Access to Information and Specialization in Urban Venture Capital Markets

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Venture capital firms are financial intermediaries, acting as control points in the flow of both capital and valuable business information. Through extensive contact networks that reach into large corporations, financial institutions, governments and universities, venture capitalists gather information about market conditions and potential investment projects. This information is used to establish a portfolio of high-growth companies. Venture capital investments are equity based; the hope is that portfolio companies will rapidly grow into multi-million dollar companies that can be liquidated on the public market.

The portfolio companies of venture capitalists are of considerable importance to the economy. These new small and rapidly growing firms are an important source of innovation and employment generation (Birch, 1979; Gudgin and Fothergill, 1984; Binks and Coyne, 1983). They also increase local efficiency (Lloyd and Mason, 1984), help regional diversification (Firn and Swales, 1978); Johnson and Cathcart, 1979), provide a window on new technology for large established firms (Onians, 1984), and generate multiplier effects (Johnson and Cathcart, 1979).

As a result of the information intensive nature of the venture capital market, investors find that they must specialize in the types of investments they make in order to develop sufficient expertise to build profitable portfolios. Venture capitalists usually specialize in certain geographic regions, funding stages, or industrial sectors (Silver, 1985; Green, 1988). Firms within a particular urban market often develop similar interests, creating an aggregate pattern of specialization. This pattern emerges because firms in the same urban market have access to similar levels of information, and a similar range of prospective projects. Pratt (1983), for example, provides the following characterization of a selection of American urban venture capital markets:

(1) firms located in New York and Chicago specializing in leveraged buyouts,

(2) firms located in Minneapolis specializing in medical and computer related venture,

(3) firms located in Dallas and Houston specializing in energy related ventures, and

(4) firms located in San Francisco, Los Angeles, and Boston specializing in seed capital and computer related ventures.

In terms of economic development, this process of specialization suggests both greater access to equity capital, and a greater ability to support the growth of certain new industries in some markets over others.

This paper provides a theoretical framework that explains why both individual venture capital firms and urban venture capital markets develop regional, funding stage, and industrial sector specializations. This is followed by an empirical investigation of specialization in both Canadian and American urban venture capital markets.

Information and Market Specialization

Characteristics of Venture Capital Markets. The investment decisions of venture capitalists are not easily modeled within the framework of traditional theories of corporate finance. This is because the

investment process is characterized by a number of sequential decisions to commit capital, each made under high levels of uncertainty. While risk reduction in traditional markets requires numbers small and diversified investments, risk reduction in the venture capital market usually leads to investment in a few highly specialized areas. Carleton (1986) outlines four additional characteristics that distinguish investment decisions in the venture capital market from those in traditional markets: (1) information asymmetry, (2) long time-horizon, (3) investment in stages, and (4) interdependence of investor and investee.

The first of these characteristics, information asymmetry, arises because of the diffuse nature of information available for an external investor to evaluate the market value of a company seeking financing. This is particularly true when the firm is small and cannot avail itself of the channels of information dissemination available in the public market. The result for the venture capitalist is that the securities of their portfolio companies are difficult to market. To make short-run returns on their investment they must rely on the cash flows of portfolio firms. In the long-run, they hope that the firm will grow sufficiently to enter the public market and thus reduce information asymmetry. Carleton notes that information asymmetry is particularly high in new high technology firms because it is difficult to separate the worth of the technology from that of the entrepreneur. The venture capitalist works to reduce information asymmetry in this case by building a strong management team that will ensure the growth prospects of the firm are independent of the entrepreneur. In so doing, the venture capitalist creates an institutional corporate setting that helps to speed the commercialization of new technology.

The second unique feature of venture capital investment is the long time-horizon before liquidation is possible. This time period typically ranges from three to seven years, but may be as long as ten years. Further, almost a third of all investments end as writeoffs while another twenty to thirty percent fail to grow, but continue to require infusions of capital. Very few firms achieve rapid sustained growth, but these few provide substantial returns to venture capitalists and contribute to adequate average returns on the portfolio as a whole.

The third characteristic is largely a function of this long time-horizon. Venture investments are made in several stages or financing rounds. The venture capitalist makes an initial investment in order to lessen information asymmetry concerning ultimate payoffs. Given this additional information, the venture capitalist can decide whether to continue with the investment through successive rounds, or abandon the investment.

The final unique characteristic is the degree of interdependence between the entrepreneur and the venture capital investor. Traditional investment situations involving secured debt are contractually simple, and the investor's return is assured regardless of the entrepreneur's level of motivation to continue the project. With venture capital investments, however, the return to the investor is dependent upon the entrepreneur's ability to bring about profits. In this case, considerable effort is expended in the design of comparatively complex contracts that both motivate the entrepreneur and reward the investor.

Venture Capital Investment Specialization. These characteristics of venture capital investment observed by Carleton are quite similar to the theoretical concepts of bounded rationality (satisficing behavior), information impactedness (differential access), small numbers bargaining (few buyers and sellers), idiosyncratic capital (unique transactions), and opportunistic behaviour defined by Phillips (1986) after Williamson (1975). Together, these concepts offer a theoretic explanation of the unique aspects of venture capital investment that lead to investment specialization.

Investors within the venture capital market operate under conditions of uncertainty where full and accurate information is often expensive or impossible to obtain. In this situation, optimal investment strategies are difficult to define and to achieve. Thus, portfolios are based on a series of satisficing decisions rather than optimal ones, reflecting the bounded 01 rationality of investors. Under these circumstances, repeated transactions can build an information base that will improve the quality of subsequent decisions. This is particularly true if the amount of information that is unique to each investment can be limited so that increasing expertise reduces the learning costs for subsequent transactions.

One method of reducing these learning costs is through specialization. The specialization of investment, particularly in terms of technology or industrial sector, results in transactions that are characterized by learning curves of increasing slope and greater overall information gain (Figure 1). In practice, specialization emerges within the staff of venture capital firms because information asymmetries are not easily corrected through purchasing, and because there is the possibility that proprietary information will be lost through the opportunistic behaviour of experts external to the investment firm.

The fact that the entrepreneur seeking financing and potential investors have differing amounts of information available with regard to the risk/reward payoffs of a project is referred to as information impactedness or information asymmetry. In perfectly functioning markets where there are many

investors and investees, information impactedness does not exist as price conveys complete information, and transaction costs are low. In the venture capital market, there are few investors and sometimes even fewer entrepreneurs offering projects with acceptable risk/reward payoffs. In this case information asymmetry is high as no market price is established. If a transaction fails to be satisfactory for either party, there are limited alternatives for subsequent transactions, because both parties have invested either human or financial capital that is fully useful only in a particular transaction. Venture capital is thus idiosyncratic because it is difficult to shift transactions among parties in the marketplace.

Typically, venture investors accept no more than two of these risks. Development risks are usually borne by the entrepreneur, and manufacturing risks are shunned because it may turn out that the product cannot be produced at a price low enough to make it attractive or competitive. The venture capitalists cannot exert managerial control over either development or manufacturing risks. The risks resulting from marketing and management are the best understood and the most easily controlled by the venture capitalist. The final risk, that due to growth, is typically borne by public investors on the open market after the venture capitalist has exited by liquefying his investment.
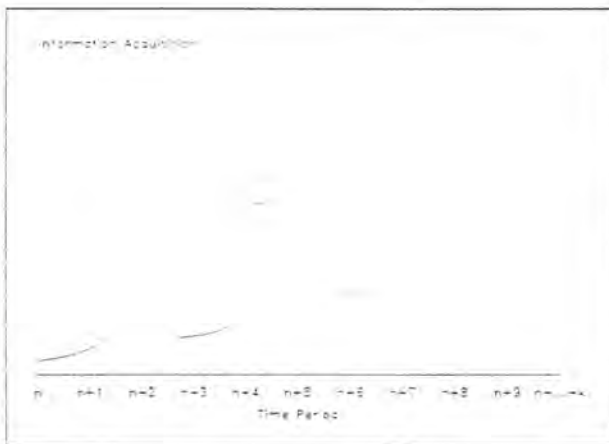

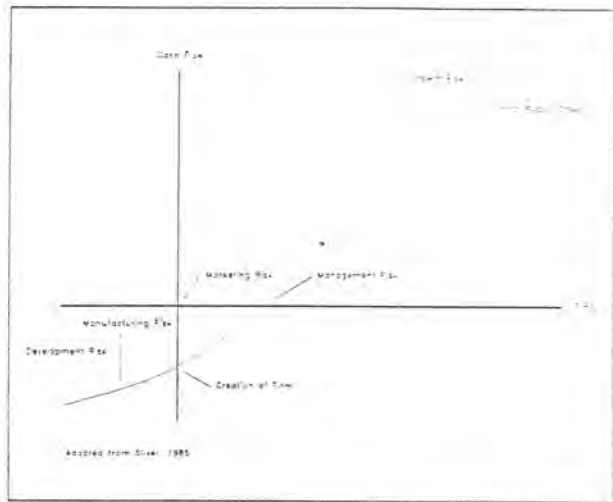figure 1 - Hypothetical Learning Curves With Specialization

figure 2 - Five Risks of a Portfolio Company

In an idiosyncratic market, the role of market mediation is often replaces by managerial control. Phillips suggests that this occurs for two reasons: (1) market based contingent claims contracts are incomplete and difficult to enforce, and (2) opportunistic behaviour may arise among either party even though success is only assured through mutual co-operation. Managerial control is established by the venture capitalist through active management of the enterprise (or through options to replace existing management) subsequent to the financial transaction. In addition, the ownership interest that accompanies most venture capital investments amounts to a vertical integration of production with financial capital further isolating both parties from the open market.

The idiosyncratic nature of the venture capital market leads investors to specialize in those stages of the funding cycle were the opportunities for managerial control are the greatest. Silver (1985) defines five risks inherent in the funding cycle of firms: (1) development risk, (2) manufacturing risk, (3) marketing risk, (4) management risk, and (5) growth risk (Figure 2).

Venture Capital Market Specialization. Individual venture capital firms become specialized because of information impactedness and the idiosyncratic nature of the market. However, firms within particular urban markets often invest in similar projects, creating an aggregate pattern of specialization. This pattern emerges because firms in an urban market have access to similar levels of information, and a similar range of prospective projects. The amount of information available in a market is largely dependent on the size of the market (Pred, 1977). The number of investment opportunities available is partly a function of market size, but it is also dependent on the ability of venture capitalists to act as catalysts in spawning additional spin-off opportunities as happened in San Francisco (silicon Valley) and in Boston (Route 128). Thus, large markets do not necessarily offer proportionally greater numbers of investment projects with acceptable risk/reward payoffs. The industrial sector and funding stage characteristics of investment opportunities are in large part dependent on the economic base of the urban

market. Thus, the choice of market in which to operate restricts the range of projects that are likely to be undertaken. Information on a broader range of projects available in other markets can be gained through the establishment of branch offices and through co-investment.

The degree of specialization evident in a market is, in part, determined by the competition between firms for projects and information. In large markets there is greater information about projects; there is also greater competition for projects. Large markets are less idiosyncratic, and venture capitalists must specialize in order to organize, interpret and utilize available information. Specialization results in the creation of a distinct market niche. In small markets there is less information, and fewer projects from which to choose. Small markets are highly idiosyncratic, and venture capitalists must specialize in order to generate enough expertise to make satisficing decisions. There is little competition in these markets, and firms have a partial spatial monopoly.

Bygrave (1987, 1988) in testing Pfeffer and Salancik's (1978) resource exchange model in the context of the American venture capital market found that the relationship between concentration and co-investment follows an inverted U. When there are few firms in a market there is little need for links to improve co- ordination, and when there are many firms it is impossible to have enough links to improve market co-ordination noticeably. The number of co-investments is, in fact, an inverse measure of the level of uncertainty in a market as Bygrave found that venture capitalists syndicate deals not to spread financial risk but to share information. He also found that specialization increases with uncertainty about innovations, technology, and people in specific industry segments. Thus, if specialization instead of co-investments is used to measure uncertainty, the relationship between market size, concentration and uncertainty can be described by a U-shaped function. Specialization is high when market concentration is low, reaches a minimum at intermediate levels of concentration, and is again high when concentration is high.

Market Specialization Data

A database of the office locations and investment preferences of both Canadian and American venture capital firms was created for the period 1973-1985 using the following industry directories: McQuillan and Taylor (1973, 1978), Pratt (1977, 1981, 1983), and Venture (1985). The use of directories to investigate market specialization is problematic because it is not known if stated preferences correspond to actual investment behaviour. Actual investment behaviour is influenced by both the investment philosophy of venture capital

firms, and the availability of sound business proposals that have an acceptable risk/return mix. Preference data, on the other hand, represents what venture capital firms would do if there were only limited constraints on the investment opportunities available to them.

Green and McNaughton (1987) found no significant difference between regional investment preferences and actual disbursements in a sample of American venture capital firms. However, data is not available to perform similar tests for industrial sector and funding stage characteristics, or to test for regional equivalency in the Canadian context. McNaughton and Green (1988) have argued that preference data is important even if these relationships cannot be established. By controlling for constraints imposed by the external operating environment of firms, preference data yield patterns that closely reflect the aggregate decision-making behaviour of firms, and not simply responses to external forces.

Market Specialization Analyses

Market Size and Concentration. The Canadian venture capital market is considerably smaller than the American market. The Canadian market consists of approximately 70 firms, having a combined capital pool of $7 billion dollars. The American market in comparison has more than 600 firms with a capital pool in excess of $18 billion. The 25 Canadian firms reporting their capital in Venture (1985) managed $1.5 billion dollars, while 432 American firms managed over $15 billion dollars (Table I). These funds are highly concentrated in a few large urban centres: 34 percent

table I Market Size and Concentration

City	Capital Under Management[1]	Mean	Three Firm Concentration Ratio	N[2]
CANADIAN MARKETS				
Toronto	$380	$42	0.77	9
Montreal	518	104	0.94	5
Calgary	30	10	1.00	3
Vancouver	41	10	0.99	4
Canada	1540	62	0.55 (0.70)[3]	25
AMERICAN MARKETS				
New York	$3103	$33	0.31	89
San Francisco	4392	54	0.30	82
Boston	2479	56	0.42	42
Los Angeles	934	27	0.45	34
Dallas	532	29	0.67	18
Chicago	245	18	0.84	14
Philadelphia	171	14	0.76	12
Washington DC	91	8	0.98	9
Denver	273	39	0.99	7
Atlanta	67	11	0.99	6
Cleveland	101	20	0.99	5
Detroit	80	16	0.99	5
Houston	30	6	0.99	5
Miami	531	106	0.99	5
Milwaukee	81	27	1.00	3
All U.S.	15084	35	0.09 (0.15)[3]	432

[1] Capital under management is in millions of Canadian Dollars for Canadian Markets, and in millions of U.S. dollars for American markets.
[2] N is the number of firms in each market that reported their capital under management in Venture (1985). For Canadian markets all firms that reported this data were included, for American markets government licensed SBICs and MESBICs were excluded because of their orientation toward debt financing (Green, 1988). All cities with more than three firms were included.
[3] Five firm concentration ratios.

of the Canadian venture capital pool is controlled from Montreal, and 20 percent is controlled from Toronto; 29 percent of the American market is controlled from San Francisco, and an additional 21 percent from New York. Toronto has more venture capital firms than does Montreal, and New York has more firms than does San Francisco, but the mean firm size is larger in Montreal and San Francisco contributing to larger capital pools. The mean firm size in Montreal is upwardly biased by the large capital base of the Federal Business Development Bank, a crown corporation.

The concentration of control over the capital pool in each urban market is closely associated with the size of the market (r = -.87) and with the number of firms participating in the market (r = - 1.0). Larger markets have more participants, each with smaller relative market shares, resulting in lower concentration ratios. The Canadian market as a whole is far more concentrated with the largest three firms controlling 55 percent of the capital base. The largest three American firms only control 9 percent of the nation's capital pool.

Market Specialization. The degree of regional, funding stage, and industrial stage specialization of firms in Canadian urban venture capital markets did not change significantly between 1973 and 1985 (Table II). The changes in the symmetric uncertainty co- efficient and G/2 ratio/1 for various years were calculated to provide a statistical measure of changes in specialization. As no significant difference was found between years, firm preferences were aggregated across the time period. Temporal stability in market specialties are confirmed by Green (1988) who applied multiple preference matrix individual scaling (INDSCAL), and a series of Wilcoxon matched pair ranked sign tests to the same data used here for American urban venture capital markets. Neither test found any systematic variation in market specialization over time.

table II Tests for Change in Market Specialization Over Time

Cross-tabulation	Change in Uncertainty Coefficient	Change in G^2 Ratio	DF
CITY*REGION			
1973-1977	-0.01	-7.5	15
1977-1981	0.00	0.7	15
1981-1985	0.00	0.5	15
1973-1985	-0.01	-6.3	15
CITY*STAGE			
1973-1977	-0.01	-1.9	21
1977-1981	0.00	-0.6	21
1981-1985	0.00	-0.3	21
1973-1985	0.00	-2.8	21
CITY*SECTOR			
1973-1977	0.00	-2.9	21
1977-1981	-0.01	-2.0	21
1981-1985	0.01	2.3	21
1983-1985	0.00	-2.6	21

NB: In no case is the G^2 ratio statistically significant.

table III Specialization Indices for Urban Venture Capital Markets

City	Regional Specialization Index	Funding Stage Specialization Index	Industry Specialization Index
CANADIAN MARKETS			
Toronto	7.8	10.1	10.5
Montreal	9.3	7.3	13.1
Calgary	20.5	16.5	39.3
Vancouver	19.6	17.8	9.4
Canada	8.2	9.7	6.3
AMERICAN MARKETS			
New York	38.0	19.0	21.4
San Francisco	51.1	17.3	26.7
Boston	40.3	16.6	22.2
Los Angeles	54.9	18.9	23.3
Dallas	31.8	16.4	24.7
Chicago	38.5	17.7	19.9
Philadelphia	27.3	20.4	22.6
Washington DC	27.6	16.8	18.8
Denver	54.3	21.8	19.5
Atlanta	50.1	13.4	31.5
Cleveland	49.7	20.8	20.3
Detroit	42.0	19.2	18.1
Houston	51.0	18.9	29.7
Miami	13.7	19.5	21.8
Milwaukee	44.9	20.4	23.7
United States	18.3	23.4	19.1

The degree of specialization varies widely by market (Table III). The specialization index/2 compares the standard deviation of regional, funding stage, and industrial sector preferences to the maximum standard deviation that would result if all firms preferred the same region, funding stage, or industrial sector. To facilitate comparisons, the index is expressed as a percentage of its maximum value. The relationship between regional, funding stage, and industrial sector specializations for each market is demonstrated graphically by series of multiple sun-ray plots (Figure 3). In these plots, regional specialization is on the horizontal axis, industrial sector is the next axis in the clockwise direction, and funding stage specialization is on the final axis. Each ray is scaled so that the polygon will intersect it in the middle if the value of a variable is equal to the sample mean. The extreme points on each ray represent the standard deviation of the distributions. Canadian markets are generally less specialized than American ones, and there is little difference between the level of regional, funding stage, and industrial sector specialization at the national level. At the urban level, most markets are highly specialized regionally. Toronto, Montreal, New York and Miami are the exception.

Each market has its own unique combination of regional, funding stage, and industrial sector specialties (Tables IV-VI). The coded table specialization index/3 classifies values based on their deviation from the median. Values in the distribution are assigned symbols based on a measure of their distance from the median (hinges and fences). The hinge is comparable to the quartiles, the inner fence the eighths, and the outer fence the sixteenths of the distribution. The pattern of regional specialization is one of self-bias: the firms in most markets prefer to invest within their

own region and perhaps in a contiguous one as well. All Canadian markets appear conspicuously averse to cross-border investment. The majority of both Canadian and American markets are averse to seed and secondary investment, and prefer investment in manufacturing and high technology.
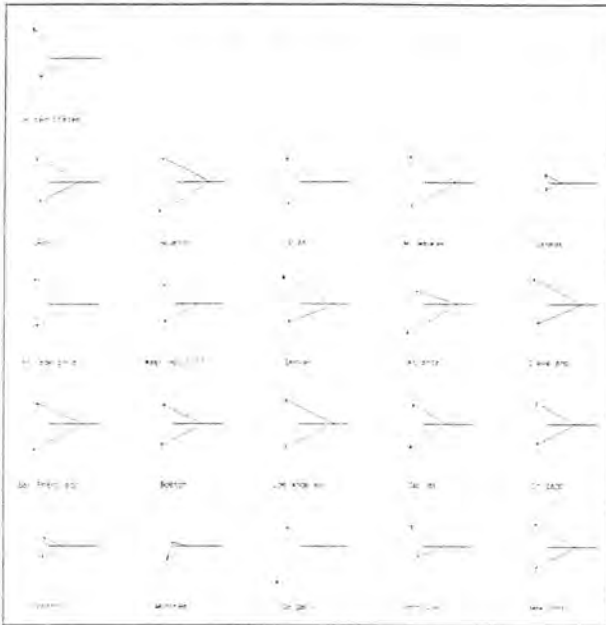

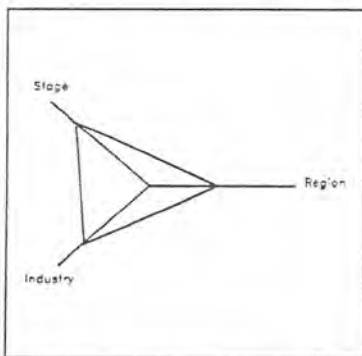figure 3 - Sun-Ray Plots of Regional, Funding Stage, and Industrial Sector Specialization

firgure 3A - Sun-Ray Plot Key

Concentration and Specialization. The specialization of urban venture capital markets is related to the level of concentration in the market (Figures 4-6). This relationship is best represented by a parabolic second order polynomial function/4. Market specialization is high at both low and high levels of concentration, and low at intermediate levels of concentration. There is only a 5 percent chance that this relationship is due to chance factors for regional specialization, but this increases to 10 percent for funding stage and industrial specialization. The small range in funding stage and industrial sector specialization over a wide range of concentration levels

further suggests that this relationship is weak in the case of funding stage and industrial sector specialization. Alternative specifications of the relationship between specialization and concentration such as linear, logarithmic, exponential, power, and higher order functions were all tested, but did not yield superior descriptions of the data.

table IV Regional Specialization of Urban Capital Markets

City	Atlantic Provinces	Quebec	Ontario	Prairie Provinces	British Columbia	United States
CANADIAN MARKETS						
Toronto	.	.	+	.	.	-
Montreal	.	+	.	.	.	-
Calgary	-	-	.	+	+	+
Vancouver	.	.	.	+	+	.

City	N.E.	M.A.	W.N.C.	Mtn.	Pac.	W.S.C.	E.S.C.	S.A.	E.N.C.
AMERICAN MARKETS									
New York	+	+	.	.	-	-	+	.	.
San Fransisco	.	.	.	.	#	.	.	.	.
Boston	+	-	.	.	.	.	.	.	.
Los Angeles	-	-	.	+	.	.	.	.	.
Chicago	.	.	.	.	-	+	.	.	-
Dallas	.	.	.	.	+	.	.	.	.
Washington DC	+	+	.	.	-	+	.	.	.
Philadelphia	+	+	.	.	.	.	.	.	.
Houston	-	-	-	#	-	#	.	.	-
Minneapolis	-	-	#	.	.	.	.	.	.
Cleveland	.	.	+	-	-	-	-	.	.
Detroit	.	.	+	.	-	.	.	.	#
Denver	+	.	-	#	+	.	-	-	.
Atlanta	-	-	-	-	-	-	#	#	.
Miami	+	+	.	.	.	.	+	+	+
Milwaukee	-	-	+	.	-	-	.	-	-

- Below inner hinge but within inner fence
. Between the hinges
+ Above upper hinge but within inner fence
# Above high inner fence

United States Census Regions
N.E.	New England		W.S.C.	West South Central
M.A.	Middle Atlantic		E.S.C.	East South Central
W.N.C.	West North Central		S.A.	South Atlantic
Mtn.	Mountain		E.N.C.	East North Central
Pac.	Pacific			

table V Funding Stage Specialization of Urban Venture Capital Markets

City	Seed	Startup	1st	2nd	3rd	4th	Acquis	Secondary
CANADIAN MARKETS								
Toronto	-	.	+	.	.	.	.	.
Montreal	-	.	+	+	+	.	.	.
Calgary	=	.	.	.	.	-	.	.
Vancouver	-	+	+	+	-	.	.	-
AMERICAN MARKETS								
New York	-	.	.	+	.	.	.	-
San Francisco	-	+	.	+	.	.	.	-
Boston	-	+	.	+	.	.	.	-
Los Angeles	-	.	.	+	.	.	.	-
Chicago	-	.	.	+	+	.	.	-
Dallas	-	.	.	+	.	.	.	-
Washington DC	-	.	.	+	.	.	.	-
Philadelphia	-	.	.	+	.	.	.	-
Houston	-	.	.	+	+	.	+	-
Minneapolis	-	.	.	+	.	.	.	-
Cleveland	-	+	.	+	.	.	.	-
Detroit	-	+	.	.	.	-	.	-
Denver	-	+	+	+	.	-	.	-
Atlanta	.	.	.	+	+	+	+	.
Miami	-	.	.	+	.	.	+	.
Milwaukee	-	.	.	.	+	.	+	.

= Below low inner fence
- Below inner hinge but within inner fence
. Between the hinges
+ Above upper hinge but within inner fence

Funding Stages Defined by Pratt (1983)
Seed	Seed (prove a concept)
Startup	Startup (product development and marketing)
1st	First Stage (initiate commercial manufacturing and sales)
2nd	Second Stage (working capital)
3rd	Third Stage (expansion of company)
4th	Fourth Stage (bridge to public market)
Acquis	Acquisitions and Management Buyouts
Secondary	Secondary (restructure or refinance)

City	Dis.	Manf.	Med.	N.R.	R.E.	Ret.	Serv.	Tech.
CANADIAN MARKETS								
Toronto	.	*	.	.	*	-	.	.
Montreal	.	*	.	.	.	.	+	*
Calgary	+	.	-	.	.	.	.	-
Vancouver	:	.	-	*	.	-	+	.
AMERICAN MARKETS								
New York	.	*	.	.	*	-	.	*
San Francisco	+	*	*	.	-	.	.	*
Boston	.	*	*	.	-	.	.	*
Los Angeles	.	*	*	.	-	*	.	*
Chicago	.	*	.	.	-	*	.	.
Dallas	-	*	.	.	-	*	.	*
Washington DC	-	*	.	.	.	.	.	*
Philadelphia	.	*	.	-	-	-	.	.
Houston	-	*	.	.	-	-	-	.
Minneapolis	+	*	.	-	-	-	.	*
Cleveland	.	*	*	.	-	-	.	*
Detroit	.	*	.	.	*	.	.	*
Denver	.	*	.	.	-	-	.	*
Atlanta	.	*	.	.	.	-	.	.
Miami	.	*	*	-	-	-	.	*
Milwaukee	.	.	*	.	-	-	.	.

- Below inner hinge but within inner fence
. Between the hinges
* Above upper hinge but within inner fence

Industrial Sectors Defined by Pratt (1983)
Dist.   Distribution
Manf.   Manufacturing
Med.   Medical
N.R.   Natural Resources
R.E.   Real Estate
Ret.   Retail
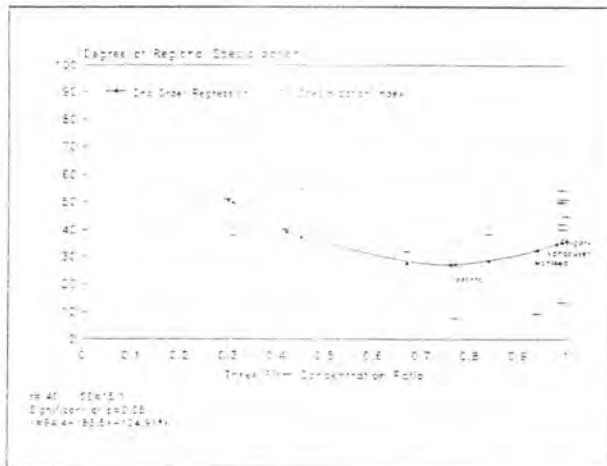Serv.   Services
Tech.   High Technology including Computers

figure 4 - Market Concentration and
Regional Specialization

Summary

This paper has provided both a theoretical
explanation and an empirical investigation of
specialization in urban venture capital markets. The
empirical analyses revealed the following results:

(1) Sources of venture capital in both Canada and the
United States are concentrated in a few urban
markets.

(2) The concentration of venture capital sources within
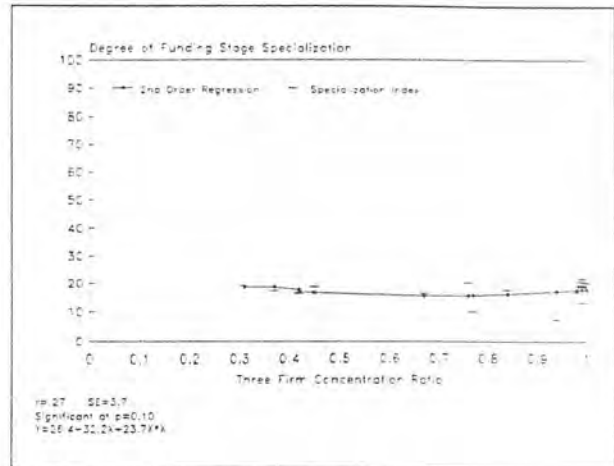an urban market is inversely related to the size of the
market.

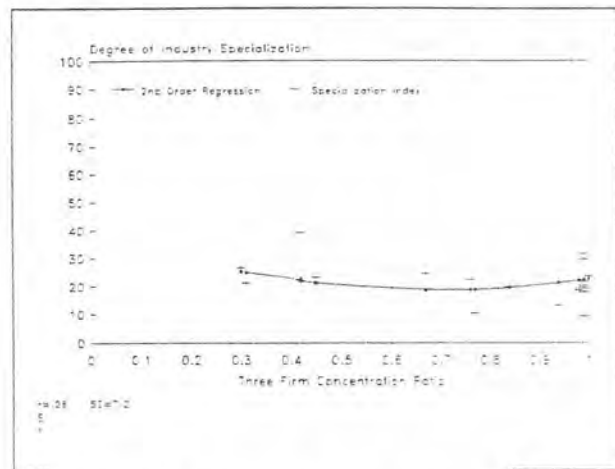Figure 5 - Market Concentration and
Funding Stage Specialization

figure 6 - Market Concentration and
Industrial Sector Specialization

(3) Market specialization has not changed significantly
over the time period 1973 to 1985.

(4) The degree of specialization varies widely by market.
Canadian markets are generally less specialized
than American ones. Each market has a unique
combination of regional, funding stage, and
industrial sector specializations.

(5) The relationship between market concentration and
specialization follows a U-shaped curve. Market
specialization is high at both low and high levels of
concentration, and low at intermediate levels of
concentration.

These results generally support a theoretical
explanation of market specialization based on the
concepts of bounded rationality, information
impactedness, small numbers bargaining,
idiosyncratic capital, and opportunistic behaviour.

Generally, in large markets where transactions are less idiosyncratic, venture capitalists must specialize in order to organize, interpret, and use all available information. In small markets where there is little information, and transactions are highly idiosyncratic, venture capitalists must specialize in order to generate enough expertise to make satisficing decisions. In markets of intermediate size, venture capitalists need not specialize to the same degree in order to properly utilize available information.

The implications for small and new firm development are clear. First, access to this form of badly needed equity capital is both hierarchically and spatially biased toward a few large centres. Second, there may be greater support for the development of certain new industries in some markets over others. While entrepreneurial talent may be ubiquitous, it cannot make an economic contribution if the enabling mechanism of capital is not available. In any case, entrepreneurs with the greatest desire to succeed may be drawn to those cities with a financial community willing to undertake the risk of venture capital. If this is the case, economic growth and job creation might concentrate in these centres.

Local economic development is in large part dependent upon a recognition that venture capital and its attendant managerial assistance is a major component in the development of small high- capacity firms. While the organized venture capital industry is not the only, or even the major form of small firm financing, it is indicative of the attitudes regarding, and the availability of, other (often informal) sources of equity capital.

Notes

[1]The symmetric uncertainty co-efficient is a measure of proportional reduction in error, and is similar to the more common measure lambda proposed by Goodman and Kruskal (1954). PRE measures are ratios of the error resulting from the prediction of the values of one variable based on the knowledge of that variable alone to the error resulting from a prediction based on knowledge of an additional variable. This particular co-efficient is said to be symmetric because no one variable is dependent on another; it is an average of two possible asymmetric measures.

The uncertainty co-efficient can be thought of as a measure of the entropy contained within an R*C table. The measure is relatively small if there is little entropy (that is, the values of the cells within the table tend to be similar) and relatively large is entropy is high (the values of the cells within the table are dissimilar). The likelihood ratio statistic (G/2) is used to determine if a significant amount of entropy exists within the table (indicating that a relationship exists between R and C). G/2 has (R-1) (C-1) degrees of freedom and follows an approximate Chi-square distribution. It is also perfectly additive, and can be easily partitioned to test the significance of a change in the uncertainty co-efficient.

The uncertainty co-efficient is operationalized in the SPSS CROSSTABS procedure, but G/2 is not available. Both are available in the SAS FREQ and BMDP 4F procedures. A program called G'2 written in BASIC and intended for use on IBM compatible microcomputers is available from the author. The uncertainty co-

efficient is presented in Theil (1972), and Goodman and Kruskal (1972). The likelihood ratio is discussed by Fienberg (1977).

[2]The specialization index used here is the ratio of the standard deviation of the data to the maximum standard deviation that would result if all firms preferred only one region, funding stage, or industry sector. This index is calculated as follows:

$$S = (\Sigma(X-\bar{X})^2/(N-1))/((N-1)*((0-\bar{X})^2))+(((\Sigma X)-\bar{X})^2) \quad \text{where,}$$

X = data, $\bar{X}$ = mean, and N = number of observations

This index can be easily calculated using compute statements in any of the popular statistical packages. A program called SINDEX written in BASIC and intended for use on IBM compatible microcomputers is available from the author. SINDEX also calculates a number of other descriptive measures.

[3]Coded tables are prepared as follows (Tukey, 1977). First the data is ordered and the median value is found. The median between this value and either extreme is calculated. These two values are the "hinges" of the distribution, and the difference between them is the "H-spread". Finer breakdowns of the distribution are then undertaken in "steps" that are 1.5 times the H-spread. Finally, values in the original distribution are assigned symbols that correspond to one of the following categories:

(1) between the hinges

(2) within the inner fence - one step outside either upper or lower hinge

(3) within the outer fence - two steps outside either upper or lower hinge

(4) far outside - more than two steps outside either upper or lower hinge

The hinge is thus comparable to the quartile, the inner fence the eighths, and the outer fence the sixteenths of the distribution. The median is the preferred measure of central tendency because of its relative insensitivity to a few extreme values. Thus, a more robust classification is achieved.

The coded table procedure is operationalized in the MINITAB statistical package. Source code in both BASIC and FORTRAN for a program to produce coded tables is available in Velleman and Hoaglin (1981).

[4]This parabolic function is of the following form:

$$Y = a + bX + cX^2 \quad \text{where,}$$

Y = a dependent variable, a = a constant, b = the first degree coefficient, c = the second degree coefficient, and X = an independent variable

This function was fit to the data by the method of least squares. This procedure can be operationalized either directly or indirectly through the use of transformation statements in all of the popular statistics packages. A program called N-ORDER written in BASIC, and intended for use on IBM compatible microcomputers is available from the author. This program is a translation of the FORTRAN code provided by Miller (1982).

References

Binks, Martin and John Coyne. (1983). The Birth of Enterprise. Westminster, UK: The Institute of Economic Affairs.

Birch, David. (1979). The Job Generation Process. Cambridge: MIT press.

Bygrave, William D. (1987). "Syndicated Investments by Venture Capital Firms: A Networking Perspective", Journal of Business Venturing, Vol. 2, 139-154.

Bygrave, William D. (1988). "The Structure of the Investment Networks of Venture Capital Firms", Journal of Business Venturing, Vol. 3, 137-157.

Carleton, Willard T. (1986). "Issues and Questions Involving Venture Capital", in Gary Libecap ed., Advances in the Study of Entrepreneurship, Innovation, and Economic Growth, Vol. 1. Greenwich, Conn.: JAI Press Inc., 59-70.

Fienberg, S. (1977). The Analysis of Cross-Classified Categorical Data. Cambridge, MA: MIT Press.

Firn, John R. and J.K. Swales. (1978). "The Formation of New Manufacturing Establishments in the Central Clydeside and West Midlands Conurbations 1963-1972: A Comparative Analysis", Regional Studies, Vol. 12, 199-213.

Goodman, L.A. and W.H. Kruskal. (1954). "Measures of Association for Cross-Classification I", Journal of the American Statistical Association, Vol. 49, 732-764.

Goodman, L.A. and Wh.H. Kruskal. (1972). "Measures of Association for Cross-Classification IV", Journal of the American Statistical Association, Vol. 67, 415-421.

Green, Milford B. (1988). "Patterns of Preference for Venture Capital Investment in the United States 1970 - 1985", Environment and Planning C, forthcoming.

Green, Milford B. and Rod B. McNaughton. (1987). "Interurban Variation in Venture Capital Investment Preferences", Urban Studies, forthcoming.

Gudgin, G. and S. Fothergill. (1984). "Geographical Variation in the Rate of Formation of New Manufacturing Firms", Regional Studies, Vol. 18, 203-206.

Johnson, P.S. and D.G. Cathcart. (1979). "New Manufacturing Firms and Regional Development: Some Evidence from the Northern Region", Regional Studies, Vol. 13, 269-280.

Lloyd, Peter E. and C.M. Mason. (1984). "Spatial Variations in New Firm Formation in the United Kingdom: Comparative Evidence from Merseyside, Greater Manchester and South Hampshire", Regional Studies, Vol. 18, 207-220.

McNaughton, Rod B. and Milford B. Green. (1988). "Minority Access to Venture Captial", Environment and Planning C., forthcoming.

McQuillan, P. and H. Taylor. (1973, 1978). Sources of Venture Capital. Ottawa: Department of Industry, Trade and Commerce.

Miller, Alan R. (1982). Fortran Programs for Scientists and Engineers. Berkeley, CA: Sybex.

Onians, Richard A. (1984). "Venture Capital Markets for the Regeneration of Industy", in Industrial Venture Capital Investors, John M. Gibb ed.. Brussels: Sevier Science Publishers, 26-34.

Pfeffer, J. and G.R. Salancik. (1978). The External Control of Organizations. New York: Harper and Row.

Phillips, Almarin. (1986). "Theorectical and Research Issues Regarding Entrepreneurship, Venture Captial and Innovation", in Gary Libecap ed., Advances in the Study of entrepreneurship, Innovation, and Economic Growth, Vol. 1. Greenwich, Conn.: JAI Press Inc., 79-82.

Pratt, Stanley. (1977, 1981, 1983). Guide to Venture Capital. 4th, 5th and 6th editions. Wesley Hills, MA: Capital Publishing Corp.

Pred, A.R. (1977). City Systems in Advanced Economies. New York: Halsted Press.

Silver, A. David (1985). Venture Capital: The Complete Guide for Investors. New York: John Wiley and Sons.

Theil, Henri. (1972). Statistical Decomposition Analysis. Amsterdam: North-Holland Publishing Co.

Tukey, John W. (1977). Exploratory Data Analysis. Reading, MA: Addison-Wesley.

Velleman, Paul F. and David C. Hoaglin. (1981). Applications, Basics, and Computing of Exploratory Data Analysis. Boston, MA: Duxbury Press.

Venture. (1985). Venture's Guide to International Venture Capital. New York: Simon and Schuster.

Williamson, O.E. (1975). markets and Hierarchies. New York: The Free Press.