The future financing needs of European small businesses:

Estimating the current and future financing needs of European SMEs using ECB SAFE data

Outline

Introduction (Project Scope)

- Estimation of current and future SMEs' financing needs

Dataset

- Descriptive Statistics of ECB SAFE data and the result of fi-compass (2019) as a benchmark

Four Econometric Models

- Heterogeneous Choice Model (HCM)
- Heteroskedastic Ordered Probit Model (Hetop)
- Ordered Probit Model with Sample Selection (Heckoprobit)
- Generalized Interval Regression Model (Gintreg)

Main Results

- Estimated Firms' Current Loan
- Estimated Firms' Future Loan

Conclusion

Introduction

Project Scope

Introduction

Two Challenges - Estimating current and future SMEs' financing needs (ToR)

- **Review fi-compass model and result**
  - Review the ECB SAFE survey data and fi-compass* model
  - Set the result of fi-compass model as the benchmark
- **Apply different approaches**
  - Four econometric models to estimate the SMEs' average loan size
  - Select the best model by comparison
- **Result of the best approach**
  - Current and future financing needs of different types of SMEs (breakdowns; country, firm size and age, main activity)
  - Comparison to the benchmark (fi-compass model)

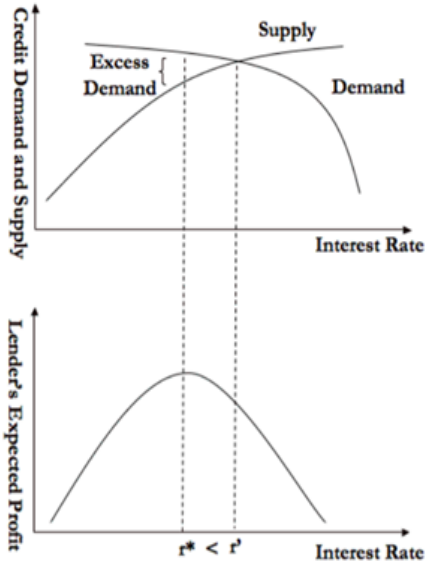
* EIF's Research & Market Analysis team developed the following methodology to compute SME financing gaps for (i) debt financing and (ii) equity financing. Fi-compass is a platform for advisory services on financial instruments under the European Structural and Investment Funds.

Main Concept of Financing Needs

- **Credit Rationing**: A situation in which lenders are unwilling to advance additional funds to borrowers at the prevailing market interest rate
  - Systematic result of '*asymmetric information*' (Stiglitz and Weiss, 1981)

  → Inefficient market distribution

- **Financing gap:** Excess demand of specific financial product such as loans, or a general lack of financial access (fi-compass, 2018)



(Kahlmann & Odeen, 2005)

➡ **Financing needs:** Focus on the specific source, **'bank loan'**, as the debt financing of SMEs

Empirical approaches to estimate SMEs' financing gaps and needs

Financing gap is more prevalent in developing countries based on the OECD Survey of 30 countries (2006)

'Debt to sales ratio' of companies and multiplied the sales by the number of companies to estimate the financial needs of MSMEs in 10 benchmark countries (2017)

Quantify the debt financing gap of European countries: Number of SMEs × Financially viable SMEs (%) × Unsuccessful SMEs (%) × Average SME loan size (2014, 2019)

➡ Our Main Scope: Estimate average loan size of SMEs by various characteristics

Dataset

ECB SAFE Data
Fi-Compass Study (2019)

ECB SAFE Data: well-established & reliable

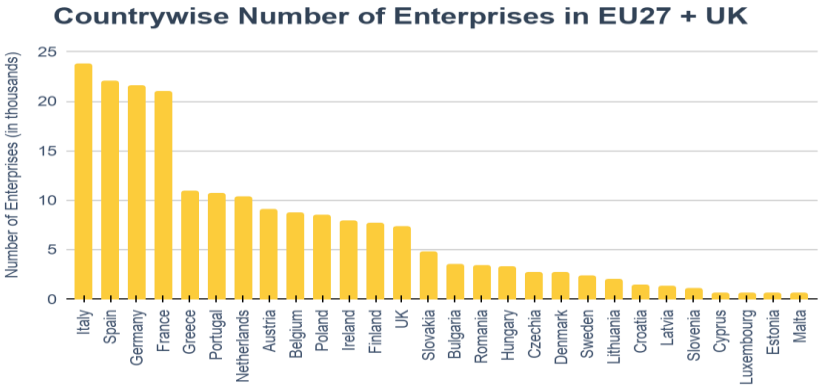
Enterprise level data from ECB SAFE (Survey on the Access to Finance of Enterprises)

- Waves 1 (2009H1) to 22 (2019H2) with 108,058 enterprises and 202,271 responses
- Focus on EU 27 + UK countries
- EC's definition of SMEs:
  - Number of employees < 250 (and)
  - Turnover ≤ €50m (or)
  - Balance Sheet ≤ €43m

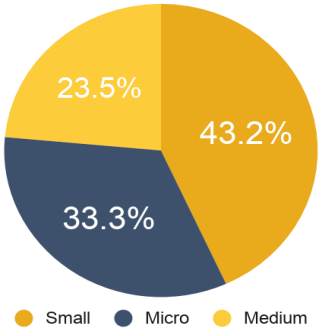
Enterprise Characteristics used for analysis

- Country of location
- Size of enterprises
- Main activity of enterprises
- Age of enterprises
- Size of loan - current (Q8A) and future (Q21)

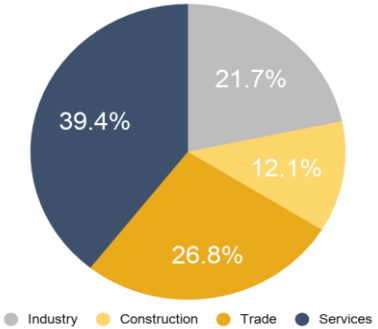
Descriptive Statistics



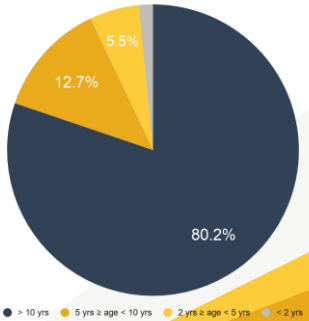
Size



Main Activity



Age



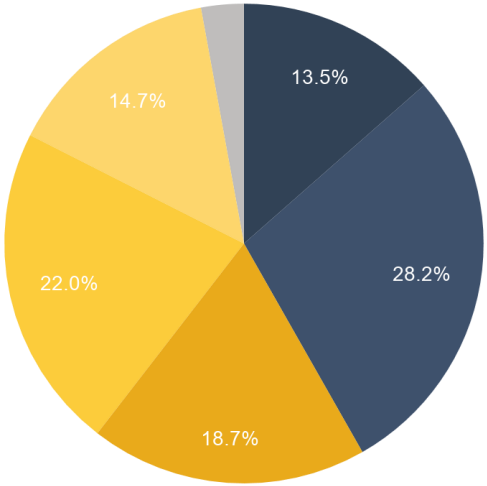
Outcome Variables from SAFE Data

Firms' Current Loan	Firms' Future Loan
Q8A: What is the size of the last bank loan that your enterprise obtained or renegotiated in the past six months or attempted to obtain in the past six months?	**Q21:** If you need external financing to realise your growth ambitions over the next two to three years, what amount of financing would you aim to obtain?

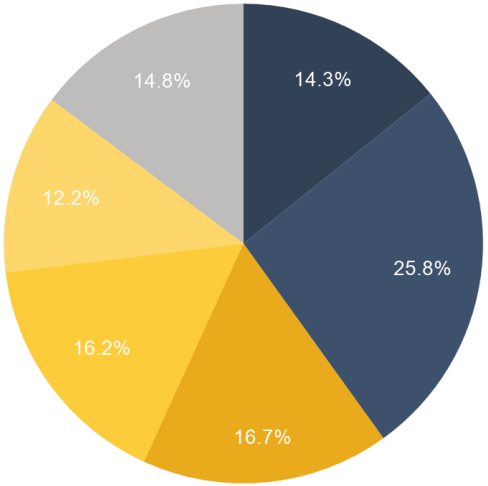
- up to €25,000
- more than €25,000 and up to €100,000
- more than €100,000 and up to €250,000
- more than €250,000 and up to €1 million
- over €1 million
- Don't know/ Not Applicable

Outcome Variables from SAFE Data

Responses to Q8A



Responses to Q21



up to €25,000 | more than €25,000 and up to €100,000 | more than €100,000 and up to €250,000 | more than €250,000 and up to €1 million | over €1 million | Don't know/ Not Applicable

fi-compass (2019) as a Benchmark

- fi-compass (2019) estimates the financing gap of SMEs using a quantitative and qualitative approach
  - Quantitative Analysis: Uses the responses to Q8A to estimate the size of the average loan by country. The lowest bound of each ordered response category of Q8A is taken as the size of the average loan
  - Qualitative Analysis: Literature review & interviews with regional loan officers

- We use the fi-compass (2019) estimates as our benchmark for comparison
  - Lack of study which used ECB SAFE data
  - Sanity check

➡ **Analytical strategy : Using ECB SAFE data, finding applicable econometric models, then comparing to fi-compass and select the best model**

Econometric Models

Heterogeneous Choice Model (HCM)
Heteroskedastic Ordered Probit Model (Hetop)
Ordered Probit Model with Sample Selection (Heckoprobit)
Generalized Interval Regression Model (Gintreg)

Heterogeneous Choice Model (HCM)

Observed collapsed version: Loan size categories from Q8A

Unobserved latent variable: Continuous loan size values

Heterogeneous Choice Model (HCM)

- Corrects for heteroskedasticity
- Fitted using *oglm* Stata program
- Estimate (i) linear predictions and (ii) standard deviation of residuals from the HCM model

Truncated Normal Distribution

- Substitute estimates into property of a two-sided truncated normal distribution, to evaluate the expected continuous loan size values

$$Y_i^* = \alpha_0 + \alpha_1 X_{i1} + \cdots + \alpha_K X_{iK} + \sigma\epsilon_i$$

$$E(X|K_i < Y^* \leq K_{i+1}) = \mu + \frac{\varphi(\alpha) - \varphi(\beta)}{\Phi(\beta) - \Phi(\alpha)}$$

Heteroskedastic Ordered Probit Model (Hetop)

Heteroskedastic Ordered Probit Model (Hetop)

- HETOP model recovers mean values based on ordered category responses
- Using combination of characteristics of enterprises, groups are formed
- For each group, we find the frequency of each ordered category response
- This table is the input for the Hetop model, using the distribution of responses, the model predicts the values of the mean

Assumptions:

- The distribution within each group across ordered response categories is not assumed to be normal, however, it is assumed that a transformation of this distribution is normal

Conditions:

- Model is fragile to missing or incomplete data across ordered categories

Ordered Probit Model with Sample Selection (Heckoprobit)

Two Step Selection Model

To model the sample selection process;

I. **Selection Equation** decides whether or not to participate
   - whether firms receive loans or not (Q7B)

I. **Outcome Equation** if so, determines how much is given
   - the amount of bank loan received (Q8A)

Model Equations

(i) *Selection Equation*

$$z_i^* = \alpha' w_i + u_i$$
$$z_i = 1\,[z_i^* > 0]$$

(ii) *Outcome Equation*

$$y_i^* = \beta' x_i + \varepsilon_i$$
$$(\varepsilon_i, u_i) \sim N[(0,0),(1,\rho\sigma_\varepsilon,1)]$$

Observation: For observations with $z_i = 1$,

$$E\,[y_i^* \mid x_i, w_i, z_i = 1]$$
$$= \beta' x_i + (\rho\sigma_\varepsilon)\left[\frac{\phi(\alpha' w_i)}{\Phi(\alpha' w_i)}\right]$$

(Greene and Hensher, 2010)

Generalized Interval Regression Model (Gintreg)

I. **Starting point - Interval Regression**; Modelling outcomes from interval censoring
   - Assumption: Normal distribution of error terms
   - Limitation: Inconsistent estimators (if errors are not normally distributed)

II. **Extension - Generalized Interval Regression**; Non-normal distribution of error
   - Flexible distribution with a wide range of skewness and kurtosis
   - MLE is used for maximizing over the unknown parameters
   - Application: Gintreg with Skewed Generalized T (SGT) distribution which means univariate 5-parameter distribution known for its extreme flexibility

Main Results

Estimated Firms' Current Loan

Choice of Econometric Model

	HCM (n 21,076)	Hetop (n 25,552)	Heckoprobit (n 19,358)	Gintreg (SGT) (n 21,967)
Loan size category (€)				
0 – 25,000	11,426	85,887 ^	16,803	47,384 ^
25,001 – 100,000	52,337	138,954 ^	38,988	85,899
100,001 - 250,000	157,462	237,814	113,197	167,261
250,001 - 1,000,000	470,210	361,380	267,388	322,155
> 1,000,000	1,873,638	500,843 ^	1,046,707	727,758 ^
Measure of Model Fit				
Akaike Information Criteria (AIC)	53,144	- *	54,412	55,582
Bayesian Information Criteria (BIC)	55,077	- *	57,678	56,246

^ Estimated representative loan size does not fall within the bounds of the loan size categories
* Unable to estimate Akaike and Bayesian information criteria for Hetop

- In terms of loan size category and model goodness of fit, Hetop and Gintreg are not suitable for estimating current loan size.

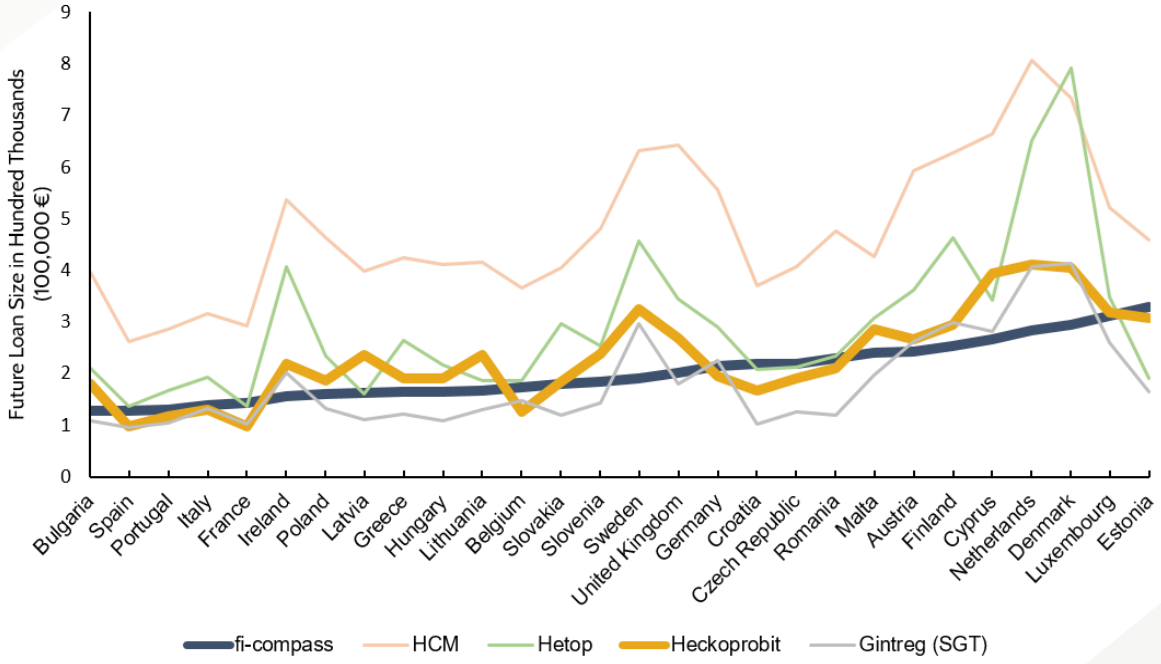
Current Loan Size by Country

(EUR)	fi-compass	Econometric models			
		HCM	Hetop	Heckoprobit	Gintreg (SGT)
Austria	**243,834**	592,139	375,687	**267,205**	261,633
Belgium	**172,648**	366,595	194,924	**126,407**	146,837
Bulgaria	**128,289**	396,691	194,197	**179,745**	109,163
Croatia	**218,168**	370,414	196,632	**166,228**	102,559
Cyprus	**266,777**	665,019	335,880	**394,297**	282,416
Czech Republic	**218,684**	407,326	221,322	**190,636**	125,598
Denmark	**293,703**	733,624	754,993	**405,859**	412,833
Estonia	**328,390**	459,006	173,398	**306,723**	164,553
Finland	**253,027**	626,581	457,848	**294,665**	299,306
France	**144,045**	292,867	143,760	**99,054**	103,112
Germany	**214,464**	557,144	291,271	**195,302**	224,339
Greece	**165,015**	424,407	271,870	**191,947**	121,705
Hungary	**165,193**	410,883	226,942	**190,112**	109,086
Ireland	**156,877**	536,784	362,301	**219,440**	201,892
Italy	**139,665**	316,418	197,443	**130,353**	133,346
Latvia	**162,046**	398,368	152,523	**236,088**	110,341
Lithuania	**167,189**	415,932	199,546	**237,422**	129,569
Luxembourg	**311,635**	520,581	289,600	**318,451**	259,451
Malta	**240,332**	426,238	251,007	**285,014**	197,324
Netherlands	**284,535**	807,877	640,099	**411,092**	405,999
Poland	**159,843**	463,739	241,461	**187,012**	131,547
Portugal	**129,431**	286,242	170,603	**118,148**	104,500
Romania	**230,379**	477,248	205,058	**211,425**	119,006
Slovakia	**179,293**	405,891	272,819	**184,289**	118,739
Slovenia	**185,189**	481,594	234,149	**238,097**	144,064
Spain	**129,198**	261,566	141,580	**97,332**	95,413
Sweden	**191,142**	631,377	422,674	**325,103**	298,399
United Kingdom	**202,834**	642,737	336,554	**269,838**	179,455

Econometric models marked by yellow are the two estimates that are relatively close to the amount indicated in fi-compass (2019)

- HCM (0 / 28), Hetop (15 / 28), **Heckoprobit (22 / 28)**, Gintreg (19 / 28)

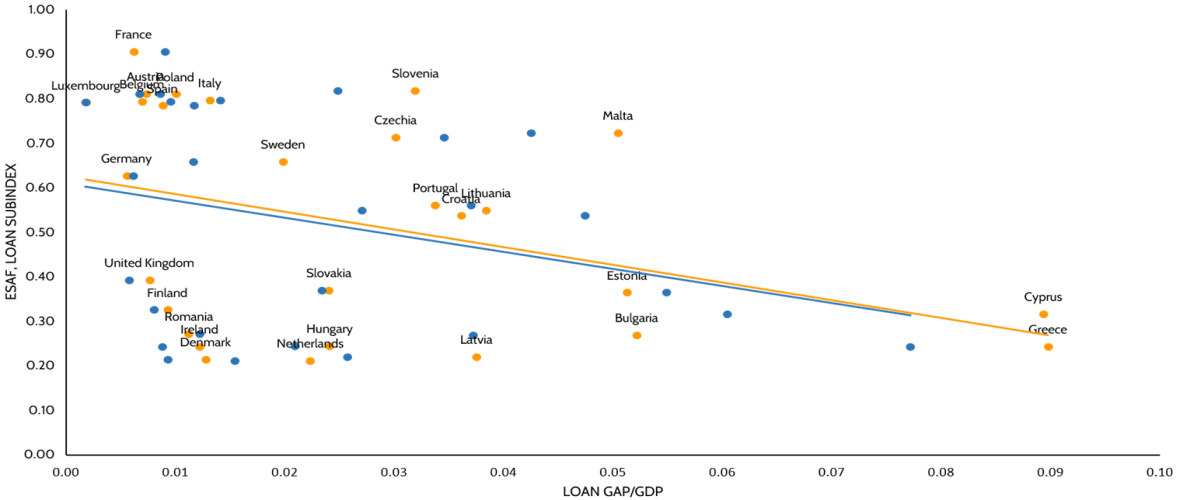
Current Loan Size by Country



- **Heckoprobit (in yellow)** shows the closest figures to **fi-compass (in blue).** This study uses Heckoprobit to estimate the current debt financing gaps.

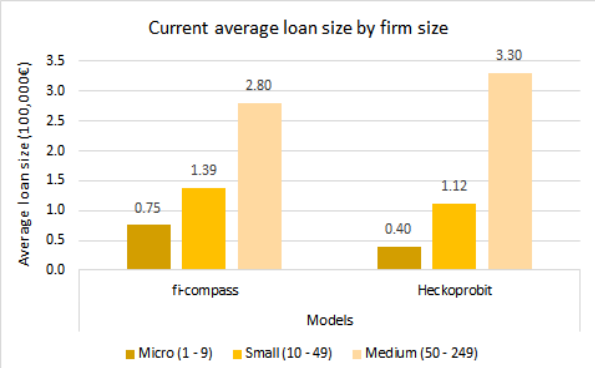
Current Debt Financing Gap

Current debt financing gap/GDP vs ESAF loan subindex

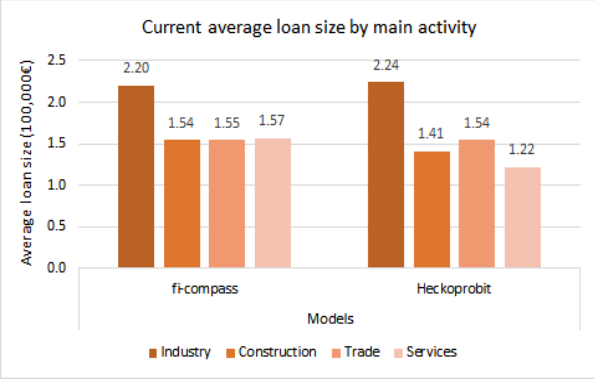


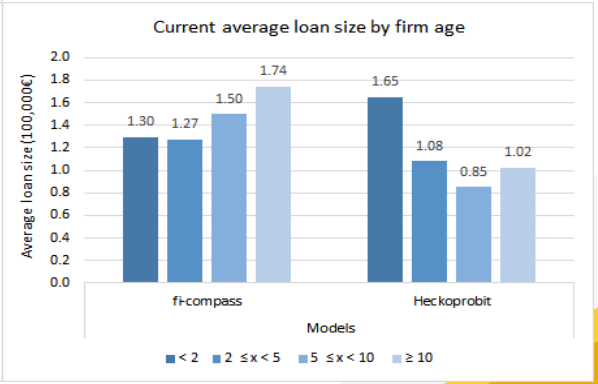
- The **EIF's SME Access to Finance (ESAF) index** is a composite indicator that monitors SMEs' external financing markets (loans, equity, credit and leasing, and macro factors) in the 28 countries.
- In cross-analysis with the ESAF loan subindex, **fi-compass (in blue line)** and **Heckoprobit (in yellow line)** show a similar downward straight line.

Current Loan Size by Firm Characteristics



- As for analysis by firm characteristics, fi-compass (2019) and Heckoprobit show similar results by firm size (top left graph) and main activity (bottom left graph)
- But, present a different result by firm age (bottom right graph).





Main Results

Estimated Firms' Future Loan

Choice of Econometric Model

HCM	Hetop	Heckoprobit	Gintreg
AIC: 95,613 **BIC: 97,629**	- -	**AIC: 22,284** **BIC: 25,083**	AIC: 112,454 BIC: 113,057

AIC: Akaike Information Criteria, BIC: Bayesian Information Criteria

1

2

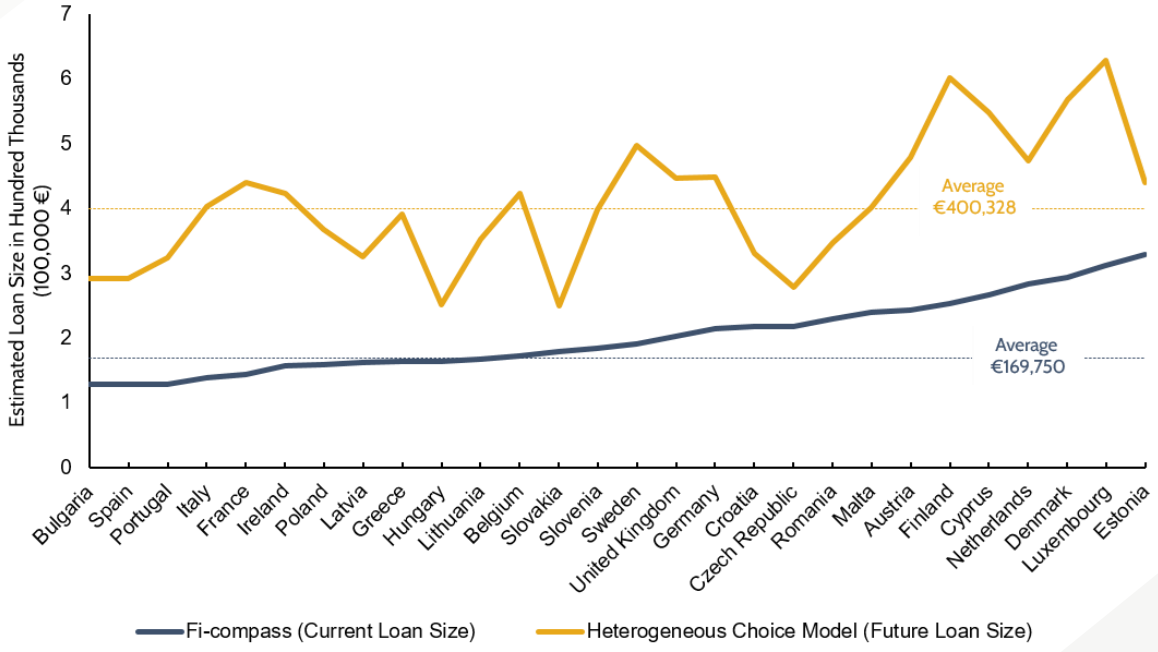
Ordered Probit Model with Sample Selection (Heckoprobit) is undesirable

- Statistically insignificant model (rho value of -0.029)
- Determining the demand of future loan is not a two-step process

3

HCM is suitable for estimating firms' future loan size

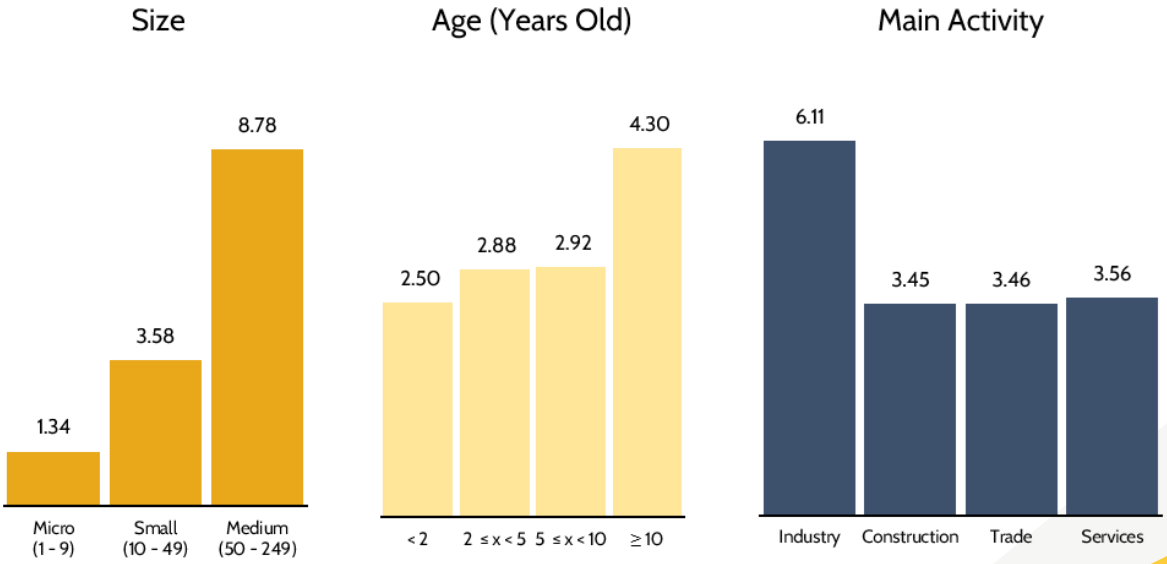
Future Loan Size by Country



- Average future loan size is larger than average current loan size of respective countries

Future Loan Size by Firm Characteristics

Average Future Loan Size in Hundred Thousands (100,000 €)



Conclusion

Summary
Implications/ Limitations/ Suggestions

Summary

- **Estimate the current and future financing needs of European SMEs based on the SAFE survey dataset**
  - Use the response of Q8A and Q21 of SAFE survey
  - Set up the result of fi-compass (2019) as a benchmark and compared four different econometric models

- **Best model to estimate current average loan is Heckoprobit**
  - **Heckoprobit** shows the closest figures to the benchmark
  - **28 countries-total mean = 155,055**

- **Best model to estimate future average loan is HCM**
  - The estimated future loan size is larger than the current loan size (fi-compass)
  - 400,328 > 169,750 (current)

Implications and limitations

- **Implications**
  - Diagnose and evaluate the financing gaps on various characteristics
  - Support effective implementation of EIF's programme
- **Limitations**
  - Theoretical limitations of econometric models
  - Future demand can be overestimated
- **Suggestion:** Revision of Q21 in SAFE survey
  - More accurate data can be obtained if a future demand period is specified
  - For example, the size of external financing 'over the next six months' to realise growth ambitions over the next two to three years

Acknowledgements

EIF Research & Market Analysis (RMA) team:

Simone Signore and **Salome Gvetadze**

LSE Supervisor:

Prof. Stephen P. Jenkins

Thank you very much

Appendix 1: Reference

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Appendix 2: Variables included in Four Models

	HCM	Hetop	Heckoprobit		Gintreg
			Selection Equation	Outcome Equation	
Dependent Variable					
Current Loan Size (Q8A)	X	X		X	X
Future Loan Size (Q21)	X	X		X	X
Loan non-taker or Loan Taker (Q7B)			X		
Explanatory Variables					
Country	X	X	X	X	X
Firm Size	X	X	X	X	X
Industry	X		X	X	X
Firm Age	X	X	X	X	X
Turnover	X		X	X	X
Ownership	X		X	X	X
Exports	X		X	X	X
Wave	X	X	X	X	X
Purpose of firm's bank Loan (Q6A)	X		X		
Financial Indicators of Firms (Q2)			X		

Appendix 3: Current Debt Financing Gap

Number of SMEs × Financially viable SMEs (%) × Unsuccessful SMEs (%) × Average loan size

(mEUR)	fi-compass	Heckoprobit
Austria	2,559	2,804
Belgium	4,265	3,123
Bulgaria	2,054	2,878
Croatia	2,440	1,859
Cyprus	1,278	1,888
Czechia	7,179	6,259
Denmark	2,753	3,804
Estonia	1,429	1,335
Finland	1,845	2,149
France	21,103	14,512
Germany	20,331	18,514
Greece	14,254	16,580
Hungary	2,764	3,180
Ireland	2,824	3,951
Italy	24,865	23,207
Latvia	760	1,108
Lithuania	1,224	1,738
Luxembourg	106	108
Malta	524	622
Netherlands	11,962	17,283
Poland	4,232	4,951
Portugal	7,542	6,885
Romania	2,481	2,277
Slovakia	2,109	2,167
Slovenia	1,137	1,461
Spain	14,037	10,575
Sweden	5,494	9,345
United Kingdom	13,694	18,217