

Market Gaps and The Financing of New Technology-based Firms

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BETTER
UNDERSTANDING



SME
FINANCING

SME FINANCING
DATA INITIATIVE

Dr. Allan L. Riding
University of Ottawa
and
Peter Webber
Industry Canada

 Government of Canada Gouvernement du Canada

Canada 

Importance of SME KBIs



- Birth and expansion of small- and medium-sized firms contribute substantially to Canadian economic welfare and job creation, especially KBIs.
 - Net private sector paid employment from small-and medium-sized firms in Canada exceeded that of large firms in seven of the eight calendar quarters 2001-2002
 - New knowledge-based firms (new KBIs) further provide a disproportionate contribution to knowledge generation, technology diffusion, innovation, productivity gains, and job and wealth creation OECD (1998).

Financing Gap?



- Widely held that start-up, small- and medium-sized KBI firms face particular difficulties with respect to raising the financial capital required to support their viability and growth
- Is this true?
 - This question is the focus of this study.

What is a KBI?



- Literately
 - Would include physicians, consultant firms, accountants, legal firms
- Popular media,
 - KBI = technology-based business

What is a KBI?



- Industry Canada
 - Specific industry codes
 - Two tiers
 1. Technology firms such as aerospace products and parts, engineering and life sciences, pharmaceuticals and medicine, satellite communications, wireless, etc.
 2. “High-knowledge” firms involved in such industries as switchgear and switchboards, industrial gas, nuclear power generation, relay and industrial controls, etc.

Why would KBIs have difficulty borrowing?



- Ibrahim (1994, ICB)

“knowledge-based businesses are perceived by banks as high risk ventures [because of a] ...

- ➔ lack of knowledge of the product/service or process innovation,
- ➔ lack of proper training for account managers on how to assess knowledge based small business,
- ➔ lack of an objective scoring system to assess knowledge based enterprises,
- ➔ high degree of uncertainty in the embryonic and start up stage, [and] lack of management and marketing skills.”

Why would KBIs have difficulty borrowing?



- Brierley (2001, p. 65)
 - Success depends on scientific knowledge and intellectual property that are difficult to value.
 - KBI firms typically lack tangible assets that may be used as collateral.
 - The firms have little or no track records and have not usually been tested in the market.
 - The staged development process (concept to prototype to initial production to scalable product sales) requires a series of financial injections. Failure to obtain the requisite capital at any point may lead to failure of the firm.
 - High rates of obsolescence.

Why would KBIs have difficulty borrowing?



- Binks and Ennew (1997)
 - ➔ Growth firms are more “informationally opaque” and hence, more likely to be subject to market gaps / capital rationing

What evidence do we have of gaps related to KBIs?



- Canadian Evidence (among others)
 - ➔ Riding and Swift (1993)
 - No evidence of difference in access to, terms of credit between technology/non-technology firms
 - Unorthodox (self-)definition of technology-based firms

Goals of this work



- Have an ongoing debate in the literature about whether or not certain classes of borrower firms may face relatively greater difficulty with access to credit.
- Empirical evidence is mixed and inconclusive, especially that which relates to access to debt financing for KBIs.
- This paper undertakes further empirical analysis of this question.



- *Survey of Financing of Small- and Medium-sized Enterprises (SME FDI)*
 - Large-scale survey of SME owners' financing experiences
 - Undertaken in 2001, studies financing experiences in 2000.



- *SME FDI*
 - Stratified sample by sector and size
 - Necessary use weighting procedures
 - Over-sampled KBIs
 - 10.5 percent of respondents vs. ~ 4 percent of general population of SMEs
 - Allows focus on KBIs

Data



Type of Loan Application	Number of Cases in Sample	Percent of Cases in Sample	Weighted Number of Cases	Weighted Percent of Cases
Term Loan	982*	33.5%	64,765	29.7%
Mortgage Loan	241	8.2%	20,135	9.2%
New LOC	861	29.4%	70,035	32.1%
New Credit Card	134	4.6%	12,215	5.6%
LOC Increase	389	13.3%	26,916	12.4%
Other Type of Loan	128	4.4%	7,762	3.6%
Loan Package	197	6.7%	16,013	7.4%
Total	2,932*	100.0%	217,841	100.0%

Objective



- Recall the objective:
 - Examine access to commercial loans for KBIs controlling for determinants of credit decision

Turndown Rates



Type of Loan(s) Sought	Turndown Incidence		Number of Cases	
	Non-KBI	KBI sectors	Non-KBI	KBI sectors
Term Loan	16.1%	21.8%	671	55
Mortgage Loan	23.7%	20.0%	152	5
New LOC	22.1%	41.4%	575	99
New Credit Card	24.7%	20.0%	73	25
LOC Increase	21.6%	12.5%	269	32

What are the factors in lending decisions?



- Traditional teaching: the “5 C’s” of commercial lending:
 - The firms’ ability to service the loan (“Capacity”).
 - The firms reliance on debt (“Capitalization”).
 - The firms’ sensitivity to economic “Conditions”.
 - The “Character” of the principal owner(s).
 - The borrower’s “Collateral.”

What are the factors in lending decisions?



- Literature on credit rationing:
 - ➔ the firm's relationship with the lender,
 - ➔ the human capital of the owners,
 - ➔ the collateral available
- What lenders say:
 - ➔ Question D.8 of the survey asks those respondents whose loan applications were turned down to identify *“what reasons were given to the business by the credit supplier for refusing to provide [the loan]”*.

What are the factors in lending decisions?



Reason	Traditional firms (N=255)		KBI Firms (N=55)	
	Relative Frequency of Mention	Standard Error	Relative Frequency of Mention	Standard Error
Insufficient income, revenues, or sales to service financing	21.1%	2.4%	27.5%	6.3%
Insufficient collateral or security	15.4%	2.1%	13.7%	4.9%
Poor credit experience or history	14.0%	2.1%	5.9%	3.3%
No reason stated by credit supplier	10.7%	1.7%	7.3%	3.5%
Insufficient cash flow	8.4%	1.6%	9.8%	4.2%
Insufficient equity	6.7%	1.5%	5.9%	3.3%
Wouldn't provide personal guarantee	5.3%	1.3%	9.8%	4.2%
Insufficient working capital	4.6%	1.2%	5.9%	3.3%
Low personal net worth	3.9%	1.1%	3.9%	2.7%
Insufficient information provided by the business	3.5%	1.1%	2.0%	2.0%
Business plan not acceptable	2.1%	0.9%	0.0%	0.0%
Management team was too inexperienced	1.1%	0.6%	0.0%	0.0%

What are the factors in lending decisions?



Variable	Sample				Weighted Estimates			
	Non-KBIs (n=539)	KBIs (n=41)	Total	p-value	Non-KBIs	KBIs	Total	
BUSINESS RISK								
R&D expenditure as % of business investment	2.0	12.0	2.7	0.000	2.3	11.1	2.5	
Expenditure on technology as % of business investment	1.6	8.2	2.0	0.000	1.3	5.2	1.4	
Loan purpose: working capital or R&D (%)	19.3%	48.8%	21.4%	0.001	25.4%	51.4%	26.0%	
Turned down by supplier (%)	2.2%	7.3%	2.6%	0.229	1.4%	3.1%	1.4%	
CONDITIONS/INDUSTRY PREFERENCE								
Rural location	31.0%	9.8%	29.5%	0.000	35.5%	6.6%	34.9%	
Exporter firm (%)	20.6%	46.3%	22.4%	0.003	16.0%	30.3%	16.3%	
AGE OF FIRM								
Legal status: Incorporated (%)	74.2%	87.8%	75.2%	0.017	64.8%	82.6%	65.2%	
Legal status: Partnership (%)	9.8%	4.9%	9.5%	0.179	7.4%	2.6%	7.3%	
Legal status: Sole Proprietorship (%)	15.6%	7.3%	15.0%	0.066	26.9%	14.8%	26.7%	
Early-Stage Firm	26.0%	12.2%	25.0%	0.016	34.2%	10.3%	33.7%	
Age of Firm (Years)	6.81	6.15	6.76	0.392	6.33	5.10	6.31	
COLLATERAL REQUIRMENTS								
Personal collateral as% of loan requested*	15.86	0.73	14.79	0.691	5.48	0.68	5.39	
Business collateral as% of loan requested*	5.14	0.96	4.85	0.757	2.09	0.66	2.06	
Total collateral as% of loan requested*	21.00	1.69	19.64	0.691	7.58	1.34	7.45	
Ratio of Assets to Loan Request*	14.42	405.83	43.70	0.327	10.65	53.08	11.52	

What are the factors in lending decisions?



CREDIT HISTORY								
Majority owner < 35 (%)	12.6%	14.6%	12.8%	0.709		14.6%	19.8%	14.7%
< 5 years of managerial experience (%)	10.4%	14.6%	10.7%	0.397		15.2%	24.6%	15.4%
Years of experience of CEO	15.6	13.8	15.4	0.292		14.8	11.4	14.7
CASH FLOW/INCOME								
Revenues per \$ of loan request*	\$42.85	\$16.11	\$41.18	0.458		\$38.06	\$8.30	\$37.52
Revenues per employee*	\$949,441	\$131,450	\$891,332	0.410		\$1,146,078	\$80,583	\$1,125,315
Ratio of EBIT to loan requested*	1.59	11.84	2.36	0.394		1.36	1.44	1.37
Ratio of Net Income to loan requested*	1.14	11.54	1.91	0.385		1.03	1.31	1.04
CAPITALIZATION								
Debt/Asset Ratio*	0.73	4.74	1.09	0.197		0.72	5.74	0.85
PERSONAL NET WORTH								
Number of owners	2.81	6.34	3.05	0.007		1.91	4.16	1.96
Woman-owned firms	7.8%	7.3%	7.8%	0.913		9.0%	13.3%	9.1%
Home based business (% female-owned)	30.2%	14.6%	29.1%	0.011		44.0%	28.4%	43.7%
LENDER RELATIONSHIP								
Number of years associated with lender	10.05	7.90	9.90	0.222		9.23	7.44	9.19
Owner's personal banking institution (%)	63.3%	31.7%	61.0%	0.000		66.9%	50.8%	66.6%
OTHER								
Highest growth tertile (%)	19.5%	29.3%	20.2%	0.192		16.2%	23.4%	16.4%
Number of employees	24.47	39.70	25.55	0.162		7.83	15.19	7.98
Annual gross revenues	\$4,943,059	\$4,206,679	\$4,891,004	0.684		\$3,040,276	\$1,498,964	\$3,009,257
Size of loan request	\$362,343	\$424,956	\$366,257	0.742		\$162,732	\$187,423	\$163,175

Methodology



- Logistic regression framework
 - Dependent variable whether or not formal application for loan was approved (=0) or declined (=1).
 - Useful framework for statistically modeling decisions.

Likelihood of turndown =

$f(\text{explanatory variables, strata variables, KBI designation})$.



- Have 32 potential explanatory variables that cross 10 logical dimensions
- Used principal components analysis to reduce 32 variables into smaller set (10 dimensions) that captures much of the underlying variation in the underlying data

Principal Components Analysis



Variable	Component									
	1	2	3	4	5	6	7	8	9	10
LOG(number of employees)	0.825									
LOG(loan request)	0.704									
LOG(revenues)	0.703			0.602						
Home based business (1 if so, else 0))	-0.662									
Ratio of EBIT* to loan requested		0.973								
Ratio of net income to loan requested		0.962								
Ratio of Assets to Loan Request		0.860								
Years of experience of CEO			0.688							
< 5 years of managerial experience (1 if so, else 0))			-0.659							
Majority owner < 35 years old (1 if so, else 0))			-0.633							
Age of firm			0.447							
Revenues per employee				0.861						
Revenues per dollar of Loan request				0.720						
R&D expenditure as percent of business investment					0.775					
Expenditure of technology as percent of business investment					0.721					
Exporter firm (1 if so, else 0))					0.524					
Number of Years Associated with Lender			0.407			0.640				
Owner's personal banking institution (1 if so, else 0))						0.560				
Gender of ownership (1 if woman-owned, else 0)						0.410				
Use of proceeds for working capital, R&D							0.684			
Debt/Asset Ratio							0.484			
Second digit of postal code is 0							-0.444			
Personal collateral to loan request								0.738		
Turned down by supplier								0.715		
Business collateral required to loan request									0.866	
Number of owners									0.475	
Growth firm (1 if in highest growth tertile, else 0)										0.806
Eigenvalues	3.38	2.67	2.08	1.62	1.40	1.17	1.11	1.08	1.07	1.01
Percentage of variance explained	10.2	20.1	27.3	33.8	40.1	44.8	49.1	53.3	57.5	61.5

Logistic Regression Results



PC	Items	Term Loans	Operating Loans
1	LOG(number of employees)		
	LOG(loan request)	-46%	-34%
	LOG(revenues)		
	Home based business (1 if so, else 0))		
2	Ratio of EBIT* to loan requested		
	Ratio of net income to loan requested		-85%
	Ratio of Assets to Loan Request		
3	Years of experience of CEO		
	< 5 years of managerial experience (1 if so, else 0))		-31%
	Majority owner < 35 years old (1 if so, else 0))		
	Age of firm		
4	Revenues per employee	-28%	
	Revenues per dollar of Loan request		
5	R&D expenditure as percent of business investment		
	Expenditure of technology as percent of business investment	+53%	+19%
	Exporter firm (1 if so, else 0))		
6	Number of Years Associated with Lender		
	Owner's personal banking institution (1 if so, else 0))	-30%	-42%
	Gender of ownership (1 if woman-owned, else 0)		
7	Use of proceeds for working capital, R & D		
	Debt/Asset Ratio	+70%	
	Second digit of postal code is 0		
8	Personal collateral to loan request		
	Turned down by supplier		
9	Business collateral required to loan request	+92%	
	Number of owners		
10	Growth firm (1 if in highest growth tertile, else 0)		
	KBI Designator (Not statistically significant but...)	-32%	+66%

Results: (1) Term Loan Applications



	Coefficient Estimate	Standard Error	p-value	Exp(B)
Significant Strata Variables				
0 employees - Manufacturing	1.951	1.056	0.065	7.04
0 employees - Wholesale/Retail	2.050	1.277	0.109	7.76
1-4 employees - Wholesale/Retail	1.736	0.653	0.008	5.67
Potential Explanatory Variables				
Principal Component 1	-0.612	0.219	0.005	0.54
Principal Component 4	-0.329	0.190	0.084	0.72
Principal Component 5	0.427	0.175	0.015	1.53
Principal Component 6	-0.354	0.240	0.141	0.70
Principal Component 7	0.531	0.252	0.035	1.70
Principal Component 9	0.651	0.332	0.050	1.92
KBI Designator (1 if KBI, else 0)	-0.382	0.745	0.608	0.68
Constant	-1.997	0.246	0.000	0.14

Results: (2) Applications for Operating Loans



	Coefficient Estimate	Standard Error	p-value	Exp(B)
Significant Strata Variables				
1-4 employees - Manufacturing	-1.285	1.115	0.249	0.28
1-4 employees – Prof. services	-0.446	0.693	0.520	0.64
5-19 employees - Primary	-0.458	1.088	0.674	0.63
5-19 employees - Manufacturing	-0.224	0.682	0.742	0.80
20-99 employees - Other sectors	-0.901	1.094	0.410	0.41
Potential Explanatory Variables				
Principal Component 1	-0.409	0.182	0.025	0.66
Principal Component 2	-1.931	1.223	0.114	0.15
Principal Component 3	-0.369	0.197	0.060	0.69
Principal Component 5	0.176	0.153	0.250	1.19
Principal Component 6	-0.544	0.213	0.011	0.58
KBI Designator Variable (=1 if KBI Else 0)	0.504	0.440	0.252	1.66
Constant	-1.918	0.277	0.000	0.15

Summary: Term Loan Applications



- Applications for term loans are more likely to be declined for:
 - Risky firms
 - High debt/asset ratios, use of long-term debt to finance working capital
 - Firms where high levels of business collateral are required
 - Firms that invest heavily in R&D, technology, exporters

Summary: Term Loan Applications



- Applications for term loans are less likely to be declined for:
 - Larger firms or loan request
 - Firms with high productivity
 - Firms with established banking relationships
 - KBI firms are no less or more likely to be turned down for term loans than non-KBIs

Summary: Applications for Operating Loans



- Applications for operating loans are less likely to be declined for:
 - Larger firms or loan requests
 - Firms with high coverage measures
 - Firms with experienced owners
 - Firms with established banking relationships

Summary: Applications for Operating Loans



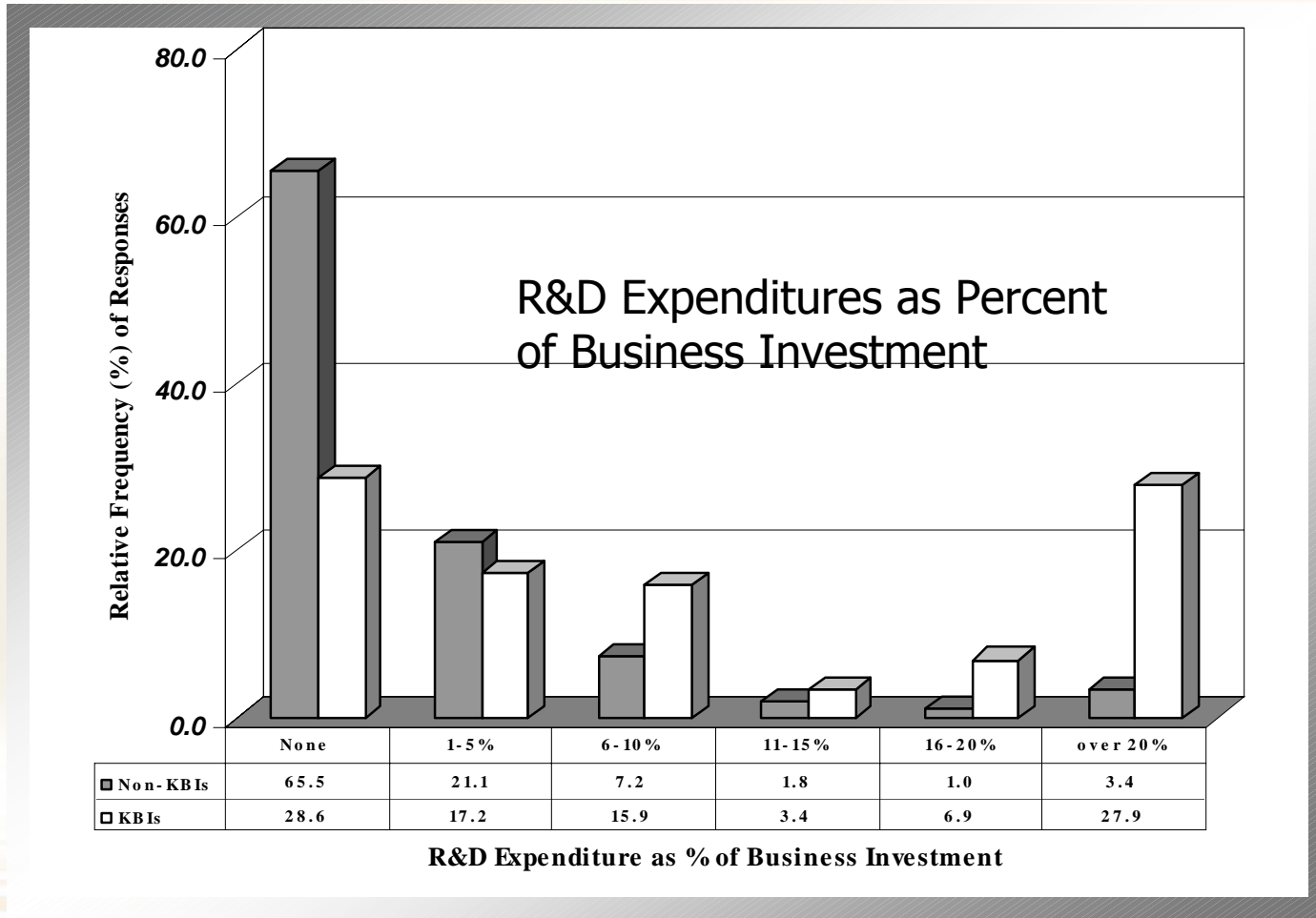
- Applications for operating loans are more likely to be declined for:
 - Firms that invest heavily in R&D, technology, exporters
 - KBI firms are no less or more likely to be turned down for term loans than non-KBIs but many KBIs invest heavily in R&D and technology and are exporters

A closer look at KBIs

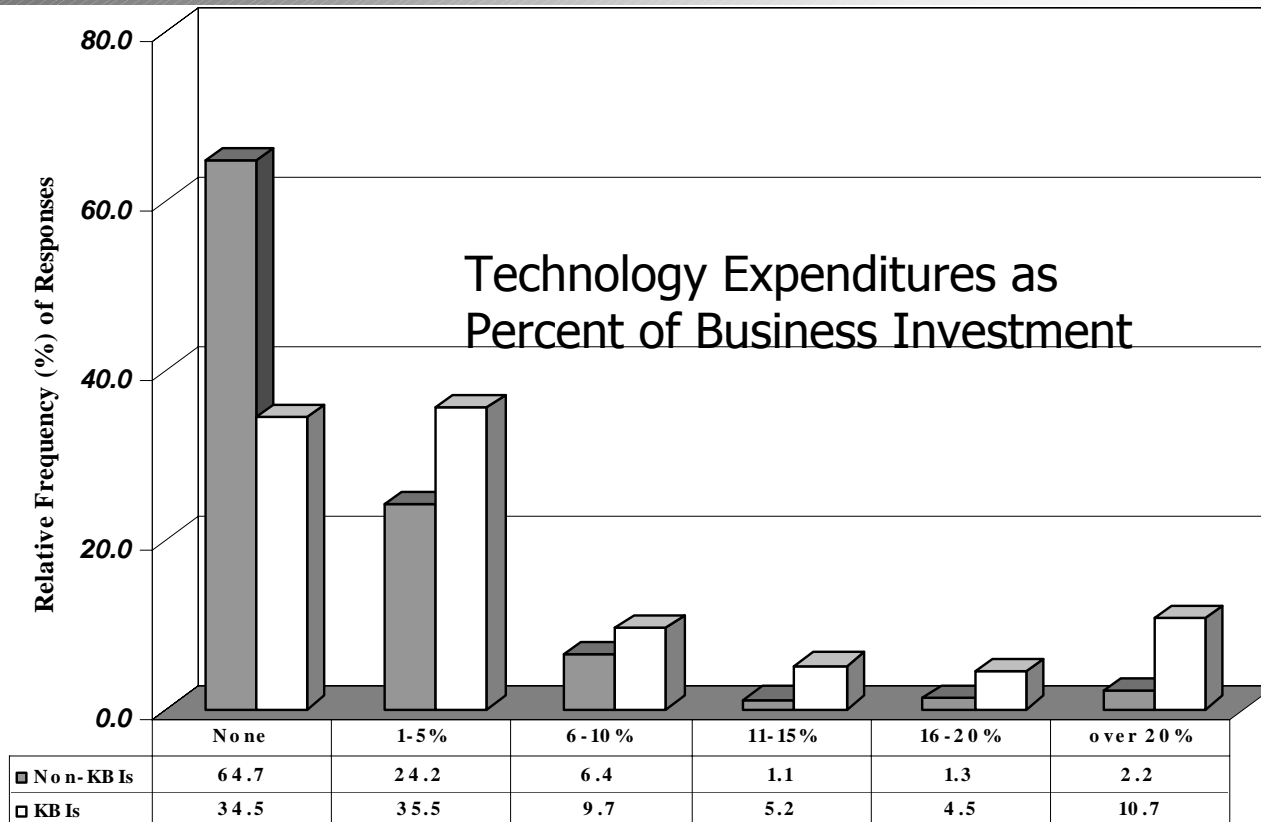


- Results show that both term and operating loan applications are more likely to be turned down for firms that invest heavily in R&D, technology, or are exporters
 - Is this just another way of identifying KBIs?

KBIs and Investment in R&D



KBIs and Investment in Technology



Technology Expenditure as % of Business Investment

Conclusions



- Research used a large and reliable data set to examine the degree to which KBI SMEs face particular difficulty with access to term and operating loans from Canadian commercial lenders.
- Sought to examine the contentions that Canadian SMEs face various types of financing gaps with particular reference to the case of KBIs

Conclusions: Size gap



- Firm/loan size was a statistically significant determinant of loan turndowns for both term loans and new operating loans.
 - Loan applications entail both fixed and variable costs associated with due diligence and these costs are part of the normal operation of the lending market.
 - Future research might focus on the extent to whether or not there is a size threshold below which lending is not economic.

Conclusions: Knowledge Gap



- Contention: KBIs face a “gap” because “financial institutions do not understand knowledge-based businesses”
- Finding: likelihood of having applications for term loans and operating loans declined did not depend on KBI designation
- No evidence of a knowledge gap as defined above.

BUT ...

Conclusions: Knowledge Gap



- Loan turndowns were more likely for firms making high levels of investment on R&D and technology, and exporters.
 - A particular category of firms
 - The three activities significantly correlated with each other
 - Firms that invest heavily in R&D also invest heavily in technology and tend to be exporters
 - A particular sub-group of Canadian businesses, but not identifiable as “KBIs”

Conclusions: Knowledge Gap



- These firms face high levels of uncertainty and are both KBI and non-KBI firms.
 - What may be at issue is the financing of innovative activity.
 - There is nothing in these results to suggest market imperfections.

Conclusions: Knowledge Gap



- These results refocus the issues.
 - What may be at issue is the financing of innovative activity. Firms that are smaller and firms that are among those that report relatively high expenditures on R&D, technology and which are likely to be exporters do appear to experience relatively high turndown rates for debt financing.

Conclusions: Knowledge Gap



- These results refocus the issues.
 - Whether or not commercial lenders are appropriate sources of financing for R&D and technology has been questioned (MacIntosh, 1994; Black and Gilson, 1998; Brierley, 2001)
 - Case has been advanced that that financing of speculative activities is best suited to equity capital, not commercial lenders
 - Are these firms “knocking on the wrong door?”