swiss economics

Forecasting E-Substitution and Mail Demand

Urs Trinkner
Martin Grossmann

Swiss Economics Working Paper 0002

July 2006

Swiss Economics SE AG
Abeggweg 15
CH-8057 Zürich

T: +41 (0)44 500 56 20
F: +41 (0)44 500 56 21

office@swiss-economics.ch
www.swiss-economics.ch

Forecasting E-Substitution and Mail Demand *

Urs Trinkner
Swiss Post and University of Zurich
Viktoriastrasse 21, CH-3030 Bern
trinkneru@post.ch

Martin Grossmann
University of Zurich
Winterthurerstrasse 92, CH-8006 Zürich
martin.grossmann@isu.unizh.ch

1. INTRODUCTION

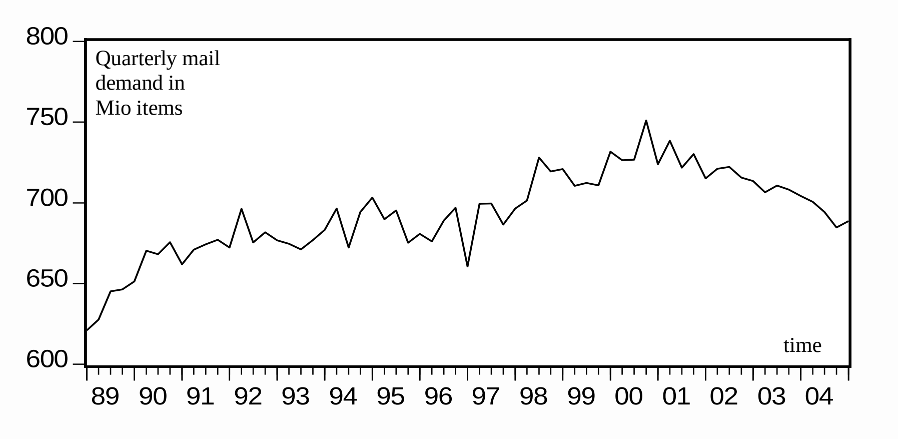
The demand for mail is facing a great challenge. In recent years, substitutes such as e-mail and SMS (Short Message Service) have become a cheap, fast and convenient alternative. In the near future, new broadband-based services, the breakthrough of digital signatures, fully Web-based payment systems, and contracting solutions will further affect the mailing industry. In Switzerland, total addressed mail peaked in the last quarter of 2000, as shown in Figure 1. Since then, mail volumes have been shrinking. Yet it is not clear whether e-substitution has been the underlying cause or whether this was due to some other factor such as the economic slowdown in Switzerland between 2001 and 2003.

It is likely that e-substitution has the potential to change the long run trends of mail demand. In the past, in many countries, gross domestic product (GDP) could explain a large amount of the variation in mail demand. More recently, countries like the US, Finland, Sweden and the Netherlands reported that GDP is a less accurate predictor of first class mail streams. Nader (2004) concludes in his study of mail trends that "GDP and, more generally, economic activity is no longer as strong a determinant of mail volume as in the past."

To get better insights about the e-substitution case in Switzerland we first look to the past. Using econometric modeling techniques, we analyze historical mail volume movements to identify trends and trend-breaks. Many authors have conducted such econometric studies previously. A brief summary can be found in Harding (2004). We apply a vector error correction model similar to the ones of Nankervis et al. (1995, 1999, and 2002) and Florens et al. (2002).

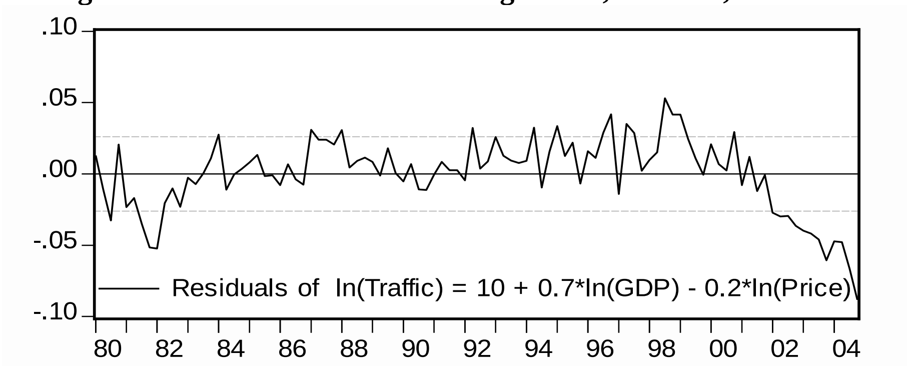
* The views expressed in this paper are those of the authors and do not necessarily reflect the opinion of Swiss Post.

Figure 1: Quarterly mail demand (seasonally adjusted)



Probably all postal services assume that the various mail streams are affected in different ways by e-substitution. However, to analyze possible trend-breaks, we need long time series on mail demand. Unfortunately, such an extensive time series does not exist on individual mail streams in Switzerland. After Swiss Post introduced fast and slow mail in 1991, no distinction between mass mail and single-piece mail has been reported until 1996. Therefore, we need to analyze aggregated mail volumes in order to get a sufficiently long time series. Aggregated mail, hereafter referred to as "total traffic," includes first and second-class mail, but not unaddressed and registered mail. Figure 2 presents the residuals of a static OLS regression of total traffic with only income (GDP) and price as explanatory variables.[1] The test statistics indicate the existence of an omitted variable.

Figure 2: Residuals of static OLS regression, R^2=97%, DW=0.57



[1] The regression is not spurious, as the three *I*(1) variables are cointegrated.

Note the autocorrelation at the end of the estimation period. The graph reveals a negative trend for the residuals after 1998. In other words, the model increasingly overestimates total traffic – a sign of e-substitution.

We proceed as follows: In Section 2, we introduce the data. Section 3 deals with possible revelations of e-substitution in time series analysis. Section 4 presents the applied error correction models including estimation results. Section 5 deals with forecasting. We summarize and conclude in Section 6.

2. THE DATA

We analyzed quarterly data from 1980Q1 to 2004Q4. The main characteristics are summarized in Table 1. The last column contains the order of integration, according to the Augmented Dickey-Fuller unit root procedure.[2] Later, the order of integration will play an important role in setting up an error correction model. Traffic, GDP and all price indices are $I(1)$. Thus, the series are nonstationary, whereas their first differences $\Delta X_t = X_t - X_{t-1}$ are stationary. All the proxies for e-substitution are either $I(0)$ or $I(2)$.[3]

In the quarterly data set, the average growth in total traffic Q was about 1.7% per year. The growth rate between 1980 and 1990 was 4.1%, substantially larger than in the following decade (+1.4%). From 2000 on, the growth rate was negative (-0.9% per year). For real and nominal *GDP*, we observe a similar trend-break in the early 1990s, when Switzerland entered a recession followed by a period of low growth. GDP can be interpreted either as income or as economic activity reflecting a need for printed communication. The ‘mail price index’, P, reflects the price of a constant basket of various mail items of total traffic. The *CPI* (consumer price index) is issued by the Swiss National Bank. We use it to compute real measures and to account for inflation when regressing in nominal terms. The Swiss ministry for telecommunications has computed the telecommunication price index since 1993. We will call it the ‘price of the substitute’ (*PS*). It is a mixed index of telecommunications products including broadband Internet access prices. The series *PS* peaks in 1995 and is followed by a steady decline until 2000. Possible reasons for the decline are the various technological innovations and/or market liberalization. Important to us, the index reflects that substitutes, such as the Internet, e-mail, and SMS, became cheaper over time. However, properties of e-substitution other than price are

---

[2] Discussion of the theory underlying unit roots, cointegration, and tests for them, can be found in Florens (2002) or Hamilton (1994).

[3] Similar to those in Nankervis et al. (2002), the results of the unit root test for the e-proxies should be treated with caution. Some of the series start late in the data set, and some are interpolated with only a few observations.

hardly captured by *PS*. Table 1 does not list any variable for quality of service. We do not expect this variable to be a crucial point for our study because quality was never an issue in Switzerland.

Table 1: Overview of quarterly data set

Time series (in brackets shortcuts)	**Data source**	**Average growth rate p.y.**	**Period of original data**	**Order of integration**
Traffic and GDP				
Total Traffic (*Q*)	Swiss Post	1.7	1980Q1 – 2004Q4	I(1)
GDP nominal	SNB	3.9	1980Q1 – 2004Q4	I(1)
GDP real (*GDP*)	SNB	1.4	1980Q1 – 2004Q4	I(1)
Price indexes				
Mail price index real (*P*)	Swiss Post	1.3***	1980Q1 – 2004Q4	I(1)
Substitutes price index (*PS*)	BACOM	0.0	1993M5 – 2004M12	I(1)
Consumer price index (*CPI*)	SNB	2.5	1980Q1 – 2004Q4	I(1)/I(2)*
Substitution proxies				
% Active e-bankers (*eBank*)	Swiss Post		1998m9 – 2004m12	I(0)
% Internet users (*eUse*)	BFS		1994 – 2004	I(2)
% Internet buyers** (*eBuy*)	BFS		2000 – 2004	I(0)
% Broadband access** (*eBb*)	BFS		1999 – 2004	I(0)
% Overall e-index (*eIndex*)	Calculated		(artificial)	I(2)
% Mobile users (*mUse*)	BACOM		1991 - 2004	I(2)
Dummies and other				
dAB	Reflects the introduction of A- and B Post in 1991			
nDays	Deviation of number of labor days from their mean			

* I(2) due to Augmented Dickey-Fuller test, I(1) with Dickey-Fuller and Phillips-Perron tests.
** These series have been extrapolated with just a few datapoints.
*** The increase in real prices was mainly due to the introduction of first class mail and the abolishment of cross-subsidies from telecommunications products.

We did not include the substitute's price *PS* in the introductory regression. A modified static regression of the kind

$$\ln(Q) = \beta_0 + \beta_1 \ln(GDP) + \beta_2 \ln(P) + \beta_3 \ln(PS) \qquad (1)$$

reveals residuals similar to the ones in Figure 2. The main difference is that the negative trend of the residuals starts in 2000 instead of 1998. We treat this as an indication that the *PS* may not sufficiently reflect the various product innovations and increasing positive network externalities of all kinds of e-substitutes. As e-substitution cannot be measured directly, we use a set of proxy variables. Loosely speaking, a proxy is a series that is somehow related to an unavailable explanatory variable for which we would like to control (in our case for e-substitution).

Table 1 lists the proxies used in our analysis. 'Active E-Bankers' (*eBank*) contains the fraction of customers who actively use Swiss Post's E-Banking platform “Yellownet”.[4] The data is available on a monthly basis. It is by far the most accurate measured proxy variable because the others are available on a semiannual basis at best, creating a need for extrapolation. Interestingly, *eBank* exhibits a constant linear trend in contrast to the other e-series, which are S-shaped (e.g., the cumulative normal distribution). The only semiannual series is the fraction of active Internet users in Switzerland (*eUse*). ‘Internet Buyers’ (*eBuy*) contains the percentage of the Swiss population that has used the Internet to buy goods. The data was collected on a yearly basis. The series start in 2000 with a high initial value of 23%. Because the available values have been close to the ones of eUse, we adjusted the series accordingly. The series *eBb* measures the percentage of the population with a broadband connection to access e-substitutes. Finally, the overall Index (*eIndex*) was constructed as the sum of the preceding series. The last variable *mUse* contains the fraction of the population with a mobile telephone. The proxy may reflect the substitution of mail through SMS.

3. E-SUBSTITUTION IN TIME SERIES ANALYSIS

E-substitution can reveal itself in various ways when performing time series analysis. A first form we encountered in Figure 2 where the plot revealed a negative trend for the residuals at the end of the estimation period. E-substitution is a straightforward explanation for this negative trend, as the e-proxies are highly significant when regressed against the residuals. A second and yet related indication for e-substitution could be that we cannot find a robust model over the whole time horizon without using any proxy for e-substitution.

If a model is estimated in natural logarithms, demand exhibits constant price elasticity. In equation (1), it equals parameter β_2 and is independent of *Q* and time. However, despite the legal monopoly of Swiss Post in the letter market, competition between physical mail and various electronic forms of written communication, such as e-mail, has evolved. In other words, one could expect increasing price elasticity and decreasing cross-price elasticity of mail demand over time. Therefore, a third way to detect e-substitution may be the estimation of model (1) over various time horizons. If price elasticity is consistently larger for samples closer to 2004, this may be a sign of e-substitution. Figure 2 shows the recursive estimates of equation (1) when the parameter for *GDP* (β_1) is restricted to 0.7 for all sample periods. The dotted lines represent +/- 2 standard errors[5]. ‘Recursive estimates’ is a procedure, in which the same equation is re-estimated for increasingly larger samples. For example, the first dot represents the estimate with a sample

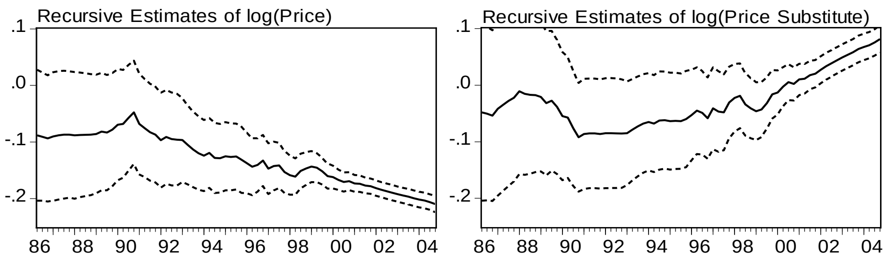
---

[4] http://www.yellownet.ch

[5] A coefficient is significantly different from zero at the 95% confidence level if zero is outside the boundary.

period from 1980Q1 to 1986Q1, whereas the last estimate has a sample period from 1980Q1 to 2004Q4. When moving to the right on the curves, the confidence bounds converge closer to the point estimates, because more observations are included in the respective estimation sample.

Figure 3: Recursive estimates yield increasing price elasticity



The depicted trends are in line with economic theory. With increasing competition between letters and the substitutes, prices become more important; customers get more price sensitive (price elasticity grows from -0.1 to about -0.2) and cross-price elasticity becomes significantly different from zero after 2002.

However, one of our objectives in this study is to forecast mail volumes in the near future. To do so, we need to find a robust model. This implies that it is not sufficient just to know that price elasticity may further increase over time.

4. LONG RUN MODELS FOR SWISS MAIL DEMAND

To forecast future mail demand it would be useful to know that the relation between mail demand, real GDP, and various other factors, such as price, availability, and quality of mail and its substitutes is stable. In the previous section we saw that all of the important variables are nonstationary $I(1)$ series. According to econometric theory, a long-run equilibrium relationship may exist for nonstationary series if they are cointegrated, i.e., that a stationary linear combination of the variables is $I(0)$. Under such conditions, a so-called (vector) error correction model (VEC) gives efficient estimates. In a VEC, the cointegrated series enter in levels.[6] The name stems from the underlying error correction mechanism shifting the equilibrium variables back to their long-run equilibrium.

We will estimate three models. The ‘traditional model’ does not include any of the e-proxies, whereas the two ‘substitution models’ do. This is the

[6] If cointegration was not found, a model in first differences would have to be specified to avoid spurious regression.

only distinction between the models. We specify for all models the same long-run dynamics such that mail demand, real GDP, and prices of mail and its substitutes represent a long-run equilibrium relationship. The Johansen Cointegration test in Table 2 indicates one cointegrating relation for all three models. If the test is performed for the four endogenous series alone, it reveals one cointegrating relation as well. We chose four lags, *L*, to include one year with our quarterly data.

Table 2: Unrestricted cointegration rank test

	Traditional model		**Substitution model 1**		**Substitution model 2**	
Endogenous variables	*Q, GDP, P, PS* in natural logarithms		*Q, GDP, P, PS* in natural logarithms		*Q, GDP, P, PS* in natural logarithms	
Exogenous variables	*dAB*		*dAB, iBank*		*dAB, iUse*	
Cointegration specification	VAR and EC with constant, no trend		VAR and EC with constant, no trend		VAR and EC with constant, no trend	
Lags of VEC	4		4		4	
Johansen Cointegration test						
Null hypothesis H_0	Trace	Max E-V	Trace	Max E-V	Trace	Max E-V
0 cointegration relation	65.36*	27.58*	56.74*	38.43*	57.56*	36.27*
1 cointegration relation	21.12	21.13	18.30	10.63	21.28	16.01
2 cointegration relation	1.604	14.26	7.67	7.28	5.26	4.73

*Denotes 1 cointegrating relationship at 95% confidence level

The functional form of the VEC that corresponds to Table 2 is, for *Q*,

$$\begin{aligned}\Delta q_t = {} & \alpha\big(\overbrace{1\cdot q_{t-1} - \beta_0 - \beta_1 gdp_{t-1} - \beta_2 p_{t-1} - \beta_3 ps_{t-1}}^{\text{Error Correction Term}}\big) + \\ & \gamma_0 + \gamma_1 dAB_t + \gamma_2 eproxy_t + \\ & \sum_L \left(\gamma_{3,L}\Delta q_{t-L} + \gamma_{4,L}\Delta gdp_{t-L} + \gamma_{5,L}\Delta p_{t-L} + \gamma_{6,L}\Delta ps_{t-L}\right) + \varepsilon_t .\end{aligned} \tag{2}$$

We find the cointegrating relationship in the error correction term. If it equals 0 at some time *t*, we have been exactly in the long-run equilibrium in the previous period *t*-1 (i.e., the error term ε_{t-1} was 0). If the error correction term is nonzero, it will influence the latest prediction according to the speed of adjustment α.

The only formal distinction between the three models lies in the choice of $eproxy_t$. In the traditional model, the term is not included at all. In the substitution models, the choice for *eproxy* will be *eBank* in Model 1, and *eUse* in Model 2.

Table 3 lists the results obtained from Johansen's two-step procedure. First, the long-run equation (the error correction term in (2)) is estimated. Thereby, the parameter of *q* is normalized to one. In a second step, the remaining parameters in equation (2) are computed.[7]

Table 3: Estimation results

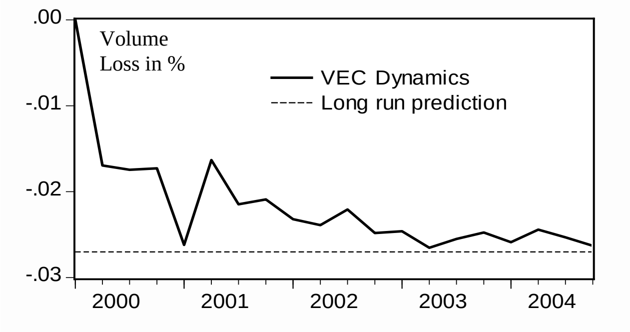
Adj. sample size: 1982Q2 to 2004Q4		**Traditional model**	**E-substitution model 1**	**E-substitution model 2**
Long run equilibrium equation				
gdp (real)		1.09 [8.14]	1.10 [9.09]	1.12 [9.58]
p (real)		-0.27 [-4.12]	-0.27 [-4.52]	-0.22 [-3.53]
ps		0.17 [4.49]	0.05 [0.60]	-0.07 [-0.57]
Constant (β_0)		1.49	1.33	1.29
Short run equation				
α		0.19 [3.98]	0.13 [2.46]	0.12 [2.03]
dAB		0.00 [0.25]	-0.01 [-0.64]	-0.01 [-0.63]
eBank			-0.21 [-4.80]	
eUse				-0.09 [-4.42]
Δq	t-1	-0.69 [-6.38]	-0.78 [-7.08]	-0.78 [-6.89]
	t-2	-0.44 [-3.4]	-0.56 [-4.18]	-0.56 [-4.07]
	t-3	-0.39 [-3.19]	-0.50 [-4.00]	-0.49 [-3.88]
	t-4	-0.25 [-2.37]	-0.33 [-3.1]	-0.32 [-2.97]
Δgdp	t-1	0.57 [2.07]	0.51 [1.91]	0.50 [1.84]
	t-2	0.19 [0.65]	0.19 [0.67]	0.16 [0.57]
	t-3	-0.02 [-0.06]	-0.05 [-0.20]	-0.06 [-0.23]
	t-4	0.11 [0.43]	0.11 [0.43]	0.10 [0.40]
Δp	t-1	-0.09 [-2.11]	-0.09 [-2.27]	-0.10 [-2.50]
	t-2	-0.07 [-1.61]	-0.08 [-1.92]	-0.09 [-2.09]
	t-3	-0.05 [-1.05]	-0.05 [-1.3]	-0.06 [-1.51]
	t-4	-0.08 [-1.71]	-0.10 [-2.23]	-0.10 [-2.29]
Δps	t-1	0.20 [2.21]	0.23 [2.65]	0.22 [2.51]
	t-2	-0.23 [-2.41]	-0.21 [-2.25]	-0.22 [-2.39]
	t-3	-0.09 [-0.86]	-0.08 [-0.81]	-0.08 [-0.87]
	t-4	-0.12 [-1.25]	-0.11 [-1.23]	-0.12 [-1.28]
Constant (γ_0)		0.01 [1.23]	0.02 [2.93]	0.02 [3.99]
Test statistics				
R^2		57%	61%	60%
Adjusted R^2		46%	51%	49%
Log likelihood		271.24	275.96	274.87
F-statistic		5.26	5.86	5.63

The values in parentheses are the t-values. According to Wald tests all lags are significant and all endogenous variables satisfy Granger causation tests. Other e-proxies do not improve the model compared with eBank and eUse. We prefer them because of better data quality.

[7] We used Eviews for our computations in which the procedure is implemented.

The goodness of fit (R^2) of the three models is acceptable.[8] A graphical fit is shown in Section 4. In general, the coefficients have signs as expected and values that are in line with previous studies. The long-run price elasticity is highly significant and ranges between -0.22 and -0.27. This tells us that a 10% increase in price will reduce total traffic between 2.2 and 2.7% in the long run. However, the speed of adjustment α seems to be quite small and it is not clear, *a priori*, what the adjustment dynamics are. Figure 4 depicts the effect of a hypothetical 10% price increase at the beginning of year 2000 according to substitution model 1. The loss in volume converges to the prediction of the long-run price elasticity (as shown by the dotted line) after about three years. One would expect demand to be more price sensitive.[9]

Figure 4: Demand shock after a 10% price increase



The main coefficient difference between the models is the long run elasticity of the substitutes' price *PS*; whereas the short run impact of a change in the *PS* is about the same among the three models, the long run effect is significant only in the traditional model. At the same time, the two e-proxies in the substitution models are highly significant. It appears that once *eBank* and *eUse* are included in the model, they provide a better approximation than the substitutes' price index does. An interpretation may be that the choice between writing a letter and sending an e-mail or SMS is dominated by other product properties than price.

---

[8] If the same model is estimated with data that was not seasonally adjusted, R^2 and adjusted R^2 are between 97% and 99% when seasonal dummies are included. The large difference to the values given in Table 3 stems from the predictive power of the seasonal dummies. Without the seasonal adjustment, most of the variation in mail demand is caused by seasonality, which is well explained by quarterly dummies. To illustrate, a static regression for Q with only a constant, a trend, and quarterly dummies yields an adjusted R^2 of 84%.

[9] See Cazals et al. (2002) for a theoretical treatment, of why time series models exhibit often lower elasticities than cross-section models.

5. FORECASTING FUTURE MAIL DEMAND

How do the three models predict future mail demand? One general possibility for forecasting with a time series model is to solve the previously estimated static model with one's own or a third party's expectations about future realizations of the independent variables for every t in the forecasting horizon $t+1 \ldots T$. This approach leads to two kinds of forecasting error: (1) erroneous expectations, e.g., the assumption of future GDP growth proves to be under- or overestimated; and (2) specification error of the previously estimated model. A second general possibility for time-series forecasting is to estimate a dynamic model in lags, so no expectations about future values of explanatory variables are necessary, at least for the one-step-ahead forecast at $t+1$. Either way, the forecasting interval for a given confidence level increases with the length of the forecasting horizon.

In order to predict with our vector error correction model we need to mix the two ways to some extent. Note that equation (2) does not include any values of the endogenous variables at time t. Thus, for predicting mail demand for the next period $t+1$, the model does not build on GDP_{t+1}: it only uses GDP_t. This property is useful for performing one-step-ahead forecasts because the model needs observed values of the endogenous variables only. Even multi-step-ahead forecasts are possible without making any forecast of the explanatory variables. To explain this, we return to equation (2). The complete VEC specification includes analogous equations for the other endogenous variables *GDP*, *P*, and *PS*. Thus, to perform a forecast for time $t+2$, we can use the predicted endogenous values from $t+1$. However, we still need to make our own expectations of the two exogenous e-proxies.

Both kinds of forecasts were carried out. The first kind is done by treating all endogenous variables, other than total traffic, as exogenous[10]. Thus, we need to predict all the explanatory variables manually. For nominal GDP, we assume 1.8% growth per year. Further, we assume nominal price stability of postal prices, and we extrapolate *CPI*, *PS*, *eBank* and *eUse* according to their past trends.[11] We solve the model stochastically to obtain confidence bounds. The results for the forecasting period from 1990Q1 to 2007Q4 are shown in Figures 5a, 6a, and 7a. The dotted line is the one-step confidence bound. From 1990Q1 to 2004Q4, the predicted values represent the model fit during the estimation period. The observations from 2005Q1 to 2007Q4 show the forecasts for the out-of-sample period. Observation 2005Q1 deserves special attention. It is the most recent realization of total traffic and enables an indicative reality check of the estimated models.

---

[10] This means that ΔQ_{t+2} is computed with our own expectation of GDP_{t+1} instead of the VEC prediction $G\hat{D}P_{t+1}$.

[11] Taken all together, this is quite a large set of assumptions.

Figures 5b, 6b, and 7b show the results from the endogenous stochastic solution of the model, i.e., only *eBank* and *eUse* are determined outside the model. The forecasting period starts in 2005Q1. The dotted lines represent the multi-step confidence bounds. Note that the solution does not account for coefficient uncertainty in linked equations.

The traditional model (TM) gives by far the most optimistic scenario for future mail demand. According to the model's results shown in Figures 5a and 5b, mail demand has now entered a period of low but positive growth. Figure 5b reveals that the model fit for the realization 2005Q1 is not as good as those obtained from the substitution models. On the other hand, the predictions for the other endogenous variables are by far the most realistic ones (not shown here).

Figure 5a: Exogenous predictions TM

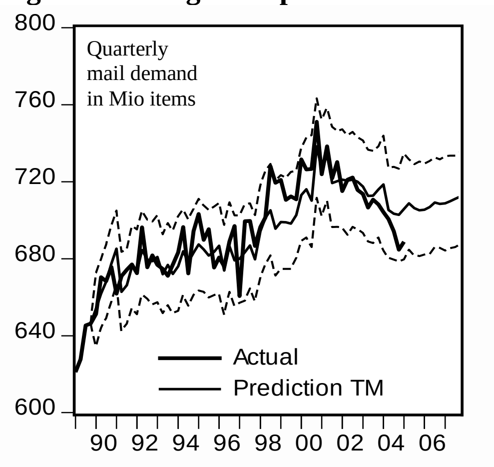
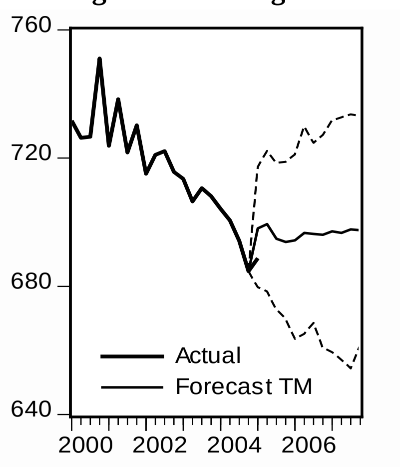


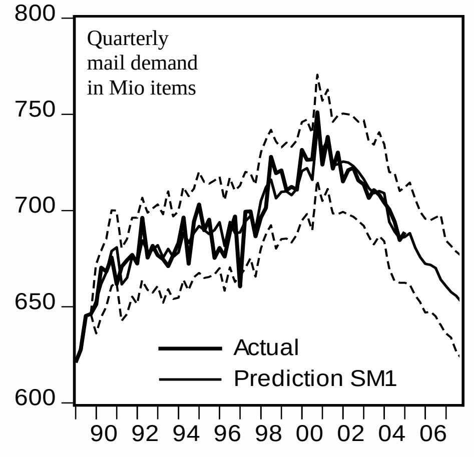
Figure 5b: Endogenous



The most pessimistic outlook is given by substitution model 1 (SM1). According to the model, the decline in aggregate mail demand will continue at an accelerated speed (Figure 6b). The one-step-ahead forecast for 2005Q4 is quite accurate. However, the predicted dynamics for the other exogenous variables are quite unrealistic. According to the endogenous solution, Switzerland will enter a heavy recession soon.

Substitution model 2 (SM2) lies somewhere in between the other two. The exogenous solution states that the decline is slowing down (Figure 7a). The fit at 2005Q1 is almost perfect. In the endogenous model, the forecasts for GDP are again very pessimistic. This can be seen indirectly by comparing Figure 7a with Figure 7b; the decline is more severe in 7b, because the endogenous forecast for GDP is much lower than our expectation of 1.8% growth.

Figure 6a: Exogenous predictions SM1 **Figure 6b: Endogenous**



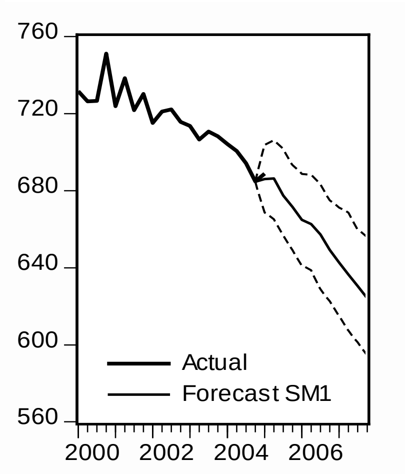
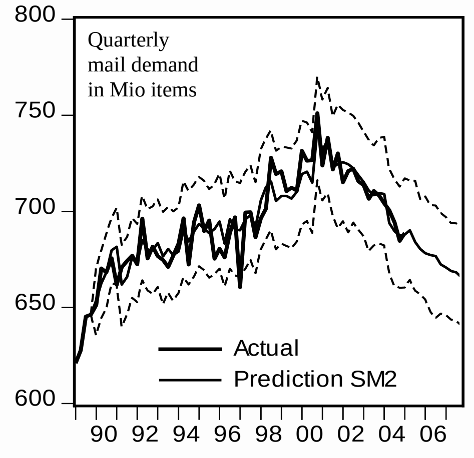
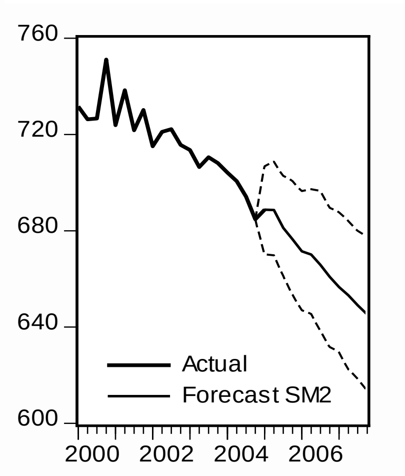


Figure 7a: Exogenous predictions SM2 **Figure 7b: Endogenous**





Comparing fit and forecast of the three models, each one has its own pros and cons. The traditional model exhibits the poorest fit, especially towards the end of the estimation period. As a direct consequence, the forecast performance at 2005Q1 is poor. Nevertheless, the endogenous predictions of GDP and prices seem to be the most realistic ones. Both substitution models predict an unrealistic negative development of future GDP. Still, they provide a better fit and a better one-step-ahead forecast.

6. DISCUSSION AND CONCLUSIONS

E-substitution is one of the most crucial issues in the postal industry. Most postal services heavily depend on their core business of delivering physical mail – once the only form of advanced long distance communication. The primary threat of e-substitution lies in the historical business model of most postal services. Over time, larger mail volumes increased economies of scale and enabled the postal services to keep postal rates low despite increasing labor costs and better service provision. A comparison between the development of real wages and real postal rates illustrates the historical postal business model. Whereas real wages grew exponentially, Swiss Post's real rates are today even lower than in the 1920s. In short, e-substitution questions the stability of this business model. Moreover, the 'political universal service model' builds on growth of mail demand. The remarkable growth over the past 100 years enabled politicians to impose uniform rates and demanding service obligations on the postal services, i.e., nationwide coverage of home delivery, without undermining the financial viability of the postal service. However, e-substitution also brings into question the stability of the political universal service model.

The intent of our research was to forecast future mail volumes and thereby to assess future e-substitution. We estimated three vector error correction models with quarterly data of Swiss aggregate mail demand. We found strong evidence that e-substitution has happened in the past few years. Moreover, two of the three models indicate that e-substitution will continue to undermine mail demand in the short and medium term. For the long term, we dare no prediction; we conclude that it is nearly impossible to make long-run forecasts with the applied techniques, because there is no unique proxy for e-substitution. Every such proxy yields another result, and combining or merging different proxies brings the same set of problems (or makes it even impossible to find a cointegrated long-run relationship). In addition, we do not know what kind of new substitutes will emerge in the near future and whether these substitutes are represented in our current proxies.[12]

Despite these limitations for long forecasting horizons, the short-run predictions seem to be accurate. Here we see the strengths of vector error correction models. They are powerful tools for forecasting the near future because they combine explanatory variables in levels, differences, and lags and still provide an economic interpretation of the results.

Inevitably, we do not know how severely e-substitution will affect mail volumes in the future. However, our model predictions are not optimistic, ranging from accelerated decline to slow growth. We therefore recommend

[12] Other econometric methods such as discrete choice analysis could resolve the problem. Nonetheless, we believe that the design of a survey with choices over hypothetical e-products would cause similar problems as e-proxies do here.

that postal services do not rely solely on their historical business models and that they prepare for the worst. In fact, many operators have initiated projects to respond to this uncertainty, e.g. with diversification into new product lines and with programs to make costs more responsive to (potentially declining) demand conditions. A key issue going forward will be for politicians and regulators to find universal service policies that do not increase the universal service provider's fixed costs.

REFERENCES

Cazals, Catherine, and Jean-Pierre Florens. 2002. "Econometrics of Mail Demand." In *Postal and Delivery Services: Delivering on Competition*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.

Florens, Jean Pierre, Sarah Marcy, and Joelle Toledano. 2002. "Mail Demand in the Long and Short Term." In *Postal and Delivery Services: Pricing, Productivity, Regulation and Strategy*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.

Harding, Matthew C. 2004. *Mail Demand Models*. Paper presented at the XIII International Conference on Postal and Delivery Economics, Antwerp, June 4-7, 2005. Available at http://www.postinsight.pb.com.

Hamilton, J.D. 1994. *Time Series Analysis*. Princeton, NJ: Princeton University Press.

Nader, Fouad H. 2004. Mail Trends. Available at http://www.postinsight.pb.com.

Nankervis, John, and Frank Rodriguez. 1995. "Aggregate Letter Traffic Demand in the United Kingdom and the Economy." In *Commercialization of Postal and Delivery Services*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.

Nankervis, John, Isabelle Carslake, and Frank Rodriguez. 1999. "How Important Have Price and Quality of Service Been to Mail Volume Growth?" In *Emerging Competition in Postal and Delivery Services*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.

Nankervis, John, Sophie Richard, Soterios Soteri, and Frank Rodriguez. 2002. "Disaggregated Letter Traffic Demand in the UK." In *Postal and Delivery Services: Pricing, Productivity, Regulation and Strategy*, edited by Michael A. Crew and Paul R. Kleindorfer. Boston, MA: Kluwer Academic Publishers.