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Kåre Soegaard Valgreen

Statistics
Danmarks Nationalbank

Survey design, survey maintenance and grossing up in the IIP and balance of payments system

January 2008

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Resumé:
Groft skitseret er verdens betalingsbalancesystemer delt op i to typer. Den ene type er baseret på bankers udlandsbetalinger, som udgør totaltællinger af populationerne, mens den anden type – heriblandt det danske – baseres helt eller delvist på stikprøver. Dette papir beskriver kort, hvordan stikprøven er udvalgt i Danmark, og hvordan der opregnes i systemet. Fokus er imidlertid på, hvordan stikprøven vedligeholdes over tid, så den over det mellemlange sigt dækker populationen både højt – dvs. der er en høj overordnet dækning – og bredt – dvs. alle instrumenter og sektorer dækkes. Der er mange lande, der står over for lignende problemstillinger, og Danmarks løsninger kan forhåbentlig give inspiration og generere diskussion.

I det danske system er sektorerne ikke-finansielle virksomheder, andre finansielle formidlere samt forsikring og pension stikprøvedækket på instrumenterne egenkapital, koncernlån mv., lån og indskud, handelskreditter, andre investeringer samt finansielle derivater. På baggrund af et dynamisk register og ved anvendelse af simpel statistisk metode vedligeholdes stikprøven og opregningen på instrumentet egenkapital. For koncernlån mv., lån og indskud samt andre investeringer er der udviklet en anden metode til at vedligeholde stikprøven. For disse instrumenter ligger opregningen konstant. Handelskreditter opregnes og vedligeholdes på baggrund af udenrigshandelsstatistikken via en meget simpel og gennemskuelig metode. Derivater og finansiel leasing antages helt dækket af stikprøven.

Abstract:
Balance of payments systems all over the world can roughly be categorised in two – settlement-based systems and survey-based systems such as the Danish. This paper deals with the selection of the Danish survey and the grossing-up estimation. Focus, however, is on the Danish methods of survey maintenance over the medium term insuring both high total survey coverage and broad coverage in terms of instruments and sectors. Many countries with survey-based systems confront similar challenges and the working paper can hopefully be of inspiration and generate discussion.

In the Danish system equity, intercompany debt, etc., loans and deposits, other investments, trade credits and financial derivatives are survey-covered for the sectors non-financial corporations, other financial intermediaries and insurance and pension funds. Using a dynamic register on financial account data and simple statistical methods the survey coverage on equity is maintained and the grossing-up is dynamically re-estimated. For intercompany debt, etc., loans and deposits, and other investments a method has been developed to maintain coverage over time while grossing-up is assumed constant. Trade credit coverage and grossing-up is maintained by a very simple method using foreign trade statistics. Derivatives and financial leasing are assumed covered by the survey.

Survey design, survey maintenance and grossing up in the IIP and balance of payments system

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January 2008

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1. Introduction

In March 2006 Danmarks Nationalbank for the first time published statistics on external financial transactions as well as external assets and liabilities (BoP/IIP) from one coherent compilation system partly based on a survey of reporters. While previously the data collection was centred on a payment-based system, the statistics are now based on the most up-to-date statistical methods and reporting formats and partly survey-based. The reform has both improved the quality of the statistics and reduced the reporting burden on the business community[1]. Denmark has by this system reform followed the developments in large parts of Europe towards more and more survey-based (BoP/IIP) systems. The practical topics of survey design and maintenance discussed in this paper are therefore relevant for many countries in Europe[2]. Hopefully the solutions to these issues presented in the paper can inspire countries confronting similar system challenges.

The new system in Denmark has two key characteristics. Firstly, the system consists of stocks, flows and valuation changes. It is therefore one coherent system for both stock and flow output statistics. Secondly, about one third of the data is now based on a survey of reporters. When designing a survey-based statistical system there are a number of key challenges. Which sampling strategy to choose for the sample and how to choose the reporters in practise? How to gross-up the data? How to maintain coverage of the sample over time? All these questions are of course interlinked and all of them are to some degree dealt with in this working paper; primarily from a practical view. The main focus, however, is on the maintenance of the survey and the grossing-up over time. The solutions ensure high coverage of the survey and thereby accuracy of the statistics in the years to come.

2. The system – an overview

The system takes advantage of two existing sources: The securities statistics and the MFI statistics. This strongly reduces the remaining areas covered by the survey of reporters; cf. the grey field in Chart 1. Administrative sources at Danmarks Nationalbank and Statistics Denmark cover the public sector by 100 per cent.

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1 For a comprehensive description of the entire system and the reasons for the system change see: "Denmark's balance of payments and international investment position", Danmarks Nationalbank, January 2007.

2 Among the countries with survey-based systems are the Netherlands, Finland, England, Ireland, Norway, Sweden, Switzerland and also the US and Canada.

OVERVIEW OF DATA SOURCES BY INSTRUMENT — CHART 1

	Portfolio investments	Direct investments		Financial derivatives, net	Other investments			
Sector/instrument	Shares and bonds, etc.	Equity	Intercompany debt, etc.		Trade credits	Loans and deposits	Other	Reserve assets
MFIs	Securities statistics (100 per cent)	MFI statistics (100 per cent)						
Other enterprises		Reporting by enterprises (*90 per cent*)						Not applicable
Government		Danmarks Nationalbank and Statistics Denmark (100 per cent)						
Households		MFI statistics and calculations						

The reporting population comprises three sectors – non-financial corporations, other financial intermediaries and auxiliaries, as well as insurance companies and pension funds. The paper deals with this survey of reporters covering approximately one third of the output statistics. The analyses in the paper are presented instrument by instrument covering all survey-covered instruments, i.e.:

- Direct investments: Equity and intercompany debt, etc.
- Other investments: Loans and deposits, trade credits and other investments (including financial leasing).
- Financial derivatives.

3. Sample design – why cut-off?

One of the first challenges when designing the new system was to select the optimal sample design. There are many issues to consider in such an analysis, but the overall criterion is to minimize the systematic errors of the sample and the costs[3]. In the following the main arguments in favour of the chosen cut-off strategy are presented.

In cut-off sampling the largest enterprises are selected as the survey sample using one or more auxiliary variable(s) correlated with the data measured – in this case transactions and stocks in external assets and liabilities[4]. By choosing the enterprises with the largest value(s) of the auxiliary variable(s) the overall coverage rate is maximised. The survey may, however, be biased because it is not selected randomly from the population – or the frame[5]. In other words, the largest enterprises may not be representative of the smallest which results in biased esti-

---

3 The term costs should be understood in its broadest sense, for instance the social costs of the reporting enterprises together with costs of implementing and maintaining the system at Danmarks Nationalbank.

4 It is not easy to give a unique, clear-cut definition of the cut-off methodology. The basic formulation (Hansen et al. 1953, p. 486-490, Sarndal et al. 1992, p. 531-533), frequently employed in the field of price collection, is characterized by a threshold so that units above are included in the sample with probability one and units below are discarded.

5 The frame is the empirical equivalent to the population.

mates of the tail. However, when choosing the largest enterprises you minimize both the non-response and the measurement error. This is an argument hardly ever mentioned in theory. The largest enterprises have most resources and specified knowledge and are therefore more stable respondents. The large enterprises typically send data by programmed systems, which means that human errors are minimized and over time deleted from the reports. In the cut-off design it is more or less the same respondents who report month after month making it possible to learn from mistakes and correct errors.

Another strong argument is that the best possible correlated auxiliary variables were available: the old settlement system's data on financial transactions and external assets and liabilities. We did have a situation of near perfect information about the population from the old system. In order to minimize the effect of the bias of the estimates, a rather large sample coverage was chosen in terms of data reported – not by number of enterprises. The population has – as many other business populations – a very skewed distribution with few large enterprises and many small and medium ones. Therefore one of the cost arguments in favour of a cut-off design is that few enterprises are needed to reach a high coverage[6]. The reporting survey only covers around 1 per cent of the Danish enterprises, but more than 90 per cent of the foreign transactions and stocks.

4. Initial selection and grossing-up

The process of building the system was divided in two steps – first transactions and then stocks and valuation changes – and so was the initial survey selection. The first and largest survey is mainly focused on transactions, but also covers a substantial part of the stocks. It comprises about 700 monthly reporters who also report some data yearly. The second, smaller survey comprises about 400 yearly reporters and its main focus is stocks.

When the initial cut-off survey(s) were chosen we had very accurate registers to choose from because the former settlement-based system in principle included the total population on transactions[7]. The old IIP (stock) system was based on a larger sample of approximately 2000 reporting enterprises and was therefore also a useful register when designing the second sample. Two main selection criteria were used.

---

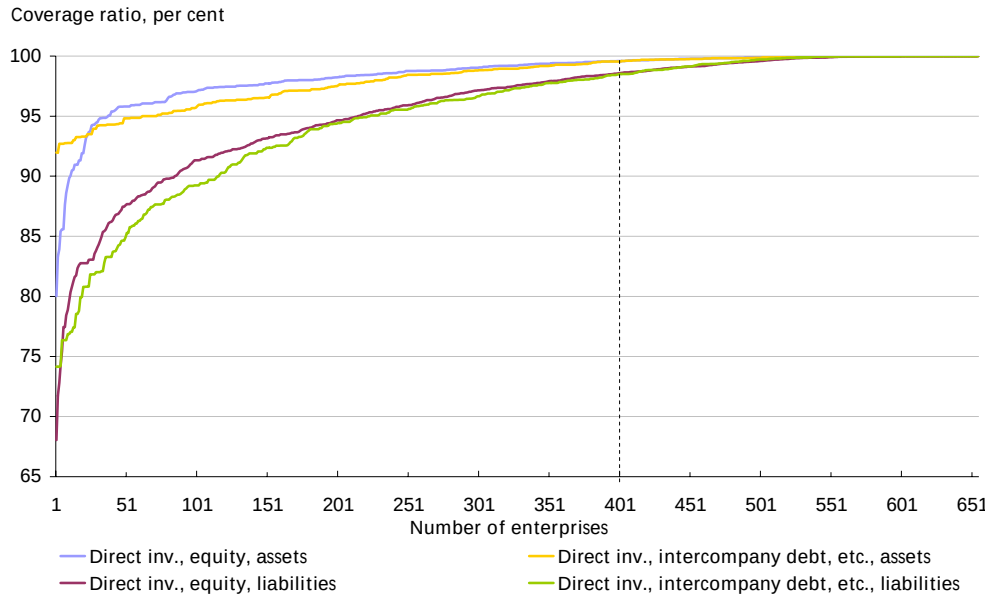
[6] As discussed in Sigman and Monsour (1995) cut-off strategies are often appropriate in business surveys because the skewness of the populations.

[7] All transactions above 250,000 DKK were registered.

Coverage rates were calculated by sector, instruments, assets/liabilities, and stocks/flows and all enterprises were selected if they were among the largest – defined by a 90 per cent threshold[8]. For instruments covering a large part of the output statistics even more enterprises were chosen in order to get a higher overall coverage rate[9].

Chart 2 illustrates the coverage rates measured on stocks of direct investments for the non-financial sector when choosing the second survey of around 400 reporters. The crossing of the Y-axis for the instruments shows how much the first and largest transaction-based sample covered of the stocks. Chart 2 also shows that choosing a relatively small extra number of enterprises to the second survey resulted in high coverage rates measured by stocks on both the asset and liability side. This analysis was done for all three sectors and all instruments on the stocks based on data from the old IIP system.

COVERAGE RATES, STOCKS OF DIRECT INVESTMENTS, BY INSTRUMENT, END 2004 CHART 2



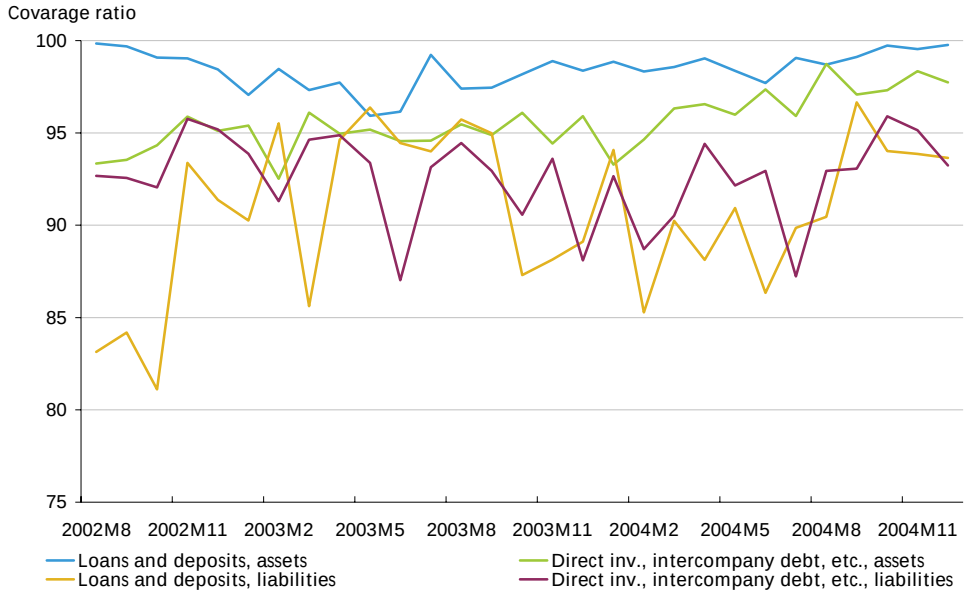
The exact same analysis was done on the flow data when the first and largest survey was chosen, covering transactions over a time period of more than two years. Chart 3 illustrates the coverage rates of both sur-

8 Trade credits were only covered in the old IIP system and not in the old settlement system. This was just one of the shortcomings in the old transactions system. Therefore trade credits have been grossed up by using data from the old IIP system – assuming same coverage on transactions and liabilities.

9 All remaining insurance and pension funds were selected in the second survey in order to focus the grossing up solely on two sectors.

veys on the instruments, intercompany debt and loans and deposits on the asset and liability side.

COVERAGE RATES, TRANSACTIONS, INTERCOMPANY DEBT AND LOANS AND DEPOSITS CHART 3



The grossing-up was then estimated by OLS regressions, by instrument and sector on time series for the period covered by Chart 3 – August 2002 until December 2004. The total from the settlement system was the dependent variable and the survey's share of the total was the explanatory variable. Single large observations were given smaller weights in the regression and the estimated coefficient minus one was then implemented as the grossing-up measures. Results of the regressions for non-financial enterprises are shown in Table 1. The parameter estimate in the table minus one is the percentage by which loans and intercompany debt is grossed-up on the asset and liability side. For instance the grossing-up on intercompany debt assets is 4.05 pct. which is added to the reported stocks and flows.

REGRESSION RESULTS ON TRANSACTIONS, INTERCOMPANY DEBT AND LOANS AND DEPOSITS FOR NON-FINANCIAL ENTERPRISES, AUG 2002 – DEC 2004 TABLE 1

	Parameter	Standard error	R^2
Intercompany debt, assets	1.04048	0.00302	0.9998
Intercompany debt, liabilities	1.07472	0.00538	0.9993
Loans granted abroad	1.00484	0.00095	0.9999
Loans received from abroad	1.08631	0.01619	0.9938

Chart 3 also illustrates the ever changing nature of the survey coverage. Over time the survey will cover a decreasing fraction of the popu-

lation. This development has so far been slowed down by the concentration of the business community – the largest cover an increasing part of the total. This explains why the overall coverage did not fall during the two years, but leads to the following important question. Given the old registers are static and the world is ever changing – how do we keep up the coverage rates and thereby the quality of the statistics and the grossing-up in the system?

5. Maintenance of the survey and grossing-up[10]

The solutions implemented to maintain the survey differ by instrument. For foreign direct investments in equity a dynamic population register based on ownership data from the commercial data provider Bureau Van Dijk (BvD) has been used to add enterprises to the survey and dynamically adjust the grossing-up. For intercompany debt, loans and deposits and other investments, two different types of analysis of financial report data (also BvD data) lead to a register containing estimated variables. This register forms the basis for maintenance of the survey coverage. The central idea is to use the near perfect information about the population existing when it was chosen and keep choosing the same types of enterprises. By choosing enterprises with the same modelled characteristics as the initial selected survey – the aim is to keep the coverage status quo. Trade credits are maintained by a simpler approach based on foreign trade statistics. The method is not described in detail. Financial leasing covers a very small part of the statistics and are not elaborated further in the paper. Derivatives are mainly traded by the largest enterprises and especially by pension funds, and they are assumed covered by the survey. Chart 4 gives an overview of the survey-covered instruments and the implemented solutions.

OVERVIEW OF SECTORS, INSTRUMENTS AND MAINTENANCE METHODS — CHART 4

	Direct investments		Other investments				Financial derivatives, net
Sector/instrument	Equity	Intercompany debt, etc.	Loans and deposits	Other	Trade credits	Financial leasing	
Non-financial corporations	Dynamic maintenance and grossing-up (BvD)	Survey maintenance based on initial selection (BvD) and constant grossing-up			Foreign trade survey - simple method	100 per cent	100 per cent
Other financial intermediaries							
Pension and insurance funds	100 per cent coverage is assumed						

[10] Jens Rask Nordestgaard has played an important role in creating and implementing the solutions for maintaining the survey population.

5.1. Foreign direct investments, equity

The commercial data provider Bureau Van Dijk (BvD) registers financial report data and specialises in data regarding ownership structures of enterprises. The ownership data in BvD can be used to specify two frames on equity as illustrated in Chart 5. The Danish enterprises owned or partly owned by more than 10 per cent by one or more foreign residents constitute the frame on the liability side. The Danish enterprises owning one or more foreign enterprises by more than 10 per cent constitute the frame on the asset side. For both the asset and liability side the fact that a precise frame can be found means that the method not only results in a maintenance register, but also in a method of dynamically re-estimation of the grossing-up. These data and the analysis below result in a population estimate measured in equity both on the asset and liability side and knowing the reported equity from the survey we have an estimate of the grossing-up together with a dynamic register from which to maintain coverage rates over time.

On the liability side calculation of Y in Chart 5 is straight forward multiplying ownership ratios by the equity of the Danish enterprises.

On the asset side some estimations are needed. Firstly, because the equity of the foreign affiliates[11] is unknown – only asset value and net turnover variables are listed. Secondly, on the asset side BvD registers ownership ratios of foreign affiliates, but not the asset value for all foreign affiliates. Therefore two estimations are needed. First, to estimate the missing assets of some foreign affiliates an OLS regression between total assets of the parent enterprises and their affiliates is estimated.

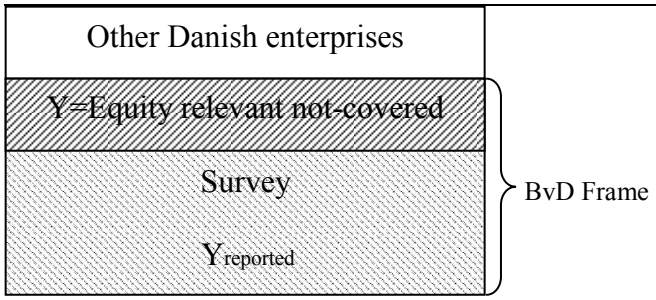
$$Assets\ affiliates_i = \left(\alpha + \beta \cdot Total\ assets\ parrent_i\right)\ \ i = 1 \ldots N$$

OLS REGRESSION ON AFFILIATED ASSETS — TABLE 2

R^2=66,3, N=790	Parameter	Standard error	T value
Intercept.....	-1154	7739	-0,15
Total assets.....	0,712	0,018	39,38

[11] Affiliates cover subsidiaries and associates.

MAINTENANCE MODEL OF FOREIGN DIRECT INVESTMENTS IN EQUITY CHART 5



The model has been tested at different points in time and also extended with more explanatory variables without improving the model significantly. The results are given by Table 2 showing that the total assets of the affiliates are estimated as constituting 71 per cent of the parent enterprise. A sensitivity analysis on the final result – the grossing-up estimates – illustrates that a 1 per cent change in the above estimate results in a 0.6 per cent change in the final grossing-up estimate corresponding to less than 1 billion in the final statistics. The total of equity on the asset side constitutes 422 billion DKK, end 2006.

The next step is to estimate equity from total assets of the affiliates. OLS regressions between equity and total assets for different populations and with many auxiliary variables gave surprisingly similar results. The variables have been transformed in order to correct for heteroskedasticity, but only the sector variable together with total assets showed significant. Changing the population of enterprises in the analysis had small effects on the model outcome. Therefore a population of all Danish enterprises registered in BvD has been used. Non-financial corporations gave quite robust results, while other financial intermediaries showed similar, but not as robust results – see Table 3 and 4.

$$Equity_i = (\alpha + \beta \cdot Total\,assets_i) \qquad i = 1 \ldots N$$

OLS REGRESSION RESULTS ON NON-FINANCIAL CORPORATIONS TABLE 3

R^2=69,12, N=84544	Parameter	Standard error	T value
Intercept	-0.255	0.003	357.8
Total assets	0.680	0.002	-82.6

OLS REGRESSION RESULTS ON OTHER FINANCIAL INTERMEDIARIES TABLE 4

R^2=59,63, N=5258	Parameter	Standard error	T value
Intercept	-0.130	0.028	-4.62
Total assets	0.699	0.026	26.70

A sensitivity test shows that a 1 per cent change in the estimate for the non-financial corporations affects the final grossing-up by less than 0.9 per cent. Measured in output data the effect on the grossing-up of stocks would be less than 1 billion DKK, end 2006 given a 1 per cent change in the estimate.

These analyses result in a population estimate on the asset side as well and, knowing the survey, we have an estimate of the grossing-up together with a dynamic register from which to maintain coverage rates over time.

GROSSING-UP ON EQUITY FOR NON-FINANCIAL CORPORATIONS — TABLE 5

Billion DKK	Reported data	Grossing-up stock
Assets	435.8	66.1
Liabilities	333.0	55.8

Table 5 illustrates the final grossing-up for non-financial corporations on the asset and liability side, end 2006. These grossing-up estimates (stock estimates) are compared with the reported data. The results in table 5 suggest that there are many enterprises outside the survey that we need to include to increase the coverage on equity and we are presently in this process.

5.2. Foreign direct investments, intercompany debt, and other investments, loans and deposits

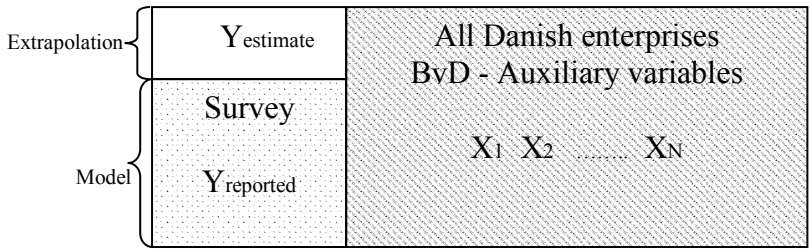
For intercompany debt, loans and credits and other investments, two methods of analysis result in one register with estimated variables. Listing these estimated variables by size gives a register from which to choose potential new candidates for the cut-off survey. The results cannot be used as re-estimation of the grossing-up because the populations or frames cannot be targeted with the necessary accuracy. Instead we model the characteristics which caused the initial selection of enterprises to the survey and thereby keep choosing the same types of enterprises keeping the existing grossing-up estimates described in section 4.

5.2.1. Method 1: OLS standard regression model of survey maintenance

Financial data for all Danish enterprises from BvD together with reported data from the survey are used. The models are estimated only for the enterprises in the survey finding a relationship between the financial data in BvD and the reported data, cf. Chart 6. When a model

fit is found the estimated coefficients are used to extrapolate for the non-covered enterprises. The extrapolation gives a Y estimate for the non-covered enterprises and ranking these Y estimates by size gives a register from which to maintain the survey.

METHOD 1: INTERCOMPANY DEBT , LOANS AND DEPOSITS AND OTHER INVESTMENTS CHART 6



The explanatory variables in the models are primarily from the BvD data source. The fundamental problem, however, is that the model fit for the enterprises in the survey does not necessarily reflect the fit for the enterprises outside, cf. the earlier discussion of cut-off sampling errors. So even though a good model fit is estimated the extrapolations will not necessarily result in the right enterprises.

The model variables are strongly correlated. Given that the explanatory variables are mostly financial report variables they must be correlated by definition and this influences the estimates. Due to the correlation it is impossible to separate the influence from the explanatory variables. This implies that regression coefficients may be estimated with too high or low standard errors and the coefficients might be positive or negative against all intuition[12]. This is, however, not the same as rejecting the model's capability to project – the models may be very precise in extrapolations. Therefore no attempt has been made to correct for colinearity.

5.2.1.1. Estimation results – loans and deposits and other investments

Loans, deposits and other investments reported from the survey on the asset and liability side are the dependent variables in the analysis. Explanatory variables are financial report data from BvD. Binary variables of branch are used in order to account for possible differences between branches – only the branch variable Finance showed significant. In order to minimize selection bias in the estimates outliers have

[12] Linear Probability Logit & Probit Models, John Herbert Aldrich, Forrest D. Nelson, John L. Sullivan. Saga Publications, 1984.

been excluded[13] together with missing value observations. The estimations only include significant variables and Tables 6 and 7 illustrate the model results on loans on the asset and liability side.

$$Loans\ granted = \left(\alpha + \beta_1 \cdot Cash\ equivalent + \beta_2 \cdot Finance_i\right)$$

$$Loans\ received = \begin{pmatrix} \alpha + \beta_1 \cdot Shareholders\ funds + \beta_2 \cdot Non\ current\ liabilities + \\ \beta_3 \cdot Employees + \beta_4 \cdot Operating\ profit \end{pmatrix}$$

LOANS GRANTED ABROAD (ASSETS) TABLE 6

	Parameter	Standard error	T-value
Adj-R^2 = 0,21 N = 256			
Intercept	29,615,041	11,129,333	2.66
Cash equivalent, (thousand DKK)	96.75	17.02	5.68
Finance (branch)	263,223,228	45,902,688	5.73

LOANS RECEIVED FROM ABROAD TABLE 7

	Parameter	Standard error	T-value
Adj-R^2 = 0,63 N = 152			
Intercept	69,243,341	48,404,609	1.43
Shareholders funds (thousand DKK)	753	111	6.82
Non-current liabilities (thousand DKK)	136	16	8.35
Employees	11,812	1,964	6.01
Operating profit (thousand EUR)	-1,354	632	-2.14

The model on the asset side only explains 21 per cent of the variations, but on the liability side 63 per cent is explained. There is, however, clear positive correlation between the dependent variables and the residuals in both models, which indicates that other factors outside the models explain the variation in the loans[14]. The models also show clear signs of heteroskedasticity in that the standard errors of the residuals increase with the size of the loans and the predicted value of the loans (corrected response).

5.2.1.2. Estimation results – intercompany debt

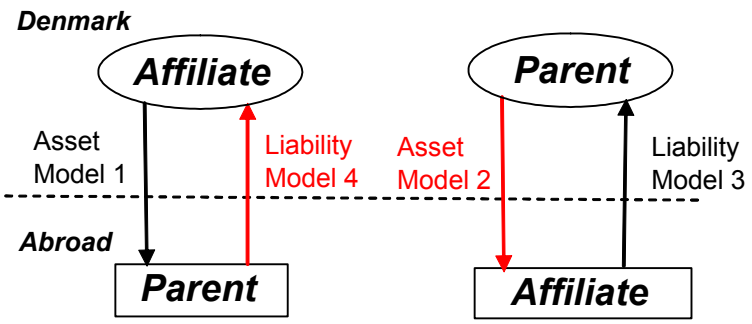
On the basis of BvD data it is possible to specify the population or frame on intercompany debt with more precision than on loans, deposits and other investments. The reason being that the ownership data from BvD makes it possible to specify the Danish enterprises owning

[13] Outliers as measured in the value of the reported loans and other investments and measured by the largest residuals in the model are excluded.

[14] Looking only at loans, excluding other investments improves the models slightly.

foreign affiliates and the Danish enterprises owned by foreign residents. Thereby the frames of enterprises with possible intercompany debt to and from foreign affiliates are specified. The two frames are illustrated as the circles in Chart 7.

LOANS AND CREDITS, AFFILIATED ENTERPRISES — CHART 7



SURVEY AND FRAME SIZE ON LOANS TO AFFILIATED ENTERPRISES — TABLE 7

	Danish affiliate	Danish parent	Total
Frame	3.778	3.152	6.421
Survey	750	458	790

The analysis is further divided by the directions of the transactions within the corporation i.e. transactions from affiliate to parent enterprise or from parent to affiliated enterprise illustrated by colour of the arrows in Chart 7. It is the direction of the arrows crossing the border (the dotted line) that determines if the transaction is an asset or a liability seen from Denmark's point of view.

Four models are estimated – one per arrow. Two frames are specified corresponding to the two circles in Chart 7. The size of the two frames and the corresponding survey samples are given by Table 7. The frames and survey samples are partly overlapping because some enterprises have both foreign affiliates and foreign parents. Therefore the column total does not match the sum of the two first columns.

Four cross section analyses are done where intercompany debt reported from the survey are the dependent variable. The results are only shown for the largest sector in the survey – non-financial corporations. Following the previous arguments outliers are excluded. Transformations by logarithm have been tested without improving the models significantly.

MODEL 1: DANISH AFFILIATES TO PARENTS ABROAD			TABLE 8
Adj. R^2 = 0,59, Number of observations = 175	Parameter	Standard error	T-value
Intercept	32,855,813	9,086,727	3.62
Shareholders funds (thousand EUR)	2.3	0.23	13.15
Current liabilities (thousand EUR)	113.51	15.69	6
Depreciation (thousand EUR)	30.73	2.9	-7.03
Non-current liabilities long-term (thousand EUR)	-866	86	-6.91
Non-current liabilities (thousand EUR)	981	160	6.81

MODEL 2: DANISH PARENTS TO AFFILIATES ABROAD			TABLE 9
Adj. R^2 = 0,93, Number of observations = 207	Parameter	Standard error	T-value
Intercept	-140,573,619	44,450,961	-3.16
Liabilities creditors (thousand EUR)	3,117	343	9.08
Employees	23,588	2,924	8.07
Financial exp. (thousand EUR)	10,390	2,299	4.52
Financial revenue (thousand EUR)	-1,263	491	-2.57
Number of shareholders	15,415,744	5,288,470	2.91
Number of subsidiaries	17,667,063	3,210,434	5.5

MODEL 3: FROM AFFILIATES ABROAD TO DANISH PARENTS			TABLE 10
Adj. R^2 = 0,38, Number of observations = 299	Parameter	Standard error	T-value
Intercept	112,278,164	27,388,465	4.1
Non current liabilities (thousand EUR)	-867	219	-3.95
Current liabilities creditors (thousand EUR)	-5,359	822	-6.51
Working capital (thousand EUR)	1,936	299	6.47
Costs of goods (thousand EUR)	420	112	3.47
Financial exp., (thousand EUR)	22,895	2,152	10.63

MODEL 4: FROM PARENTS ABROAD TO DANISH AFFILIATES			TABLE 11
Adj. R^2 = 0,60, Number of observations = 198	Parameter	Standard error	T-value
Adj. R^2 = 57,34, N =323			
Intercept	18,375,975	19,753,165	0.93
Non-current liabilities (thousand EUR)	-615	110	-5.56
Working capital (thousand EUR)	968	189	5.11
Costs of goods sold (thousand EUR)	-145	33	-4.38
Depreciation (thousand EUR)	8,895	611	14.54
Intercept	18,375,975	19,753,165	0.93
Non-current liabilities (thousand EUR)	-615	110	-5.56

As expected the best fitted models are model 2 and 4 with loans going from parents to affiliates. These loans are best described by the available financial characteristics of the Danish enterprise. Especially loans going from Danish parents to affiliates abroad seem to be characterised be the Danish parent's financial data. The model describes almost 93 per cent of the variation in the loans. Around 60 per cent of the variations in loans going from parents abroad to Danish affiliates are described by the model. Analysing the residuals from all the models suggests heteroskedasticity. This indicates a sizable selection bias

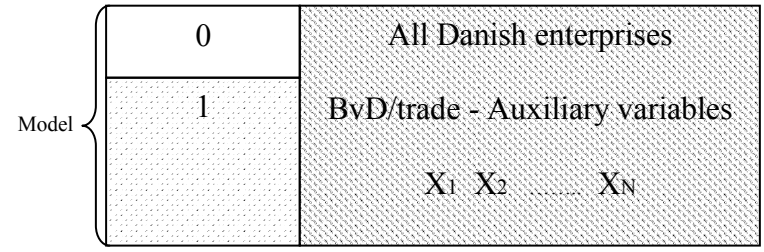
probably due to the cut-off design. Therefore the predictions of method 1 – on intercompany debt and loans, deposits and other investments – are primarily used as helping guidelines, whereas the prediction results from method 2 are the primary indicator when maintaining the survey.

5.2.2. Method 2: A probit model of survey maintenance

Because of the inherent bias of method 1 caused by the nature of cut-off sampling, a second method is introduced. It takes into account the fact that enterprises inside and outside the survey could be very different on other financial parameters than size. Financial data from all Danish enterprises from BvD from the time of the initial selection, together with the knowledge of which enterprises were initially selected, is used, cf. Chart 8.

The model is estimated for all enterprises finding a relationship between the financial data in BvD at the time of the selection and a binary variable which is 1 if the enterprise was in the initial survey, and 0 otherwise. When a model fit is found the estimated coefficients are used on the most present financial data to estimate the probability of an enterprise being selected for the initial survey. Ranking these probabilities by size results in a register from which the survey is maintained. The idea is to model the characteristics which caused the initial selection and thereby indirectly keep using the same selection criteria maintaining the original grossing-up estimates.

METHOD 2: INTERCOMPANY DEBT, LOANS AND DEPOSITS AND OTHER INVESTMENTS CHART 8



5.2.2.1. Estimation results and maintenance

The enterprises initially selected are given the value 1, and active enterprises outside the initially selected survey are given the value 0:

$$y_i = \begin{cases} 1 \text{ if initially selected} \\ 0 \text{ if not initially selected} \end{cases}$$

It is of course crucial that only the initially selected enterprises' characteristic are modelled and that it is auxiliary data from the time of the initial selection which is used – in this case financial data from 2004.

$$prob(y_i = 1) = \Phi\begin{pmatrix} \alpha + \beta_1 \cdot Fixed\,assets + \beta_2 \cdot Current\,assets + \\ \beta_3 \cdot Non-current\,liabilities + \beta_4 \cdot Current\,liabilities_{\,i} \end{pmatrix},$$

where Φ is the cumulative distribution function of the standard normal distribution. The OLS probit estimation gives the results in Table 12 when choosing only significant variables.

The model seems intuitive, in that the probability of an enterprise being selected for the survey is increasing with the significant balance sheet variables. The negative intercept illustrates that if the enterprise has neither assets nor liabilities the probability of being selected for the survey is close to zero[15]. Also notice that because all coefficients are positive it is just an optimal method of ranking the enterprises by their balance sheets, but weighing the significant balance sheet items optimally.

MODEL 1: PROBABILITY OF BEING SELECTED FOR THE INITIAL SURVEY, BALANCE SHEET VARIABLES — TABLE 12

Financial account variable	Parameter	P-value
Intercept	-2.09	>0.0001
Fixed assets	0.0130	>0.0001
Current assets	0.0676	>0.0001
Non-current liabilities	0.0252	>0.0001
Current liabilities	0.0833	>0.0001

In the model above only stock variables are considered, but the statistics cover both stocks and flows. Two other models are estimated based on both stock and flow data, including gross profits in model 2 and EBIT in model 3.

MODEL 2: PROBABILITY OF BEING SELECTED FOR THE INITIAL SURVEY, INCLUDING GROSS PROFITS — TABLE 13

	Parameter	P-value
Intercept	-2.12	>0.0001
Gross profits	0.0379	>0.0001
Fixed assets	0.0532	>0.0001
Current assets	0.0538	>0.0001

[15] Applied Regression Analysis and Multivariable Methods, David G. Kleinbaum, Lawrence L. Kupper, Keith E. Muller and Azhar Nizam. Duxbury Press 3'rd edition.

MODEL 3. PROBABILITY OF BEING SELECTED FOR THE INITIAL SURVEY, INCLUDING EBIT — TABLE 14

	Parameter	P-value
Intercept	-2.07	>0.0001
EBIT	0.0968	>0.0001
Fixed assets	0.0110	>0.0001
Current assets	0.0602	>0.0001
Non-current liabilities	0.0241	>0.0001
Current liabilities	0.0784	>0.0001

One way of evaluating the predictions of these models is to look at the models' predictions for enterprises which have been included in the survey since 2005. These have primarily been found by reading newspapers[16]. Would the models have found these important enterprises and given them high selection probabilities? Table 15 illustrates the prediction results for the 10 largest of these enterprises – measured by the reported data[17]. The results show that all three models have high estimated probabilities for the 10 largest enterprises included since the initial survey selection.

MODEL PREDICTIONS OF ENTERPRISES LATER INCLUDED IN THE SURVEY — TABLE 15

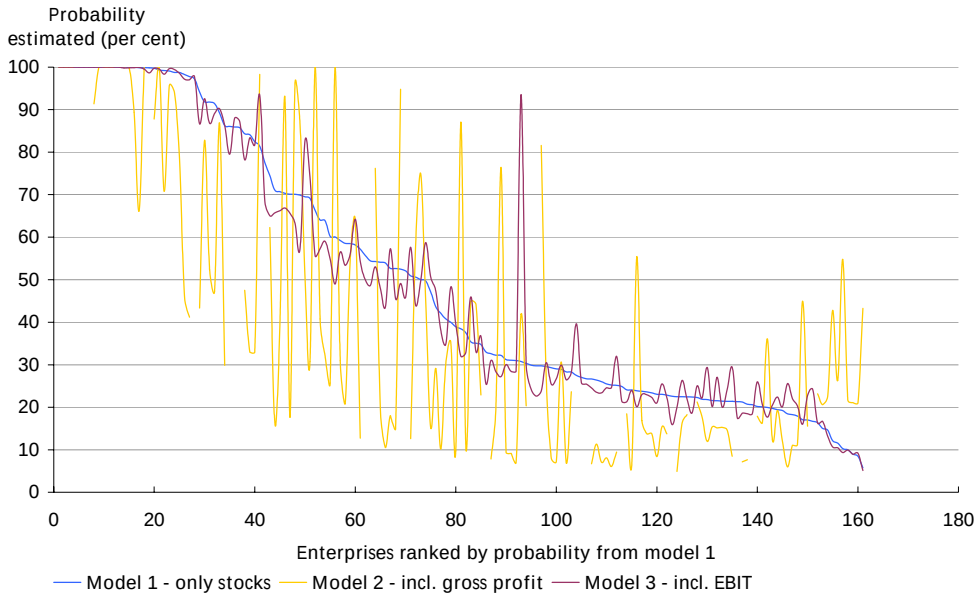
	Estimated probability Model 1	Estimated probability Model 2	Estimated probability Model 3
Enterprise 1	1	1	1
Enterprise 2	1	1	1
Enterprise 3	1	1	1
Enterprise 4	1	1	1
Enterprise 5	1	1	1
Enterprise 6	0.99	0.97	0.99
Enterprise 7	0.97	0.84	0.96
Enterprise 8	0.96	-	0.93
Enterprise 9	0.81	0.64	0.71
Enterprise 10	0.67	0.40	0.50

Chart 9 illustrates the number of enterprises by the probability level estimated – ranked by the probability estimate of model 1. The model's predictions in the Chart shows little practical difference between model 1 and 3, but some differences when using model 2. Using the 2005 financial report data and thereby predicting the number of enterprises with predicted probabilities above 95 per cent results in the same 16 enterprises for all three models.

[16] Until the methods described in this paper were implemented, new enterprises were found by reading newspapers. Some important new enterprises have been found this way – but the discoveries have only been regarding equity because they have the highest news value.

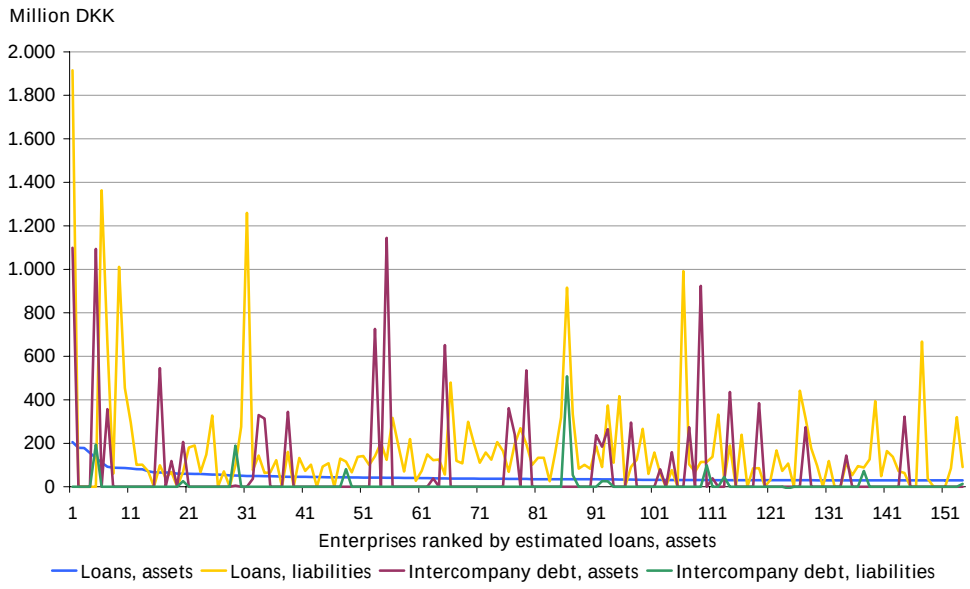
[17] The names of the enterprises have been deleted on account of confidentiality.

PROBABILITY ESTIMATED BY MODEL 1-3 RANKED BY MODEL 1 CHART 9



When choosing new enterprises the predictions of the models estimated using method 1 are also used as helping guidelines. The prediction results of these models are presented in Chart 10 ranked by the estimated loans on the asset side. The predictions by method 1 are more varied especially regarding predicted loans on the liability side and intercompany debt assets. Single enterprises with peaks in the Chart will also be selected as survey reporters even if their estimated probabilities in Chart 9 are low.

PREDICTIONS OF LOANS AND INTERCOMPANY DEBT BY METHOD 1 CHART 10

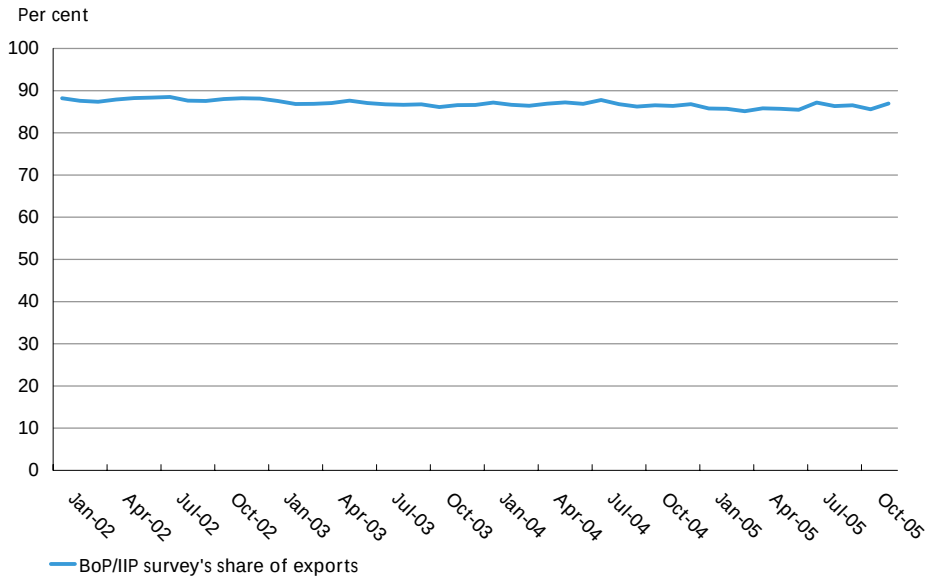


One approach to assure the precision of the existing grossing-up estimates when adding new enterprises, is to assume similar aggregated growth rates for all enterprises inside and outside the survey. Thereby the value of the missing enterprises can be calculated residually and the value of all the enterprises to be included as reporters is then given. Another more pragmatic approach is to choose all the relevant enterprises with a probability greater than 10 per cent and/or with peaks in Chart 10 as reporters accepting that the rest is not explored further and covered by the existing grossing-up estimates. So far this has been the strategy resulting in around 160 relevant enterprises. Evaluating the results of asking these enterprises will give an idea of the precision of the models and we are currently in this process.

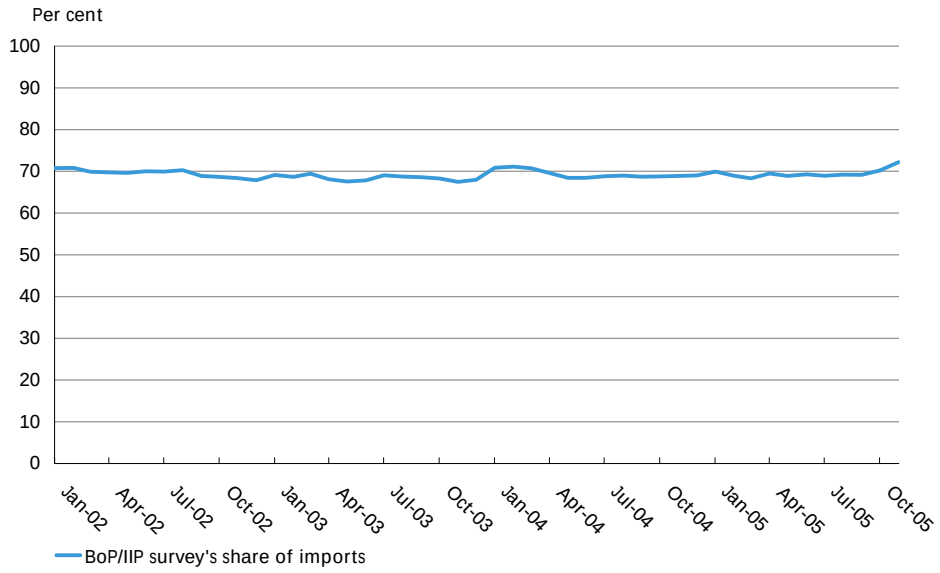
5.3. Trade credits

Trade credits account for a smaller part of the output statistics. Therefore a simpler approach has been implemented. The trade statistics published by Statistics Denmark are based on a dynamic survey of approximately 10,000 enterprises. Taking this survey as a total count on foreign trade is a fair assumption. The further assumptions needed are perhaps harder to justify, but they are done to keep the method simple and transparent. Chart 11 shows how much our survey of non-financial corporations account for, measured by imports and exports from primo 2002 until ultimo 2005. On average the survey accounts for 86 per cent of the exports and 69 per cent of the imports. The solution implemented is to assume that the survey then covers 86 and 69 per cent of the trade credits.

SURVEY OF NON-FINANCIAL CORPORATIONS' SHARE OF EXPORTS — CHART 11



SURVEY OF NON-FINANCIAL CORPORATIONS' SHARE OF IMPORTS CHART 12



In 2006 the stocks of trade credits reported from non-financial corporations was 94 billion DKK on the asset side and 45 billion DKK on the liability side and grossing up the asset side by 16 per cent and the liability side by 31 per cent. The implementation of this new method from September 2007 resulted in new grossing-up estimates for 2006 by 13 billion DKK on the asset side and 14 billion on the liability side. Table 16 compares the old and the new grossing-up estimates to the reported stocks.

GROSSING-UP ESTIMATES ON TRADE CREDITS TABLE 16

Billion DKK	Reported stocks	Initial estimates	New estimates
Asset side	93.8	15.4 (16 per cent)	13.1 (14 per cent)
Liability side	45.1	9.1 (20 per cent)	14.0 (31 per cent)

Other financial intermediaries and insurance companies and pension funds have almost no trade credits and are not grossed up.

5.4. Financial leasing and derivatives

Financial leasing accounts for a very small fraction of the output statistics, and derivatives are primarily traded by a few of the largest enterprises and mainly by pension funds which are covered by the survey. Table 17 illustrates the reported stocks together with grossing-up estimates for 2006 based on the initial survey selection. Based on these facts a total count has been assumed since September 2007.

STOCKS AND GROSSING-UP ON DERIVATIVES AND FINANCIAL LEASING TABLE 17

Billion DKK	Reported	Initial grossing-up	Total
Derivatives (net)	39,9	1,3	41,2
Financial leasing assets	4,6	0,2	4,8
Financial leasing liabilities	1,7	0,3	2,0

6. Concluding remarks

The solutions described in the working paper ensure that the survey keeps a high, broad and constant coverage of the population over the medium term – thereby ensuring accuracy of the statistics. Although the methods seem quite robust now they may not catch all survey relevant enterprises in the future. Therefore a larger consensus survey may be necessary to keep coverage in the longer term or alternatively new registers may appear making it possible to distinguish survey-relevant enterprises with higher accuracy.

7. Literature

Aldrich A.H., Nelson F.D., Sullivan J.L., Linear Probability Logit & Probit Models. Saga Publications, 1984.

Bee M., Benedetti R., Espa G. (2007) A Framework for Cut-off Sampling in Business Survey Design. Discussion Paper, Universita Degli Studi di Trento.

Denmark's balance of payments and international investment position, Danmarks Nationalbank, 2007.

Hansen M.H., Hurwitz W.N., Madow W.G. (1953) Sample Survey Methods and Theory, Vol. II. New York: Wiley.

Kish L, Selected Papers. Edited by Graham Kalton and Steven Heeringa. Wiley-Interscience, 2003.

Kleinbaum D.G., Kupper L.L., Muller K.E. and Nizam A. Applied Regression Analysis and Multivariable Methods, Duxbury Press 3'rd edition.

Kousgaard N., Milhøj A., Anvendt regressionsanalyse for samfundsvidenskaberne, Akademisk Forlag A/S, 1993.

Milhøj A., Stikprøveteori for økonomi og erhverv, Akademisk Forlag, 1994.

Sarndal C.E., Swensson B. and Wretman J. (1992) Model Assisted Survey Sampling. New York: Springer.

Sigman R.S. and Monsour N.J. (1995) Selecting samples from list frames of businesses. In Business Survey Methods (eds B.G. Cox, D.A. Binder, B.N. Chinnappa, A. Christianson, M.J. Colledge and P.S. Kott), New York: Wiley.