The Dynamics of External Financing*

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August 7, 2000

Abstract

A dynamic process underlying firms' discrete financial choices has previously been found, but without controlling for unobserved heterogeneity, this dependence can either be of a "true" nature or an effect of firm-specific characteristics that we cannot observe. This study extends previous research focusing on firms' discrete external financing decision by adapting a model by Honoré and Kyriazidou (2000), which accommodates both fixed effects and a lagged dependent variable, which makes it possible to establish the nature of the dependence. We find that there is a smoothing of financing, even after controlling for unobserved heterogeneity, and also that unobserved heterogeneity plays a significant explanatory role.

Keywords: Corporate Finance, Discrete Choice, State Dependence.

JEL Classification: C25, G32

*I am grateful to Matz Dahlberg, Jan Södersten and seminar participants at Uppsala University for their helpful suggestions. Ekaterina Kyriazidou has kindly provided a gauss code, help and advice, for one of the estimators used.

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1 Introduction

It is often observed that an individual that has experienced an event in the past is more likely to do so again. One explanation is that experiencing an event alters the relevant preferences, costs or constraints, i.e. "true state dependence". Another explanation is that individuals differ in certain permanent unmeasured variables that influence their probability of experiencing the event, i.e. "spurious state dependence". This point was originally brought forward by Heckman (1981b). Distinguishing between these two explanations is important. In the former case, the experience has a genuine behavioral effect, while in the latter, the previous experience seems to be a determinant of future experience solely because of it being a proxy for temporally persistent unobservable factors that determine choices. Hence, a proper test for dependence should control for unobserved individual-specific effects.

Empirical studies on firms' discrete financial choices are usually static [e.g. Marsh (1982), MacKie-Mason (1990), Jung et al. (1996)]. Exceptions are Helwege and Liang (1996), who, however, do not control for individual specific effects, and Corres et al (1997), who use random effects to control for unobserved heterogeneity. Helwege and Liang find that firms that previously acquired external financing are more likely to do so again. Also, De Haan and Hinloopen (1999), who follow the approach of Helwege and Liang for a sample of Dutch firms, find evidence of the same behavior. But neither of these studies considers unobserved heterogeneity. This makes it impossible to conclude whether the

persistence is of a "true" nature.

If there are large costs associated with acquiring external capital, firms should tend to raise excess funds when entering capital markets to avoid the need of doing so again in the near future. On the other hand, external financing can be associated with positive side effects. If firms repeatedly are in the market for new capital, the monitoring cost can be reduced when the suppliers of the "new" capital monitor the firm's management. Additionally, long-term relationships between borrowers and lenders can lower the cost of asymmetric information, which make debt financing less costly for firms that have gained a good reputation on the capital markets. Also, a number of empirical studies show that firms that frequently issue equity can do so to a lower cost. Smith (1986) suggests that the market reaction is a function of the predictability of the issue, and, hence, frequent equity issuers cause a less negative market reaction than those who seldom issue equity [see McDaniel et al (1994), Bayless (1994), and Jung et al (1996)].

This study focus on the discrete external financing choice, as Helwege and Liang (1996), and Belt and Klein (1993), and extends these by controlling for unobserved heterogeneity. The discrete choice model of Honoré and Kyriazidou (2000), makes it possible in the presence of unobserved heterogeneity to investigate the external financing choice in a dynamic setting, since it accommodates both a lagged dependent variable and fixed effects. We extend the existing literature on discrete financial choices by considering both a dynamic structure,

and unobserved heterogeneity when allowing the unobserved individual-specific effects to be correlated with other explanatory variables, i.e. treating the individual effects as fixed. In accordance with previous studies, we find that firms that previously acquired external financing are more likely to do so again. However, neglecting unobserved heterogeneity overstates the economic importance of the lagged choice in the sense of "spurious state dependence". After controlling for unobserved heterogeneity, firms that acquired external capital in the previous period are approximately 8 percentage points more likely to acquire external financing than firms that did not acquire external capital in the previous period.

The paper is organized as follows. In section 2, we describe different explanations for persistence in firms' external financing choice. In section 3, we define the explanatory variables. The different econometric estimators used are discussed in section 4, followed by a description of data in section 5. In section 6, the results are reported, and, finally, section 7 offers some concluding remarks.

2 Internal or External funds?

Understanding processes underlying firms' discrete financial choices is important, especially since firms play a significant role in the financial markets. By acquiring external financing, firms obtain financing for future investments. Alternatively, by having large operating cash flows or by adapting a low dividend payout policy, firms can to a larger extent rely on internally generated funds. It is also possible that firms restrict dividends, in periods when operational cash flow are large, to build up financial slack in form of working capital.

If internal and external capital were perfect substitutes, financial factors would be irrelevant to investments. If not, investments can depend on the availability of internal finance, access to new debt or equity financing. Since managers know more than investors about investment opportunities and their profitability, a plausible assumption is that this information asymmetry affects the choice between external and internal financing. If so, the cost of an additional unit of external finance will exceed the opportunity cost of internally retained funds. This wedge causes underinvestment by firms that lack internal funds

In a sample of US firms that went public in 1984, Helwege and Liang (1996) investigate if the pecking order theory can explain why external capital is acquired. They include an indicator variable for firms that raised funds externally in the previous year. If there are large fixed costs associated with acquiring external capital, firms should tend to raise excess funds when entering capital

markets. Helwege and Liang argue that if firms raise excess funds to avoid costs of having to raise funds again in the near future, then the previous financing variable will have a significant negative coefficient. However, Helwege and Liang´s result implies a significant positive relationship between the previous financing variable and the possibility of external funds, i.e. firms that once have acquired external funds are more likely to do so again. De Haan and Hinloopen (1999) also find this positive relationship. They suggest that it indicates some "learning effect", i.e. firms that have a positive experience when acquiring external funds can be more inclined to use external finance than firms that do not have this experience.

In order to explain firms' behavior, the quest is to find theoretical arguments and empirical findings for why a "learning effect" exists. Also, one must examine whether this persistence is an effect of unobserved heterogeneity or of a "true" nature. Following arguments support persistence in firms' external financing choice.

For public issues: The empirical evidence for a negative market reaction to the announcement of equity issue is solid [e.g. Denis (1994), Masulis and Korwar (1986), Asquith and Mullins (1986)] and, also, the observed price reduction at the equity issue announcement is positively related to the firm-specific amount of asymmetric information [e.g. Dierkens (1991)]. A similar, but not as large, negative price effect is also observed for public debt announcement [Manuel et al (1993)]. Studies of frequent and non-frequent equity issuers show that

the announcement effect of equity issuance from frequent issuers cause a less negative market reaction than from those who seldom issue equity. Smith (1986) suggests that the market reaction is a function of the predictability of the issue. Thus, firms that frequently issue equity can do so to a lower cost in terms of a smaller price reduction of their shares outstanding [see McDaniel et al (1994), Bayless (1994), and Jung et al (1996)].

For private debt: Diamond (1989) argues that a long-term relationship between borrowers and lenders lower the cost of asymmetric information. Recent work at Sveriges Riksbank suggests that good relations with a bank increase the possibility that a firm will obtain a loan. Continuing relationships can entail lower costs for lenders that make a series of loans to the same borrower [see Daltung and Nedersjö (1997)]. Also, Easterbrook (1984) argues that external financing can be associated with positive side effects. By obtaining external financing, the suppliers of the "new" capital monitor the firm's management and the shareholders' monitoring cost is reduced if firms constantly are in the market for new capital.

3 Explanatory variables

The econometric model by Honoré and Kyriazidou (2000) makes it possible to include additional regressors other than the lagged dependent variable. When doing so, we follow previous studies, which makes it possible to investigate one of the implications of the pecking order theory, as described by Myers (1984). The pecking order theory implies that firms obtain external financing only when internal funds are not sufficient to finance investment projects. To test the pecking order theory, Helwege and Liang (1996) estimate a logit model to predict external financing. If internal financing are preferred, the amount of available funds should affect the decision to acquire external financing, e.g. an increase in the cash deficit should increase the likelihood of external finance. Variables for cash deficit or funds flow deficit has previously been used by Auerbach (1985), MacKie-Mason (1990), and Myers and Shyam-Sunder (1999).

When an imbalance between operating earnings and committed investments and dividends occur, the firm chooses between either acquiring external finance or reducing the stock of working capital. According to the pecking order theory, the firm should, if possible, avoid external financing. A larger deficit makes it more probable, for any given level of the stock of working capital, that the firm must acquire external capital. We follow Helwege and Liang (1996) and define the expected cash deficit (DEF) as the sum of investments net of sold physical assets and dividend payments less operating earnings before depreciation. To avoid simultaneity, all variables that can be characterized as decision variables,

i.e. dividends and investments, are measured for the year prior to the financing decision. The cash deficit is denominated with total assets, which are measured in the beginning of the period since total assets are contaminated by the effects of the external financing decision.

The stock of working capital (WC) measures the amount of financial slack. De Haan and Hinloopen (1999) measure financial slack as the proportion of liquid assets on the balance sheet. However, we choose to use the stock of working capital, i.e. current assets net of short-term debt. An advantage is that the stock of working capital relates liquid assets to short-term debt, which gives a better picture of the firm's financial flexibility. If firms with larger amount of financial slack are less likely to raise external finance it favors the hypothesis that internal financing is preferred, i.e. firms with a larger stock of working capital are further away from the critical point, where external financing becomes unavoidable. Working capital is denominated with total assets, and is measured in the beginning of the period for two reasons. First, working capital can be characterized as a decision variable. Secondly, if firms raise excess funds when acquiring external capital, the stock of working capital is likely to be contaminated by the external financing decision.

We also include sales growth ($SALGR$). Firms with a higher growth in sales can be more likely to acquire external capital for any given level of expected deficit, since they have more fleeting investment opportunities, and therefore a larger demand for capital. To capture any possible size effect we also include

firm's size ($SIZE$) measured as the log of total assets in the beginning of the period. Since the cash deficit is denominated with total assets, large firms can have small deficits that nevertheless are large sums of money. These firms are expected to finance these deficits externally, despite the deficits' small size relative to total assets.

We define the external financing variable (EXT) following Helwege and Liang (1996). The dependent variable, external finance, is equal to one if a firm either issues public equity or if its long term debt stock has grown with at least 10 percent, and equal to zero otherwise. We define the long-term debt stock by excluding pension liabilities. Helwege and Liang (1996) include an indicator variable for firms that raised funds externally in the previous year. Previous financing (EXT_{t-1}) is an indicator variable which takes the value of one if external finance was acquired in the previous period, and the value of zero otherwise.

Table 1. Expected sign, explanatory variables

DEF	expected cash deficit	$+$
$SALGR$	sales growth	$+$
WC	working capital	$-$
$SIZE$	log of total assets	$+$
EXT_{it-1}	lagged choice	$+/-$

If the costs for receiving external funds are less for firms that more frequently are in the market for external capital, a positive coefficient for the lagged depen-

dent variable is expected. On the other hand, substantial costs associated with external financing should make external financing an isolated phenomenon, and we should expect a negative sign. If the previous external financing decision is of importance for firms when deciding whether or not to acquire external capital, we should recognize this as true state dependence. But to correctly control if the nature of the dependence is of a "true" nature, or an effect of firm characteristic that we can not observe, we must have a dynamic discrete model with fixed effects. In the next section, we discuss the discrete choice model of Honoré and Kyriazidou (2000), which accommodates both a lagged dependent variable and fixed effects.

4 Econometric specification

As was noted in the introduction, it is often observed that an individual that has experienced an event in the past is more likely to do so again. However, as Heckman (1981b) brought forward, distinguishing between "true dependence" and "spurious state dependence" is important. In the case of "true dependence", the experience has a genuine behavioral effect, while in the case of "spurious state dependence", the previous experience appears to be a determinant of future experience solely because it is a proxy for temporally persistent unobservable factors that determine choices. Hence, a proper test for dependence should control for unobserved individual-specific effects.

In this paper, the importance of unobserved heterogeneity and a dynamic structure in the firm's external financing choice will be investigated by estimating the probability of external finance using five different estimation methods.

The five methods are:

ML: Static model, no unobserved heterogeneity.

$$P\left(y_{it}=1\right)=F(x_{it}\beta)$$

MLL: Dynamic model, no unobserved heterogeneity.

$$P\left(y_{it}=1\right)=F(x_{it}\beta+\gamma y_{it-1})$$

CL: Static model, unobserved heterogeneity.

$$P(y_{it}=1)=F\left(x_{it}\beta+\alpha_i\right)$$

CLL: Dynamic model, unobserved heterogeneity, Conditional likelihood.

$$P\left(y_{it}=1\right)=F(x_{it}\beta+\gamma y_{it-1}+\alpha_i)^{CL}$$

HK: Dynamic model, unobserved heterogeneity, Honoré and Kyriazidou.

$$P\left(y_{it}=1\right)=F(x_{it}\beta+\gamma y_{it-1}+\alpha_i)$$

where $F\left(.\right)$ is a logistic cumulative distribution function.

Model ML and MLL are estimated with the maximum likelihood estimator. These models assume homogeneity; i.e. the unobserved individual differences are treated as random events. Belt and Klein (1993) use Model ML, and both Helwege and Liang (1996) and De Haan and Hinloopen (1999) use model MLL, when estimating the likelihood of external financing.

Unlike in the cross-sectional models, maximum likelihood estimates are inconsistent in fixed effects' panel data models, since, for a fixed T, the number of parameters α_i increases with N. This implies that α_i cannot be consistently

estimated for a fixed T. However, if $T \to \infty$, then maximum likelihood of α_i and β are possible. In absence of dynamic feedback from the lagged choice, Chamberlain (1980) suggested a conditional likelihood approach, Model CL, to estimate panel data logit models with fixed effect of the form

$$P(y_{i0} = 1|x_i, \alpha_i) = p_o(x_i, \alpha_i) \tag{1}$$

$$P(y_{it} = 1|x_i, \alpha_i) = \frac{\exp(x_{it}\beta + \alpha_i)}{1 + \exp(x_{it}\beta + \alpha_i)} \qquad t = 1, ..., T; T \geq 2 \tag{2}$$

where β is the parameter of interest, α_i is an individual-specific effect which may depend on the exogenous explanatory variables $\mathrm{x}_i = (x_{i1}, ..., x_{iT})$, and where y_{i0} may or may not be observed.

When using fixed effects, parameters for time-invariant variables cannot be estimated, since α_i captures these effects. Inference concerning β is based on the conditional probability of a particular history of choices between 0 and 1 is dependent of α_i, given the total number of times that the individual has chosen 1, $\sum_t y_{it}$, and given that there is at least one switch between the two alternatives. If $\sum_t y_{it} = 0$ or T, these groups contribute zero to the likelihood function and are discarded. Consider the case where $T = 2$, then the only relevant case is when $(y_{i1} + y_{i2} = 1)$.

Then

$$P(0,1) = \frac{1}{1+\exp(x_{i1}\beta+\alpha_i)} \times \frac{\exp(x_{i2}\beta+\alpha_i)}{1+\exp(x_{i2}\beta+\alpha_i)} \quad (3)$$

$$P(1,0) = \frac{\exp(x_{i1}\beta+\alpha_i)}{1+\exp(x_{i1}\beta+\alpha_i)} \times \frac{1}{1+\exp(x_{i2}\beta+\alpha_i)} \quad (4)$$

Thus, the conditional probability is

$$P[(1,0)|(y_{i1}+y_{i2}=1)] = \frac{P(1,0)}{P(0,1)+P(1,0)} = \frac{\exp[(x_{i2}-x_{i1})\beta]}{1+\exp[(x_{i2}-x_{i1})\beta]} \quad (5)$$

The α_i´s have been eliminated and β may be estimated by maximizing the conditional likelihood function.

The conditional likelihood approach can also be used to estimate panel data logit models where the lagged dependent variable is the only explanatory variable, provided that there exists at least four observation per individual. A problem is that the model does not permit the use of exogenous variables. All it tells is whether y_t depends on y_{t-1}. When including other explanatory variables, as in model CLL above, the residual in time period t will not be independent of the explanatory variables in time period $t-1$, resulting in biased and inconsistent estimates, [see, e.g. Arellano and Honoré (1999)].

Honoré and Kyriazidou (2000) demonstrated that identification of the dynamic logit is feasible if the econometrician has access to four or more observations per individual, when the additional explanatory variables are strictly exogenous. The unobserved individual-specific effects may be correlated with

the observed covariates in an unspecified way. Their suggested estimators are consistent and asymptotically normal, provided that the errors are i.i.d. and logistically distributed. We will describe the identification strategy for $T = 3$. Consider the events A$\equiv\{y_{i0}$=d$_{i0}, y_{i1} = 0, y_{i2} = 1, y_{i3} = d_{i3}\}$, and B$\equiv\{y_{i0}$=d$_{i0}, y_{i1} = 1, y_{i2} = 0, y_{i3} = d_{i3}\}$ where d$_{i0}$ and d$_{i3}$ are either 0 or 1. Here conditioning only on the sufficiency class, i.e. $\sum_{t=1}^{T} y_{it}$, will not eliminate the individual effects.

In general $P(A|x_i, \alpha_i, A \cup B)$ will depend on α_i, which is the reason why a conditional likelihood approach will not eliminate the fixed effect. However, Honoré ´and Kyriazidou show that the individual effects can be eliminated and the parameters are identified if $x_{i2} = x_{i3}$. Then

$$P(A|x_i, \alpha_i, A \cup B, x_{i2} = x_{i3}) = \frac{1}{1 + \exp((x_{i1} - x_{i2})\beta + \gamma(d_{i0} - d_{i3}))} \quad (6)$$

$$P(B|x_i, \alpha_i, A \cup B, x_{i2} = x_{i3}) = \frac{\exp((x_{i1} - x_{i2})\beta + \gamma(d_{i0} - d_{i3}))}{1 + \exp((x_{i1} - x_{i2})\beta + \gamma(d_{i0} - d_{i3}))} \quad (7)$$

which does not depend on α_i.

If the continuous variables in $x_{i2} - x_{i3}$ have a power density at 0, one can derive an estimator, which puts increasing weights on observation for which x$_{i2}$ is close to x$_{i3}$. Honoré and Kyriazidou propose for the binary choice model, in

the case of general T, that β and γ are estimated by maximizing

$$\sum_{i=1}\sum_{1\le t<s\le T-1} 1\{d_{it}+d_{is}=1\}K\left(\frac{x_{it+1}-x_{is+1}}{h_n}\right)\times \ln\left(\frac{\exp((x_{it}-x_{is})\beta+\gamma(d_{it-1}-d_{is+1})+\gamma(d_{it+1}-d_{is-1})1\{s-t>1\})^{d_{it}}}{1+\exp((x_{it}-x_{is})\beta+\gamma(d_{it-1}-d_{is+1})+\gamma(d_{it+1}-d_{is-1})1\{s-t>1\})}\right)$$

where $K(.)$ is a kernel density function which gives the appropriate weight to observation i, i.e. more weight to observations with smaller differences, and h_n is a bandwidth which shrinks as n increases. The estimator will have a slower rate of convergence than $n^{-\frac{1}{2}}$. Also, as the number of continuous exogenous regressors increases, the rate of convergence will be slower.[1]

A major limitation of their approach is the assumption that $x_{it}-x_{is}$ has support in a neighborhood of 0 for any $t \neq s$, which rules out time-dummies as explanatory variables.[2] An advantage is that, in contrast to other likelihood-based approaches, the Honoré and Kyriazidou approach does not require modeling of the initial observation of the sample. Further, it does not make any assumption about the statistical relationship of the individual effects with the observed covariates, or with the initial conditions, [Honoré and Kyriazidou (2000)].

[1] A suggested bandwidth form is $h_n = h \times n^{-\frac{1}{2*s+k}}$, where h is the bandwidth constant, k is the number of exogenous continuous regressors, and s is the number of times that the kernel density function is continuously differentiable on its support. For a normal density, s is equal to 2. See Honoré and Kyriazidou (2000) for further details.

[2] Chintagunta et al (1998) also mention the following limitations: First, the assumption that the errors in the underlying threshold-crossing model are independent over time. Secondly, since individual unobservable effect can not be estimated it is not possible to carry out or compute elasticities for individual agents or at specified values of the explanatory variables. However, it is possible to calculate elasticities for the observed sample population.

Table 2. Summary of econometric models

Model	ML	MLL	CL	CLL	HK
Heterogeneity	No	No	Yes	Yes	Yes
Lagged dependent variable	No	Yes	No	Yes	Yes
Consistent	Yes	Yes	Yes	No	Yes

A Monte Carlo study performed by Chintagunta et al (1998) shows that the conditional logit methods, CL and CLL, give a smaller average bias of the exogenous variables than the Honoré and Kyriazidou estimator. CLL gives smaller average biases for all the exogenous variables. On the other hand, the CLL estimator performs very badly when estimating the coefficient of the lagged dependent variable, which is significantly underestimated. On average the bias ranges from 80 to 100 percent of the true value depending on design. Chintagunta et al (1998) conclude that the conditional logit appears to be the most robust in estimating the coefficient on the exogenous variables, but produces poor estimates of the coefficient for the lagged dependent variable. The HK estimator produces estimates with small biases, both for the exogenous regressors and the lagged dependent variable, which makes the HK estimator preferable when estimating a dynamic model in the presence of unobserved heterogeneity.

Since we have four exogenous and continuous regressors, a bandwidth of the form $\mathrm{h}_n = h \times n^{-\frac{1}{8}}$ is chosen for the HK method, where n denotes the number of strings (firms), and h is a positive constant set to 8. Monte Carlo studies by Honoré and Kyriazidou (2000) with four exogenous continuous variables show that the cost is not high for introducing additional parameters. The functional

form for the kernel function $K(.)$ is the multivariate normal density function. Regarding the bandwidth constant, the Monte Carlos conducted by Honoré and Kyriazidou (2000) show that the mean absolute error (MAE) decreases as the bandwidth constant increases. The MAE becomes fairly constant when h is set to 8 or more. In the Monte Carlos by Chintagunta et al (1998), the HK estimates show no pattern of bias as the bandwidth increases, and, in general, the standard deviations of the coefficients decrease as the bandwidth increases. When Chay and Hyslop (1998) apply the HK estimator, the coefficient-estimates of the exogenous regressors are sensitive to which bandwidth constant, h, that is chosen, while the estimate of the state dependence, γ, is insensitive to the choice of bandwidth constant.[3]

5 Data

Data will be used from the database CoSta, which consists of information on nonfinancial companies located in Sweden during the period 1979 to 1996. It contains information on the income statements and balance sheets of legal entities. More information about CoSta is available in the Appendix. From the original dataset, the following sample selections have been made. Companies with less than 20 employees are excluded. Also, companies with a financial year other than twelve months, and companies that are not identical from previous

[3] Therefore, to show the sensitivity of the results when alternative bandwidth constant are chosen, we report additional results for the HK method in the Appendix. In Appendix we set h to 0.5, 2, 5, 20 and 100.

year, are excluded. We construct a panel of all firms we can follow through the sample period 1991-1996. Also, firms were only included if complete data were available both for the dependent and the explanatory variables through the period of estimation. These sample selection result in a total of 13662 observations, 2277 firms. Summary statistics for the variables used are given in table 3.

Table 3: Characteristics of firms.

Variable	Obs	Mean	Std. dev	Min	Max
EXT	13662	0.4587908	0.4983171	0	1
DEF	11385	-0.0836438	0.1745284	-1.834095	3.432081
WC	11385	0.2231406	0.2186433	-0.9458874	0.8840445
$SALGR$	11385	0.083328	0.4493094	-0.998735	29.44143
$SIZE$	11385	10.93524	1.33547	7.232733	16.09387

The sample mean of frequency in the market for external capital are 2.75 with a standard deviation of 1.63. Table 4 displays this distribution.

Table 4. Frequency in the market for external capital.

Occasions	0	1	2	3	4	5	6
Frequency	936	2256	3408	3054	1854	966	1188

Table 5 displays the number of firms seeking external financing over the sample period. It is a fairly even distribution with the lowest value in 1992, when approximately 43,0 percent of the sample acquired external financing, in contrast to the peak in the initial period 1991 with a percentage of 51,8 percent.

Table 5. Number of firms seeking external capital per year

Year	91	92	93	94	95	96
Observations	1179	978	985	1005	1069	1052
Proportion	0.518	0.430	0.433	0.441	0.469	0.462

In this final sample there is a low frequency of equity issues. Only 350 observations, 2.56 percent of the sample, issue equity. External finance is dominated by debt. 44.4 percent of the observations have increased their debt stocks by at least 10 percent during the last year. 154 of the 350 observations that issued equity also raised new debt. A rather large percentage of the sample, 88.0 percent, does invest. These investments must be financed internally or externally. Those firms who do not invest or have negative investment should have smaller incentives to seek external financing. Table 6 displays the conditional distribution of investment and financing.

Table 6: Conditional distribution of investment and financing.

$_{EXT}\backslash^{INVD}$	1	0	Total
1	0.4071	0.0517	0.4588
0	0.4731	0.0681	0.5412
Total	0.8802	0.1198	1.0

Note: if external financing; EXT=1, if positive investments INVD=1.

More than five percent of the sample seek external financing without investing. One explanation for this phenomenon can be that some of the firms have obtained external financing at the end of year t and invest in the beginning of $t+1$. Nearly seven percent of the sample do neither obtain external financing

nor invest. The main source of financing investments is internally generated funds. Table 7 displays the pairwise correlation of the included variables.

Table 7: Pairwise correlations, explanatory variables.

Variable	EXT	DEF	WC	$SALGR$	$SIZE$	$Yt-1$
EXT	1.0000					
DEF	0.0194*	1.0000				
WC	-0.0570*	-0.0107	1.0000			
$SALGR$	0.0259*	-0.0472*	-0.0241*	1.0000		
$SIZE$	-0.0169	0.1068*	-0.0586*	0.0098	1.0000	
EXT_{t-1}	0.2225*	0.1144*	0.0412*	0.0298*	0.0083	1.0000

Note: * significance at the 5 percent level or better.

6 Results

The results are reported in table 8. Models that do not consider unobserved heterogeneity, both without (ML) and with (MLL) a dynamic structure, are presented in column one and two. In column three and four are the results from the conditional likelihood approach, without (CL) and with (CLL) a dynamic structure presented. The results for the HK-estimator are reported in column five. As previously been mentioned, note that of the three models that include the lagged dependent variable, i.e. MLL, CLL and HK, only the MLL and HK models provide a consistent estimate of the lagged choice.

Table 8: Estimation results. Probability to obtain external financing.

Model	ML	MLL	CL	CLL	HK8
DEF	0.2790**	-0.0355	0.6157***	0.8961***	0.1772
	(0.1128)	(0.1148)	(0.1887)	(0.1944)	(0.1657)
WC	-0.5325***	-0.6704***	-3.4396***	-3.2408***	-3.8163***
	(0.0870)	(0.0896)	(0.2338)	(0.2342)	(0.2334)
$SALGR$	0.1599**	0.0789	0.0098	0.0499	0.1313
	(0.0656)	(0.0554)	(0.0695)	(0.0829)	(0.0826)
$SIZE$	-0.0360***	-0.0392***	-1.4826***	-1.3852***	-1.2972***
	(0.0143)	(0.0146)	(0.1270)	(0.1276)	(0.1171)
EXT_{t-1}		0.9365***		-0.4607***	0.3359***
		(0.0394)		(0.0513)	(0.0384)
constant	0.3990**	-0.0885			
	(0.1657)	(0.1695)			
n[4]	11385	11385	8815	8815	5321
Timedummies	Yes	Yes	Yes	Yes	No

Notes: ***,**,* denotes significance at the 1, 5, and 10 percent level, respectively.

Standard errors are inside parentheses. In HK8 the bandwidth constant h is set to 8.

[4]The different estimation techniques have different restrictions on which observations that contribute to the likelihood function. The methods that have the lagged choice as an explanatory variable, MLL, CLL and HK, use only the initial value of the dependent variable from the first year of the path. The models that do not include the lag, CL and ML, do not use the initial information of each path. Further, the conditional likelihood methods, CL and CLL, only use observations with at least one switch after the initial value. Only these observations contribute to the likelihood function. The HK estimator is the most restrictive, considering only observations with switches in the middle four periods giving an effective string length of $\mathsf{T}-2$.

Consistent with the pecking order theory, the expected cash deficit (DEF) has a positive impact on the probability of obtaining capital externally. However, when the lagged dependent variable is included in the model and consistently estimated, i.e. in the MLL and HK models, the coefficient is no longer significant. In the previous studies, Helwege and Liang (1996) do not receive a significant coefficient for the expected cash deficit, while De Haan and Hinloopen (1999) do, as expected, receive a significant positive coefficient.

The stock of working capital (WC) is negatively related to the possibility of obtaining external financing, and is significant in all models at the one percent significance level. This is consistent with the pecking order theory, indicating that firms prefer internal financing and substitute external financing against financial slack. This result is consistent with De Haan and Hinloopen's (1999), who measure financial slack as the ratio of liquid assets to total assets. However, when adding firm-specific effects, the coefficient changes from about -0.6 in, ML and MLL, to over -3 in the CL, CLL, and the HK. The same pattern can be recognized for the coefficient for firm size (SIZE), which also changes dramatically when adding firm-specific effects. This indicates that these two variables are correlated with some unobserved characteristics, resulting in upward biased results in the models assuming homogeneity.

In contrast to previous studies, i.e. Helwege and Liang (1996), De Haan and Hinloopen (1999), and Klein and Belt (1993), which all find a positive relationship between firms' size and the possibility of external financing, larger

firms are less probable to seek external financing. This difference can be due to the fact that previous studies ignore unobserved heterogeneity, which in this sample gives upward biased results. Another difference is that previous studies focus on publicly listed companies, while this sample contains a larger variety of companies. It is possible that, for any given level of expected deficit, a smaller firm have more fleeting investment opportunities relative to their capital stock.

The coefficient for the lagged dependent variable is significant at the one percent significance level in all models with a dynamic structure, i.e. MLL, CLL, and HK. A negative sign on the coefficient of lagged choice would imply that there are higher costs associated with external financing than possible benefits of repeatedly obtaining external financing. In that case, when entering the capital markets, firms would rather acquire more capital than needed than smooth financing over time. A positive sign indicates the existence of positive side effects associated with repeatedly being in the market for external capital. These reduce the costs of the information asymmetry between management and financiers.

In both models that consistently estimate the lagged dependent variable, i.e. MLL and HK, the coefficient is positive at the one percent significance level. In the MLL model, the positive effect of the previous financing variable is 0.94. However, introducing heterogeneity as in the HK model lowers it substantially to 0.34. Thus, the MLL ignore possible heterogeneity, which introduce spurious state dependence, giving upward biased results. In contrast to the two models

that consistently estimate the lagged dependent variable, the CLL estimator estimate the coefficient for the lagged dependent variable negative at the one percent significance level. The fact that maximum likelihood estimators produce biased estimates of the lagged choice in models with both fixed effects and a lagged dependent variable is well documented [e.g. Heckman (1981a)]. This is also supported by the results from the Monte Carlo simulations by Chintagunta et al (1999), which show that the conditional likelihood estimator with fixed effects underestimate the coefficient for the lagged choice.

A drawback with the HK estimator is that it does not allow for timedummies. The four other methods have been estimated including timedummies in table 8. For comparable reasons, we have also estimated these estimators without timedummies. Table 10 in the Appendix reports these additional results. These show that the results are not particularly sensitive to the inclusion of timedummies. Also, to show the sensitivity of the results from the HK model to which bandwidth constant that are chosen, we estimated the HK model with several bandwidth constants. Table 11 in the Appendix reports these additional results, which show that only the coefficient for the expected cash deficit is sensitive to the choice of bandwidth constant.

Finally, we turn to the economic implications of the point estimate for the state dependence. Since the lagged choice is discrete, we calculate semi-

elasticities based on discrete changes,

$$-\frac{\Delta\Pi_{it}}{\Pi_{it}} = -\frac{(\Pi_1 - \Pi_0)}{\Pi_0} = -(1 - \frac{e^{\gamma}}{1 + (e^{\gamma} - 1)\,\Pi_{it}})$$

where Π_{it} is the probability that external financing is acquired. We calculate semi-elasticities for the MLL and HK8 at three different probabilities, Π_{it} = 0.25, 0.5, 0.75. These probabilities correspond to fixing $x_{it}\hat{\beta} + \alpha_i$ to -1.1, 0, and 1.1, respectively.

Table 9: Economic importance, lagged choice

Estimator \ Π_0	0.25	0.50	0.75
Π_1			
Π_1^{MLL}	0.4592	0.7184	0.9292
Π_1^{HK8}	0.3400	0.5832	0.8268
Changes in probability			
$\Delta\Pi^{MLL}$	0.2092	0.2184	0.1346
$\Delta\Pi^{HK8}$	0.0678	0.0832	0.0594
Semi-elasticities			
MLL	0.8382	0.4368	0.1792
HK8	0.2722	0.1664	0.0768

Note: $\Delta\Pi = \Pi_1 - \Pi_0$, where $\Pi_0(\Pi|y_{it-1} = 0)$, and $\Pi_1(\Pi|y_{it-1} = 1)$.

From the elasticities in table 9, we note that the lagged choice has a strong influence on the external financing choice in both estimation methods. Having acquired external capital in the previous period increases the probability of ac-

quiring external financing again from 0.50 to approximately 0.58 using the HK8 estimate and to 0.72 using the MLL estimate. By not including fixed effects, the importance of the lagged choice more than double. Thus, the economic importance of the lagged choice is overstated in the MLL estimate by the presence of "spurious state dependence". However, from the HK estimate we can conclude that a firm currently acquiring external financing is more likely to do so again in the next period in the sense of "true state dependence".

7 Conclusions

This study has examined the dynamic process underlying firms' discrete external financing choice, and possible explanations for why a smoothing of financing previously has been found. Previous studies focusing on firms' discrete external financing decision find a smoothing of financing, but ignore unobserved heterogeneity. Without controlling for unobserved heterogeneity, this dependence can either be of a "true" nature or an effect of firm-specific characteristics that we cannot observe. Introducing heterogeneity, as in the HK model, lowers the degree of the dependence. Thus, ignoring possible heterogeneity, introduces spurious state dependence giving upward biased results.

After controlling for unobserved heterogeneity we still find a smoothing of financing, and also that unobserved heterogeneity plays a significant explanatory role. The presence of "spurious state dependence" makes us overstate the

importance of the lagged choice. The increase in the probability of acquiring external financing of acquired external financing in the previous period is more than twice as large than when including fixed effects. However, even after controlling for unobserved heterogeneity, firms that acquire external capital is approximately 6 to 8 percentage more likely to do so again in the next period.

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8 Appendix

8.1 Additional results

Table 10: Estimation results without timedummies.

Model	ML	MLL	CL	CLL
DEF	0.2653**	-0.0689	0.4058**	0.7072***
	(0.1114)	(0.1136)	(0.1813)	(0.1877)
WC	-0.5220***	-0.6554***	-3.2013***	-3.002***
	(0.0869)	(0.0894)	(0.2292)	(0.2295)
$SALGR$	0.1823***	0.1059*	0.0702	0.1213
	(0.0661)	(0.0554)	(0.0801)	(0.0888)
$SIZE$	-0.0331***	-0.0358**	-0.9885***	-0.9003***
	(0.0142)	(0.0146)	(0.1109)	(0.2295)
EXT_{t-1}		0.9288***		-0.4683***
		(0.0394)		(0.0510)
constant	0.2725*	-0.1256		
	(0.1596)	(0.1643)		
n	11385	11385	8815	8815
Timedummies	No	No	No	No

Note: ***,**,* denotes significant at the 1, 5 and 10 percent level respectively.

Standard errors are inside parentheses.

Table 11: Estimation results for the HK estimator. Different bandwidths

Model	HK05	HK2	HK5	HK20	HK100
DEF	1.7300***	0.4142**	0.2103	0.1559	0.1530
	(0.307)	(0.173)	(0.166)	(0.166)	(0.166)
WC	-5.5512***	-4.0465***	-3.8310***	-3.8116***	3.8046***
	(0.408)	(0.2404)	(0.233)	(0.234)	(0.234)
$SALGR$	-0.0604	0.1230	0.1363	0.1229	0.1216
	(0.177)	(0.090)	(0.084)	(0.082)	(0.082)
$SIZE$	-2.9897***	-1.5784***	-1.3414***	-1.2680***	-1.2646***
	(0.249)	(0.126)	(0.118)	(0.116)	(0.116)
EXT_{t-1}	0.3173***	0.3343***	0.3353 ***	0.3371***	0.3387***
	(0.056)	(0.039)	(0.038)	(0.038)	(0.038)

Note: ***,**,* denotes significant at the 1, 5, and 10 percent level respectively. Standard errors are inside parentheses. HK05, HK2, HK5, HK20 and HK100 denotes bandwidth constants of 0.5, 2, 5, 20 and 100 respectively.

8.2 CoSta

CoSta is administrated at the Department of Economics, Uppsala University, Sweden. The database is constructed mainly by an extract from Enterprises - Financial Accounts but also by The Corporate Group Register, which are both collected from Statistics Sweden. CoSta contains only corporations, economic associations, trading companies, limited partnerships and foundations. Companies that have income less than 50.000 SEK are excluded and also companies in

real estate management, ISIC 7. CoSta covers corporations and economic associations during the period 1979 to 1996. Companies owned by municipalities and also companies in the farming sector, ISIC 1 are excluded. Furthermore, for the period 1979 to 1983, only companies in the business services, ISIC 832, within financing, insurance, real estate and business services, ISIC 8, and companies in the personal and household services, ISIC 95, within community, social and personal services, ISIC 9, are included in CoSta. For the period 1984 to 1996 companies in CoSta that belongs to a corporate group are identified and selected information from The Corporate Group Register is added. Information on corporate group affiliation, and the state as a corporate group mother or a daughter is available for these companies.[Hansen (1999)]

8.3 Definition of variables

The variables used are defined as in Hansen (1999). The firms operating earnings before depreciation is defined as:

$$OPEAR_{it} = Var011_{it}$$

Investment is a measure of spending on machinery, equipment and business structures. It also takes into account assets acquired through takeovers, net of assets sold.

$$E(I_{it}) = I_{it-1} = Var115_{it-1} + Var119_{it-1} - Var127_{it-1} + Var116_{it-1} + Var120_{it-1} - Var128_{it-1} + Var117_{it-1} + Var121_{it-1} - Var129_{it-1}$$

where the investment dummy (INVD) takes the value of one if $I_{it} > 0$, otherwise zero.

Sales growth is defined as:

$$SALGR_{it} = \frac{Var005_{it} - Var005_{it-1}}{Var005_{it-1}}$$

The firm is seeking external finance if the long-term debt stock, net of pension provisions, has grown with at least 10 percent.

$$\frac{(Var088_{it} - Var85_{it}) - (Var088_{it-1} - Var085_{it-1})}{Var088_{it-1} - Var085_{it-1}}$$

or if new equity is issued, $\text{Var112}_{it} > 0$

Working capital (WC) is defined as total current assets net of total current liabilities, denominated with total assets

$$WC_{it} = \frac{Var063_{it-1} - Var083_{it-1}}{Var077_{it-1}}$$

Dividends (DIV) are expressed in percentage of total assets.

$$E(DIV_t) = DIV_{it-1} = Var111_{it-1}$$