i.e. if the number of days

[6] http://www.ipc.be/index.php?option=com_content&task=view&id=43&Itemid=152

increase, quality is said to have fallen. Therefore in our model if variables have a positive relationship to average days they have a negative relationship with quality and vice versa.

The overall estimation strategy that we employ is pooled OLS with origin and destination fixed effects. We have included a structural break in our model to coincide with the beginning of the liberalisation of outbound cross border mail from January 1st 2004, This followed from EU Directive 2002/39/EC. Our analysis therefore only includes the impact of the access variables from year 2004 onwards. The other key drivers of quality (GDP, Volumes, Input Costs, Population Density) are included in the model pre 2004, but their coefficients are allowed to vary pre and post 2004. We have also included a separate time trend for each sub-period.

The results of the pooled OLS analysis with origin and destination effects are presented in Table 3 below. Coefficients on market variables are estimated separately for periods pre- and post-2004, the year in which access legislation took effect.

Table 3: Results of Pooled OLS with Origin and Destination Effects
Dependent variable : ln(avg_days); R2 = 56%

Post Access			Pre Access		
Variable	**Coefficient**	**Robust Std. Error**	**Variable**	**Coefficient**	**Robust Std. Error**
lnPrice1	-0.0916	0.0228***			
Presortmin	-0.131	0.0254***			
lnEntrypoints	-0.102	0.0333***			
lnMinimumvolumes	-0.00104	9.21E-03			
lnMaxweights	-0.0454	6.60E-03***			
lnTargets	-0.0415	0.0233*			
lnPopDensity	0.978	0.362***	lnPopDensity	0.990	0.363***
lnGDP	0.00902	0.0520	lnGDP	-0.0837	0.0563
lnVolume	0.0976	0.0976	lnVolume	-0.528	0.0811***
lnLabour Cost	0.283	0.114**	lnLabour Cost	-0.522	0.0731***
Volume2	-0.00375	0.00363	Volume2	0.0188	0.00320***
Trend	-0.03443	0.00313***	Trend	-0.0305	0.00308***
Constant	70.5	6.43***			

Notes: *, ** and *** denote significant at the 10%, 5% and 1% level respectively.
Coefficients of origin and destination dummy variables omitted for brevity.

The results indicate significant effects from nearly all the access variables on quality of service in post. The only variable that does not have a significant impact is minimum

volumes. The price following access shows a positive and significant impact on quality (negative to average days). The coefficient value indicates that an increase in the price of a standard bulk letter item from 2004 of 1% leads to a decrease in the average number of days to deliver of 0.1%. Presort_min, and the number of entry points are also found to have a positive and significant impact on quality of service provision. An increase in presort minimum of 1%, leads to a decrease in the number of days of 0.13%, and an increase in the number of entry points by 1% leads to a decrease in the number of days of 0.1%. The final significant access variables are maximum weight and the target delivery. Both of these variables also have a significant and negative impact on the number of days thus indicating a positive impact on quality of service. Considering the coefficient values, an increase in maximum weight of 1% reduces average days by 0.05%. Similarly with targets, a 1% increase leads to a 0.04% reduction in average days. The finding in relation to maximum weight seems counter intuitive.

The time trends included in the model, which are picking up the unobserved exogenous change in quality over time, have a significant and negative relationship to the average number of days. This indicates a general trend towards higher quality service provision over time that is not correlated with the other explanatory variables.

Considering the non-access drivers of service quality, we analyse their impact both pre and post access availability in 2004. Population density has a negative and significant impact on quality in both periods. An increase in population density of 1% leads to an increase in the average days of approximately 1% in both periods. This result is unexpected, since postal delivery is often thought to exhibit economies of density. Such economies should reduce the cost of providing a given level of quality as density rises.

Real GDP does not have a significant association with quality either pre or post access. Volume's impact on quality is a quadratic relationship, so its impact on quality will vary depending on the volume[7]. At the means of the data, the impact is to increase quality, but as volumes get large, the quality should decrease, as evidenced by the negative coefficient on lnvol and the positive coefficient on lnvolume-squared (volume2). Pre access, volume had a significant impact on quality (both coefficients), but insignificant post access. This indicates that volume and quality are positively related, which is also a counter intuitive finding. Post

[7] This is in general consistent with previous work (Swinand 2004).

access volume does not have a significant impact on the average days to delivery. A quadratic volume term is also included. This is not significant post access but is significant pre-access. The sign on this term is negative indicating an increasing impact as volume increases.

Production inputs are proxied by labour costs. The impact pre and post access varies. Pre access, labour costs had a negative and significant impact on the number of average days indicating that the variable is positively related to quality. Post access the impact is still significant but the sign on the variable changes to indicate a positive relationship to the average number of days and therefore a negative impact on quality. This post access finding is in line with Swinand *et al.* (2009) who find that wages seem to have a negative impact on quality. They note that this could be a proxy for inflexible work practices and other related factors.

6. Conclusions and Directions for Future Research

This paper tests the impact of bulk access conditions on quality of service in postal services. A significant innovation of this paper is that we have derived a number of variables capturing the cross section conditions of access for a panel of European countries. Using a pooled OLS estimation strategy with origin and destination fixed effects, we have found that access conditions, in the main, have a significant and positive impact on quality of service in the postal sector. Access prices, the number of entry points, pre sort min, maximum weight and quality targets all have a significant and positive impact on quality.

Naturally, there are always caveats with such empirical research, and the main uncertainty is to what extent the results can be extended to future policy for general bulk mail. Naturally such cautions apply for any kind of empirical and predictive work.

We believe the results show a significant impact of access conditions but should be interpreted with much caution. This naturally suggests future research. For future research, it would be interesting to include additional variables describing access conditions and market conditions, particularly as more generalised forms of access become available at posts throughout the EU/UPU/UNEX areas. As countries change access regimes over time, this should also assist researchers in isolating the effects of such arrangements from other factors that lead to variation in postal quality. Another interesting issue that could be considered as more data becomes available is possible endogeneity/reverse causality of some of the access variables.

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