# State-Level Determinants of Entrepreneurship and a Preliminary Measure of Entrepreneurial Climate

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*State and local governments increasingly look to entrepreneurship as a means of stimulating economic growth. However, can the public sector play a role in promoting entrepreneurial activity—and if so, what should that role be? The authors investigate independent effects of financial and human entrepreneurial capital and ideas on entrepreneurial activity in the 50 states. Financial entrepreneurial capital has an inverse U-shaped relationship with entrepreneurial activity, suggesting there are limits to using increasing amounts of financial capital to stimulate entrepreneurship, all else being equal. The authors rank each state in terms of predicted and actual entrepreneurial activity scores and propose a preliminary measure of the entrepreneurial "climate" of each state. Although most states are ranked near where casual analysis might place them, the authors find that others have predicted values that differ significantly from actual values. This suggests that climate may be an important factor in stimulating entrepreneurial activity.*

> Despite its importance and overarching presence in market-based economies, entrepreneurship is an elusive concept. At its most general, it is the ability to marshal resources to seize new business opportunities. Entrepreneurship, defined in this broad sense, is central to economic growth.
>
> —Organization for Economic Cooperation and Development (OECD) (1998, p. 41)

With the growing belief in the dominant role of small firms in the economic growth of communities and the nation (Birch, Haggerty, & Parsons, 1999; Ernst & Young, 1998; Kotler, Jatusripitak, & Maecincee, 1997; McKee, 1994; OECD, 1998; U.S. Small Business Administration, 1998), the question of whether public policy can be used to stimulate entrepreneurship is of increasing interest to state and local government officials. This concern is magnified in many places by the employment consequences of globalization and the downsizing of large companies. In many communities, entrepreneurial activity is now viewed as a potentially important source of job growth, as old employment relationships are changed dramatically in the "new economy."

State economic development policy is increasingly seen as a potentially significant factor influencing development patterns. Although states are not functional economic units, they have the

AUTHORS' NOTE: We are grateful to the editor and two anonymous reviewers for valuable comments on an earlier version of this manuscript and to Kris Kimel for stimulating our interest in this topic. This study was funded in part by the Kentucky Science and Technology Corporation in Lexington. Opinions expressed are our own, and we are responsible for any remaining shortcomings in this article.

ECONOMIC DEVELOPMENT QUARTERLY, Vol. 15 No. 1, February 2001 58-70

power to influence many of the factors important to economic development. And while the federal government has wide-ranging authority, in certain key areas—such as education, taxation, planning and zoning, and the environment—state authorities are the dominant decision makers.[1] As an example of the perceived importance of state economic development policy, the Corporation for Enterprise Development (1998) publishes a widely circulated annual report ranking the states in terms of their attractiveness to business. Similarly, the voluminous academic literature on "waves of development" is couched in terms of the types of programs that states put into place to influence business development (Bartik, 1991; Bradshaw & Blakely, 1999; Eisinger, 1988; Foster, 1988; Isserman, 1994).

Although relatively large variability exists in the rate of new business formation in different regions of the United States, little systematic knowledge exists about the determinants of entrepreneurship at the state level.[2] Furthermore, despite its acknowledged importance, we are aware of no studies that specifically attempt to measure or approximate entrepreneurial climate at the state level. By contrast, a sizable literature exists on business climates, which focuses on factors such as taxes and labor force growth (e.g., Brace, 1993; Fantus Company, 1975; Goetz, 1997; Grant & Company, 1979; and the summaries of the Fantus & Grant papers in Plaut & Pluta, 1983). However, these writers tend to be concerned with businesses locating from outside a state, and the literature has a strong industrial or manufacturing orientation, including an emphasis on industrial recruitment. As states and local governments move beyond industrial recruitment approaches and seek to develop locally based businesses and foster clusters of related small firms, questions of how entrepreneurial activity can be amplified become important to state policy.

One purpose of this article is to suggest an approach that can begin to assess the influence of the state entrepreneurial climate on entrepreneurial activity and, indirectly, on employment growth and the formation of new businesses. To accomplish this, we propose a model of the entrepreneurial process that can be estimated using conventional regression methods. The genesis of the model is a simple production function: entrepreneurial activity (an output) arises from a combination of various entrepreneurial inputs or resources. A complicating factor is the imprecise nature of both the endogenous and exogenous variables. Although many people speak of entrepreneurial behavior, there is not a single well-accepted definition of the concept, and there are no precise theories of how entrepreneurial activity takes place. Thus, much of our work is offered in the spirit of trying to provide a beginning framework for a more refined definition of the concepts.

In the model, we specify entrepreneurial activity as a linear function of three categories of ingredients of entrepreneurship: new ideas and innovations, human capital, and financial capital. This analysis reveals the independent effects of these "inputs" on entrepreneurship. In addition, we interpret the residual value for each state from this regression as a proxy for entrepreneurial climate or culture within a state. This is analogous to a "Solow-type" residual familiar from economic growth studies, in which the unexplained variation in a regression of output growth on inputs of capital and labor is attributed to unmeasured knowledge (Barro & Sala-I-Martin, 1995; Solow, 1956).

**. . . we interpret the residual value for each state from this regression as a proxy for entrepreneurial climate or culture within a state. . . analogous to a "Solow-type" residual.**

Alternatively, one can think of the modeling effort as being analogous to estimating a frontier production function (Greene, 1997) in which the error term is a compound term consisting of at least two types of disturbance; one is the usual zero mean random error that is common to all ordinary least regressions, whereas the other has some (perhaps nonzero) mean value that reflects systematic behavior that is not incorporated in the set of exogenous variables. The frontier production function, defined as the maximum entrepreneurial output that can be obtained from a given amount of entrepreneurial inputs, is beyond the reach of all states. However, some states are closer to reaching this frontier than are others because they have a more favorable entrepreneurial climate.

Although our model cannot capture the full richness of the entrepreneurial process, it offers a way to formally specify a structure that begins to address the important questions of whether and how states can influence entrepreneurial activity. This constitutes a unique addition to the literature in that it moves beyond studying only individual-level characteristics as predictors of entrepreneurial success (Bartik, 1991; Bates, 1993; Evans & Leighton, 1989; Malecki, 1988, 1990; Reynolds, Storey, & Westhead, 1994) and recognizes that the environment in which individuals operate plays a role in their behavior (Kristensen, 1994). Otherwise, there would be no real role for policy because entrepreneurial behavior would be a strict function of individuals' characteristics.

## CONCEPTUAL FRAMEWORK AND METHOD

A state's climate can be supportive of, detrimental to, or neutral with respect to entrepreneurship. For example, two states with the same levels of entrepreneurial inputs will have different outputs of entrepreneurship if they have different climates. Alternatively, a state with low levels of inputs may generate the same level of output as a state with higher levels of inputs if the state has a climate that is more conducive to, or supportive of, entrepreneurial activity.

The climate includes subtle or "soft" factors, such as whether entrepreneurs are celebrated by the press and public officials. For example, Birch et al. (1999) argue,

> Tolerance and recognition of new and different people doing new and different things is (*sic*) the hallmark of a place in which entrepreneurs will start and grow companies. Such . . . people want to be wanted. They want to be recognized and respected for what they have done. They will gravitate to a place that reveres them and will avoid places that treat them badly. (p. 13)

Birch et al. (1999) further propose the following test as a measure of establishing whether a local community has a favorable entrepreneurial climate.

1. When the mayor of the city meets with business leaders, are there as many chief executive officers of mid-size growth companies as bankers and corporate executives?
2. Are entrepreneurs invited to join the best athletic, social, and country clubs? Have they joined?
3. Does the local newspaper follow the fortunes of start-ups and mid-size growth companies with the same intensity and sophistication as it does large corporations?
4. Are innovative companies able to recruit nearly all of their professional work force from the local area?
5. Is there a sizeable, visible venture capital community?
6. Does the local university encourage its faculty and its students to participate in entrepreneurial spinoffs, and do they?
7. Do growth-company CEOs and venture capitalists hold at least a quarter of the seats on boards of the three largest banks?
8. Does the city's economic development department spend more time helping local companies grow than it does chasing after branch facilities of out-of-state corporations?
9. Does the governor of your state meet regularly with entrepreneurs to seek their views?
10. Can you quickly think of 10 recent spinoffs—growth companies started by entrepreneurs who have left large companies? (p. 13)

With each affirmative answer scoring 10 points, a total score of 70 points or higher produces a "passing" grade, according to these authors.

The concept of an entrepreneurial climate or culture is inherently difficult to quantify and measure empirically, but it is typically seen as a potentially important factor influencing entrepreneurship. Such a measure would be valuable to state and local decision makers as well as to private entrepreneurs in comparing the desirability of different states as locations for starting a new business.

**We distinguish between entrepreneurial activity that is essentially Schumpeterian and activity that is driven simply by income and population growth.**

We distinguish between entrepreneurial activity that is essentially Schumpeterian and activity that is driven simply by income and population growth. The former involves fundamental change in an economy based on new products, combinations of inputs, or production processes, and it is consistent with the definition used by the OECD (1998) in the quote at the beginning of this article. The latter activity is not entrepreneurial because it involves "more of the same" or a linear growth.

For example, according to our definition, fast-food franchises do not qualify as entrepreneurial firms.

As a first approximation, we propose to measure this climate as the residual from a regression of entrepreneurial activity on the three inputs of basic ideas, human capital, and financial resources available for entrepreneurship in a state. We hypothesize that there are three basic building blocks or exogenous inputs into the entrepreneurial process ($E$): ideas and innovations ($I$), human capital ($H$), financial capital ($F$), and entrepreneurial climate ($\Omega$), which is not directly measurable, and a random error component ($\varepsilon$):

$$E = a + bI + cH + dF - \Omega + \epsilon.$$

In this equation, $a$, $b$, $c$, and $d$ are parameters to be estimated; the latter three capture the effect of the various entrepreneurial inputs on $E$. New ideas and innovations ($I$) are needed to generate new products and production processes, but they require the presence of human ($H$) and financial capital ($F$) to in fact materialize (Jaffe, 1989; Kotler et al., 1997; Tyson, Petrin, & Rogers, 1994). These basic ingredients, together with the entrepreneurial climate or culture that has been fostered in a state, jointly determine the entrepreneurial capacity of the state. A state's entrepreneurial climate determines the effectiveness or efficiency of the process that translates the raw ingredients into entrepreneurial activity. Over time, new firm formations lead to economic growth and prosperity—which, in turn, change the basic entrepreneurial building blocks in subsequent periods.

The critical issue is how one measures these variables. Perhaps the easiest to measure is financial capital, but even here, it is clear there are multiple dimensions. Equity capital is different from debt capital, and both types of capital can be bundled with other useful services such as management advice or access to markets. Similarly, human capital may be influenced by level of formal education, number of individuals with advanced degrees in science or management, or number of people with experience in managing a business. Both measured variables representing ideas and innovation and the entrepreneurial process are even less easily operationalized. One type of idea can be measured by patents applied for or granted, but there are many other ideas or innovations that are not patented. In some ways, the dependent variable, entrepreneurial process, is easier to measure because it ultimately involves decisions and outcomes that can be directly observed. It clearly has a lot to do with new small-firm formation, but it is more than this—because some small firms are not entrepreneurial, whereas some large firms are; thus, simple counts of small firms or proprietorships are only part of the picture.

The last variable, entrepreneurial climate, is particularly difficult to quantify because it is not directly observable and because there is no agreed-upon set of characteristics that defines it. Yet, a sufficient literature exists to suggest its potential importance. For these reasons, we adopt the approach of not directly estimating a parameter for the variable—instead, we argue that its influence is embedded in the residual.

The residual from this regression is that component of entrepreneurship that is not associated with the specific levels of the building blocks in each state.[3] A positive residual (measured as actual minus predicted entrepreneurial activity) suggests a level of entrepreneurship greater than that predicted from the given building blocks. The opposite is true of a negative residual. In principle, therefore, the residual is a proxy of the relative degree to which the entrepreneurial climate or culture of a state, the broad parameters of which are set by public and private community leaders, encourages or hinders entrepreneurial efforts.

## DATA AND JUSTIFICATION OF VARIABLES

Thus, we are in the position of relying upon sets of variables that are arguably correlated with the variables of interest but are not identical. Furthermore, there is no single variable that captures the complete essence of each of the four variables identified above, but we suggest that it is possible to define a proxy, or instrument, for these variables by constructing clusters of variables that individually have something to do with the variable of interest but are not individually strong enough to represent the idea.

**For the dependent variable, we include *Inc.* (1996) 500 firms . . . as well as initial public offerings (IPOs) issued in the technology sector.**

We employ the variables shown in Table 1 in the analysis, grouped according to *E*, *I*, *H*, and *F*. For the dependent variable, we include *Inc.* (1996) 500 firms (see below) as well as initial public offerings (IPOs) issued in the technology sector. Rapidly expanding companies, as measured by revenue growth, are the backbone of a dynamic entrepreneurial economy in which individuals identify and take advantage of new economic opportunities. According to *Inc.* (1996), its annual ranking of the 500 fastest growing firms provides key insights into current entrepreneurial conditions and activities, in addition to showcasing firms with significant potential for future growth.

Some entrepreneurs raise funds to expand their businesses more aggressively than others, by offering stock in their companies through the public equities market. To a large extent, this reflects the entrepreneur's confidence in his or her product as well as a desire to take the product to new markets and to expand operations. Generally, companies and entrepreneurs from industries on the leading edge of the product cycle are represented here. Although IPOs could be viewed as a financial input into the entrepreneurial process, we include them as an output because they represent more of an outcome of entrepreneurial effort rather than an early-stage activity. In other words, an IPO represents the reward to the entrepreneur from having developed a successful new product (output). Because of the sector's relative importance, we include only IPOs in the technology sector.

Among ideas and innovations, we include Small Business Innovation Research grants and patents. The Small Business Innovation Research measure shows how successfully small businesses in a state compete for grants from one of the major sources of federal R&D seed funds for companies. Success in obtaining these funds depends on the quality of the idea underlying the proposed innovation, its technical merits, and its commercial potential. Patents are an obvious measure of how many new ideas are generated in a state; they are a direct measure of entrepreneurial energy, creativity, persistence, and confidence.

We use the percentage of adult population that has earned at least a college degree as our measure of human capital stocks in a state. Although successful completion of high school may provide a minimal educational foundation for entrepreneurs, a college degree offers additional exposure to ideas and information and provides greater credibility with investors, which can increase access to finance for developing and marketing a new product.

The last measure, financial capital, consists of two variables: venture capital commitments and Small Business Investment Company funds. Venture capital is a key source of financial liquidity for entrepreneurs seeking to develop their ideas into marketable products or enterprises. A Small Business Investment Company is an otherwise private source of funding for small business ventures that is backed up through a partnership with the federal government, which makes funds available at favorable loan rates to private profit-seeking Small Business Investment Company firms.

Because we are working with only 50 states, our degrees of freedom in selecting variables for the regression analysis are severely limited. We therefore collapse different measures of the output of entrepreneurship, together with the inputs of ideas and innovations and human and financial capital, into single measures as follows, with data sources shown in parentheses (see Table 1). In all cases, the most recent year for which data were available at the time this study was initiated was selected; where data were readily available and the value of each variable changed noticeably from one year to the next, data from more than 1 year were averaged together.

**Colorado, California, Massachusetts, Virginia, and Maryland have the highest entrepreneurial output scores (*E*), whereas Hawaii, Wyoming, Alaska, Montana, and North Dakota have the lowest scores.**

To aggregate the subset of variables for each major indicator, each series was first normalized into a *z* score by subtracting the mean and dividing by the standard error of each series:

$$z_i = \frac{x_i - \bar{x}}{s}.$$

Subsequently, the normalized series were added together for use in the regression equation. Detailed state-level scores on each of the four indicators, along with each state's ranking, are reported in Appendix A. Colorado, California, Massachusetts, Virginia, and Maryland have the

**TABLE 1**
**List of Dependent and Independent Variables and Their Sources**

| |
|---|
| Dependent variable (output) |
| Entrepreneurial activity (2 measures) |
| *Inc.* 500 firms per million state population, 1995-1997 average[a] |
| Initial public offerings offered in the technology sector per million population, 1996-1997[b] |
| Independent variables (inputs) |
| Ideas and innovations (2 measures) |
| Small Business Innovation Research grants awarded per million persons, 1995[c] |
| Patents issued per million population, 1996[d] |
| Human capital (1 measure)[e] |
| College graduates, percentage of persons 25 years or older, 1996 (U.S. Department of Commerce) |
| Financial capital (2 measures) |
| Venture capital commitments per person, 1995 and 1996 average (venture economics)[f] |
| Small Business Investment Company funds disbursed per person, 1996[g] |

NOTE: State-level population data were obtained from the population pages on the U.S. Bureau of the Census Web site (http://www.census.gov).
a. *Inc.* (http://www.inc.com/500/).
b. *IPO Monitor* (http://www.ipomonitor.com, using a Web-based search of the company's proprietary database on the keyword *technology* for all companies, states, ZIP codes, and area codes).
c. B. Connolly (personal communication, June 16, 1997).
d. U.S. Patent and Trade Office (http://patents.uspto.gov).
e. Day and Curry (1997); A. Curry (personal communication, 8/4/1997), U.S. Bureau of the Census (http://www.census.gov).
f. C. Crockett, the Gazelle Group, Inc. (personal communication, 7/3/1997).
g. U.S. Small Business Administration (http://www.sbaonline.sba.gov/INV/tables/table13.html#13).

highest entrepreneurial output scores ($E$), whereas Hawaii, Wyoming, Alaska, Montana, and North Dakota have the lowest scores.

## EMPIRICAL RESULTS AND DISCUSSION

Linear regression results corrected for heteroscedasticity, using White's (1980) method, are reported in Table 2. To allow for nonlinearities and interactions among the regressors, squared terms were entered along with interaction terms among the variables. This specification essentially approaches a translog production function, which in turn serves as a local second-order approximation to any arbitrary production function and provides considerable flexibility while preserving desirable properties based on theoretical considerations.

Only one interaction term was statistically different from zero, implying a positive interaction between ideas and human capital stocks. The squared term was statistically different from zero only in the case of financial capital. In general, the regressors perform well in this regression model, and 60% of the variation in the dependent variable is associated with the variation of this particular vector of regressors.

As expected, a larger pool of raw ideas and basic innovations is positively associated with entrepreneurial activity, as measured here. The same is true of human capital. Furthermore, a positive interaction exists between ideas and human capital. A higher level of either variable enhances the effectiveness of the other variable in stimulating entrepreneurial activity:

$$\partial E / \partial I = 0.396 + 0.189H$$

and

$$\partial E / \partial H = 0.400 + 0.189I.$$

**. . . opportunities exist to expand entrepreneurship by increasing the human capital base of a state.**

This result suggests that opportunities exist to expand entrepreneurship by increasing the human capital base of a state. Such an expansion will increase the effectiveness with which ideas are translated into entrepreneurial outputs. Similarly, the same stock of human capital will yield a

TABLE 2
**Regression Results for Determinants of Entrepreneurial Activity (*E*)**

| *Variable* | *Coefficent (t statistic)* | *Beta Coefficient* | M | SD |
|---|---|---|---|---|
| Constant | −0.0414 (−0.24) | | | |
| Ideas and innovations (*I*) | 0.396*** (−2.8) | 0.415 | 0 | 1.765 |
| Human capital (*H*) | 0.400† (−1.62) | 0.237 | 0 | 1 |
| $I \times H$ | 0.191** (−1.9) | 0.282 | 1.298 | 2.442 |
| Financial-capital (*F*) | 0.338** (−2.26) | 0.329 | 0 | 1.64 |
| $F^2$ | −0.0764** (−2.15) | −0.431 | 2.637 | 9.513 |
| *R*-squared | 0.6 | | | |
| Adjusted *R*-squared | 0.555 | | | |

NOTE: Sample size is 50. The *t* statistics are based on White's (1980) consistent variance estimates. The beta coefficient is calculated as $b(s_x/s_y)$, where $b$ is the actual coefficient and $s$ refers to the standard deviation of the independent ($x$) and dependent ($y$) variables.
†$p \leq .1$ (one-tailed). **$p = .05$. ***$p \leq .01$ (two-tailed).

greater payoff in terms of entrepreneurship the larger are the number of ideas and innovations generated in a state.

The results also indicate that the greatest gains from expanding financial capital resources are obtained from the earliest investments and that further expansion of such capital will not be translated into higher gains in entrepreneurship because diminishing returns set in. The relationship between $E$ and $F$ follows an inverted U-shape (or parabola), where $E$ increases as $F$ increases up to the point at which $F = 2.235$. Beyond this level, additional financial capital depresses $E$. Given the levels of the other two inputs ($I$ and $H$) and the entrepreneurial climate, further expansion of $F$ provides a negative return in terms of entrepreneurial output.

The minimum and maximum values for financial capital are −1.362 and 8.287. In the data sample, 48 states are below the turning-point value of 2.21 for financial capital (see also Appendix A). Thus, for most states, improvements in entrepreneurial activity could be achieved by increasing financial input variables because the turning point—or point of diminishing returns—has not yet been reached.

## STATE-LEVEL ENTREPRENEURIAL CLIMATE

When the positions of specific states are examined in terms of their entrepreneurial climate (see Table 3), the results are broadly consistent with where popular opinion might place the states. There are few obvious surprises in terms of the states that have relatively high levels of both predicted and actual levels of entrepreneurship. These are the states that typically appear in rankings of entrepreneurial hot spots. Virginia, Colorado, and California all have high levels of entrepreneurial activity. Florida, Massachusetts, Utah, and Maryland are only slightly lower. Similarly, the lagging group, composed of West Virginia, Mississippi, Kentucky, Louisiana, and South Dakota, is also consistent with popular perceptions. The relative positions of some other states are not as easily reconciled. One might have expected higher rankings for Texas and Washington, for example, or lower rankings for New Jersey and New Hampshire.

The model results indicate that there is a relatively large unexplained component (regression residual)—which, we argue, incorporates the effect of state entrepreneurial climate. Consider the states of Connecticut, Massachusetts, and Colorado, all of which expend roughly the same aggregate level of inputs, as suggested by their predicted level of entrepreneurial activity. From the

TABLE 3
**Estimated Measures of Entrepreneurial Climate**[a]

| *State* | *Actual Score* | *Predicted Score* | *Climate* | *Rank* | *State* | *Actual Score* | *Predicted Score* | *Climate* | *Rank* |
|---|---|---|---|---|---|---|---|---|---|
| Alabama | –0.74 | –1.02 | 0.28 | 18 | Montana | –1.96 | –0.23 | –1.73 | 48 |
| Alaska | –1.96 | –0.58 | –1.38 | 47 | Nebraska | 0.19 | –1.02 | 1.21 | 7 |
| Arizona | 0.57 | –0.63 | 1.20 | 8 | Nevada | –1.11 | –0.95 | –0.16 | 30 |
| Arkansas | –0.87 | –1.46 | 0.59 | 12 | New Hampshire | 2.04 | 2.18 | –0.13 | 29 |
| California | 3.78 | 2.30 | 1.48 | 4 | New Jersey | 1.76 | 1.25 | 0.52 | 13 |
| Colorado | 5.25 | 3.63 | 1.62 | 3 | New Mexico | –0.84 | –0.27 | –0.57 | 37 |
| Connecticut | 0.79 | 3.43 | –2.64 | 49 | New York | 0.10 | 0.57 | –0.47 | 35 |
| Delaware | 0.31 | 0.63 | –0.33 | 33 | North Carolina | –0.47 | –0.58 | 0.11 | 23 |
| Florida | 0.92 | –0.51 | 1.44 | 5 | North Dakota | –1.96 | –1.00 | –0.95 | 45 |
| Georgia | 1.60 | –0.61 | 2.21 | 2 | Ohio | –0.44 | –0.28 | –0.16 | 31 |
| Hawaii | –1.96 | –1.05 | –0.91 | 44 | Oklahoma | –0.55 | –0.72 | 0.17 | 20 |
| Idaho | –1.50 | –0.89 | –0.61 | 40 | Oregon | –0.25 | –0.14 | –0.11 | 27 |
| Illinois | 0.05 | –0.19 | 0.24 | 19 | Pennsylvania | –0.35 | –0.33 | –0.02 | 25 |
| Indiana | –1.12 | –1.03 | –0.08 | 26 | Rhode Island | 0.53 | 0.51 | 0.02 | 24 |
| Iowa | –1.00 | –1.32 | 0.32 | 17 | South Carolina | –1.15 | –0.78 | –0.36 | 34 |
| Kansas | 0.17 | –0.17 | 0.33 | 15 | South Dakota | –1.21 | –1.38 | 0.16 | 22 |
| Kentucky | –0.48 | –1.31 | 0.82 | 9 | Tennessee | –0.93 | –0.33 | –0.60 | 39 |
| Louisiana | –1.77 | –0.99 | –0.78 | 41 | Texas | 0.41 | –0.33 | 0.74 | 10 |
| Maine | –1.52 | –0.61 | –0.91 | 43 | Utah | 2.41 | 1.17 | 1.24 | 6 |
| Maryland | 3.05 | 2.37 | 0.68 | 11 | Vermont | –1.49 | 1.75 | –3.25 | 50 |
| Massachusetts | 3.60 | 3.43 | 0.17 | 21 | Virginia | 3.19 | 0.26 | 2.93 | 1 |
| Michigan | –0.36 | –0.23 | –0.13 | 28 | Washington | 1.00 | 0.62 | 0.38 | 14 |
| Minnesota | 1.27 | 0.95 | 0.32 | 16 | West Virginia | –1.96 | –1.46 | –0.50 | 36 |
| Mississippi | –1.66 | –1.35 | –0.31 | 32 | Wisconsin | –0.63 | 0.62 | –1.25 | 46 |
| Missouri | –0.78 | –0.21 | –0.58 | 38 | Wyoming | –1.96 | –1.17 | –0.79 | 42 |

a. Calculated as the difference between the predicted and actual score (the residual).

model, it appears Massachusetts gets a return that is about what it should expect, and Colorado does slightly better. However, Connecticut has a low return on its investment, as does Vermont. By contrast, both Virginia and Georgia have much higher levels of entrepreneurial activity than their levels of inputs would suggest. Virginia's position may reflect the influence of suburban growth around Washington, D.C., whereas growth in Georgia may be related to the rapid growth in recent years of Atlanta, which has become a dominant business and financial center for the Southeast. In both cases, the business environment may reflect more than the economic conditions prevailing in that state.

Some results are perplexing: Florida, Nebraska, and Kentucky do not make large investments in entrepreneurial activity, but they perform far better than the model predicts. They are in the top 10 in terms of differentials between predicted and actual entrepreneurial activity (see Table 3). Although they make modest investments in developing entrepreneurs, they get very strong returns, whereas other states such as Wisconsin and New York make larger investments but get less back. In addition, with the exception of California, states where major federal research laboratories are found do not do well. New Mexico, Tennessee, and Illinois all have much lower levels of actual entrepreneurial experience than the model predicts, given their inputs.

**. . . a potential spatial pattern emerges for states with the best entrepreneurial climates. . . when the top 10 states are plotted, a pattern emerges that basically includes the U.S. South census region and the southern states of the U.S. West census region.**

Because a potential spatial pattern emerges for states with the best entrepreneurial climates, we estimated an additional regression equation. In particular, when the top 10 states are plotted, a pattern emerges that basically includes the U.S. South census region and the southern states of the U.S. West census region (California, Nevada, Utah, New Mexico, Colorado, and Arizona). Figure 1 shows the top and bottom five states. The result for a regression that includes these states as a dummy variable (South) is as follows:

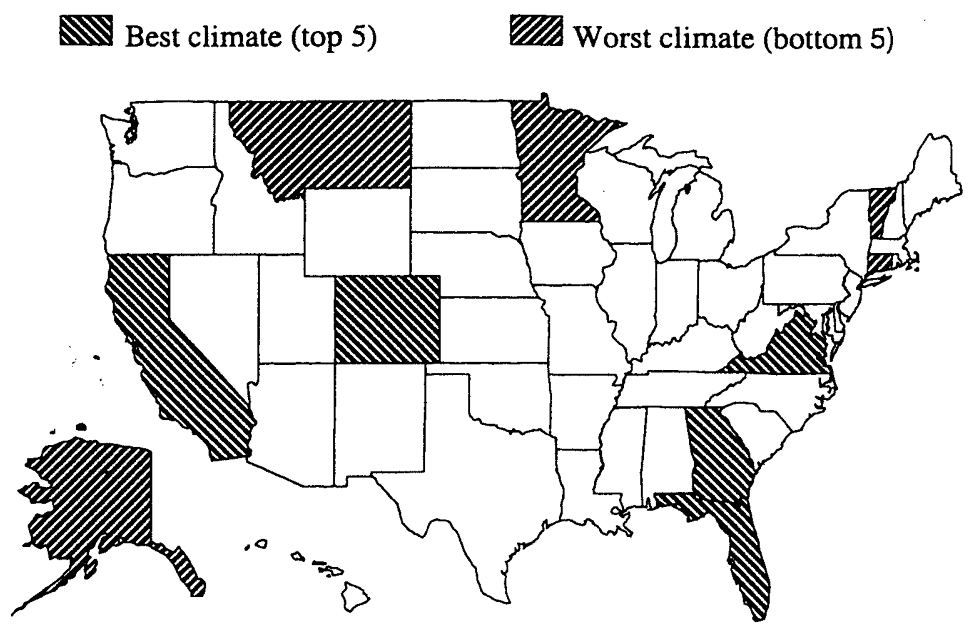


**Figure 1: The Nation's Best and Worst Entrepreneurial Climates**

$$E = \underset{(2.98)}{-0.623} + \underset{(2.07)}{0.271I} + \underset{(3.64)}{0.892H} + \underset{(1.37)}{0.112I \times H} + \underset{(1.82)}{0.278F} - \underset{(1.78)}{0.0485F^2} + \underset{(4.55)}{1.450South}$$

$R$-squared = 0.730; adjusted $R$-squared = 0.693

The regression results are remarkably robust to this specification change, with only the interaction term now becoming statistically indistinguishable from zero in a two-tailed test and the $R$-squared value increases noticeably. Furthermore, the rankings of the five best and worst states in terms of entrepreneurial climate do not change profoundly. Four of the top five states (Virginia, Georgia, Colorado, and Florida) remain among the five top states, and three of the bottom five states (Vermont, Connecticut, and Alaska) remain at the bottom. Because the inclusion of the dummy variable is somewhat ad hoc, we retain the results in Table 3 as our basic measure of state entrepreneurial climate.

In addition, we estimated a frontier production function using the same data set. The results of this estimation are reported in Appendix B, Table 1. Although some of the $t$ statistics are no longer different from zero in this model, in part because of the small sample size, the parameter estimates are generally similar to those obtained in the ordinary least squares model in Table 2. Furthermore, the relative ranking of the states according to the climate measure $\Omega$ is remarkably close to the ranking obtained using ordinary least squares.

## CONCLUSION

We caution that these results should be interpreted as indicative and preliminary at this point. They are of interest because the successful use of a simple production function relationship suggests that there is some link between the aggregations employed here of inputs and the output of entrepreneurial behavior. States that are widely seen as being entrepreneurial leaders or laggards hold their positions in the model. But what the model adds is the notion that these rankings involve some significant differences in the composition of inputs. States have varying proportions of the three measured inputs—ideas and innovations, human capital, and financial capital—which suggests that states do follow different approaches, some of which are more successful than others.

Implicit in the model is the idea that the proportions of these inputs may matter, at least for the positive interaction between ideas and human capital and because of the potential for diminishing returns to financial capital. Another implication of the model is that states are right in paying attention to education because it has strong implications for the kinds of entrepreneurial behavior we measure. Conversely, it would appear that as in many other cases, simply making more money available may not be the answer. In terms of policy, the most obvious places states can play a direct role are in education and finance. Although we believe that ideas and innovations are important—as is climate—it is less easy to see how states go about fostering either of these factors other than through the school system.

The results are also interesting because although the specific inputs account for a considerable amount of the variability in levels of entrepreneurship, a great deal remains unexplained, and the residual could well be the "soft factor" of entrepreneurial climate. Having said this, we recognize that there are significant analytical problems associated with relying on this type of approach. Although climate may be part of the residual, we do not know which portion of the residuals for each state is determined by differences in climate. Consequently, one may best interpret these results as suggesting that there may be considerable benefits in continuing the search for a measure of entrepreneurial climate so that it can be explicitly introduced into the model. In the interim, the model suggests that ongoing investments in traditional inputs such as education, funding for research, and small-business finance or development can play a role in increasing entrepreneurial activity in different states, depending on where they are located on the inverse U-shaped curve.

## APPENDIX A
**Raw Scores and Ranks for Aggregate Variables Used in the Regression**

| | *Entrepreneurship* | | *Ideas and Innovations* | | *Human Capital* | | *Financial Capital* | |
|---|---|---|---|---|---|---|---|---|
| *State* | *Score* | *Rank* | *Score* | *Rank* | *Score* | *Rank* | *Score* | *Rank* |
| Alabama | –0.743 | 30 | –1.006 | 34 | –1.159 | 45 | –0.837 | 31 |
| Alaska | –1.959 | 48 | –0.648 | 29 | 0.975 | 8 | –1.264 | 41 |
| Arizona | 0.571 | 14 | 0.714 | 13 | –0.603 | 37 | –1.267 | 42 |
| Arkansas | –0.874 | 33 | –2.270 | 48 | –1.948 | 49 | –1.315 | 44 |
| California | 3.783 | 2 | 2.870 | 4 | 0.882 | 10 | 2.059 | 4 |
| Colorado | 5.246 | 1 | 3.662 | 3 | 1.717 | 4 | 1.606 | 7 |
| Connecticut | 0.790 | 13 | 2.776 | 5 | 2.158 | 3 | 2.166 | 3 |
| Delaware | 0.305 | 17 | 1.042 | 11 | 1.021 | 7 | –0.862 | 32 |
| Florida | 0.923 | 12 | 0.282 | 21 | –0.603 | 36 | –0.783 | 30 |
| Georgia | 1.604 | 9 | –1.476 | 43 | –0.139 | 27 | 0.096 | 17 |
| Hawaii | –1.959 | 50 | –1.303 | 37 | 0.209 | 25 | –1.211 | 40 |
| Idaho | –1.499 | 41 | –0.075 | 24 | 0.626 | 14 | –1.322 | 45 |
| Illinois | 0.048 | 21 | 0.284 | 20 | 0.348 | 19 | –0.418 | 25 |
| Indiana | –1.116 | 37 | –1.473 | 42 | –1.577 | 48 | –0.573 | 27 |
| Iowa | –1.000 | 35 | –1.971 | 46 | –0.394 | 32 | –1.142 | 39 |
| Kansas | 0.168 | 19 | –1.264 | 36 | 0.812 | 11 | 0.905 | 11 |
| Kentucky | –0.483 | 27 | –2.377 | 49 | –1.275 | 46 | –0.944 | 35 |
| Louisiana | –1.770 | 44 | –0.941 | 32 | –0.881 | 42 | –0.922 | 34 |
| Maine | –1.519 | 42 | –0.967 | 33 | –0.765 | 40 | –0.044 | 19 |
| Maryland | 3.050 | 5 | 1.769 | 9 | 2.204 | 1 | 0.297 | 15 |

(*continued*)

**APPENDIX A continued**

| | Entrepreneurship | | Ideas and Innovations | | Human Capital | | Financial Capital | |
|---|---|---|---|---|---|---|---|---|
| State | Score | Rank | Score | Rank | Score | Rank | Score | Rank |
| Massachusetts | 3.600 | 3 | 6.187 | 1 | 2.181 | 2 | 8.287 | 1 |
| Michigan | –0.365 | 24 | 0.059 | 23 | 0.440 | 18 | –0.093 | 21 |
| Minnesota | 1.266 | 10 | 0.572 | 16 | 0.766 | 13 | 1.979 | 5 |
| Mississippi | –1.657 | 43 | –2.253 | 47 | –1.415 | 47 | –1.070 | 37 |
| Missouri | –0.785 | 31 | –1.356 | 40 | 0.302 | 21 | 1.401 | 8 |
| Montana | –1.959 | 47 | 0.606 | 14 | –0.255 | 30 | –0.760 | 29 |
| Nebraska | 0.186 | 18 | –1.640 | 44 | 0.232 | 24 | –0.872 | 33 |
| Nevada | –1.106 | 36 | 0.292 | 19 | –0.927 | 43 | –1.362 | 48 |
| New Hampshire | 2.041 | 7 | 3.764 | 2 | 1.068 | 6 | –1.086 | 38 |
| New Jersey | 1.764 | 8 | 1.068 | 10 | 1.230 | 5 | 0.407 | 13 |
| New Mexico | –0.841 | 32 | 1.914 | 8 | –0.510 | 35 | –1.362 | 50 |
| New York | 0.096 | 20 | 0.187 | 22 | 0.604 | 16 | 1.051 | 9 |
| North Carolina | –0.466 | 26 | –1.134 | 35 | –0.463 | 33 | –0.012 | 18 |
| North Dakota | –1.959 | 46 | –0.285 | 25 | –0.719 | 39 | –1.362 | 47 |
| Ohio | –0.442 | 25 | –0.691 | 30 | –0.162 | 29 | 0.231 | 16 |
| Oklahoma | –0.550 | 28 | –0.898 | 31 | –0.672 | 38 | –0.462 | 26 |
| Oregon | –0.251 | 22 | 0.898 | 12 | –0.046 | 26 | –1.021 | 36 |
| Pennsylvania | –0.351 | 23 | –0.352 | 26 | –0.162 | 28 | –0.259 | 24 |
| Rhode Island | 0.527 | 15 | 0.310 | 18 | 0.348 | 20 | 3.459 | 2 |
| South Carolina | –1.145 | 38 | –1.349 | 39 | –1.136 | 44 | –0.118 | 23 |
| South Dakota | –1.212 | 39 | –1.765 | 45 | –0.510 | 34 | –1.362 | 49 |
| Tennessee | –0.931 | 34 | –1.306 | 38 | –0.811 | 41 | 1.688 | 6 |
| Texas | 0.412 | 16 | –0.462 | 28 | –0.255 | 31 | –0.064 | 20 |
| Utah | 2.410 | 6 | 1.976 | 7 | 0.604 | 15 | –0.096 | 22 |
| Vermont | –1.494 | 40 | 2.037 | 6 | 0.952 | 9 | 0.907 | 10 |
| Virginia | 3.195 | 4 | 0.408 | 17 | 0.766 | 12 | –0.583 | 28 |
| Washington | 1.003 | 11 | 0.582 | 15 | 0.604 | 17 | 0.397 | 14 |
| West Virginia | –1.959 | 45 | –2.637 | 50 | –2.041 | 50 | –1.308 | 43 |
| Wisconsin | –0.634 | 29 | –0.367 | 27 | 0.232 | 23 | 0.583 | 12 |
| Wyoming | –1.959 | 49 | –1.426 | 41 | 0.279 | 22 | –1.362 | 46 |

SOURCE: State-level population data were obtained from the population pages on the U.S. Bureau of the Census Web site (http://www.census.gov); *Inc.* (http://www.inc.com/500/; *IPO Monitor* (http://www.ipomonitor.com, using a Web-based search of the company's proprietary database on the keyword *technology* for all companies, states, ZIP codes, and area codes); B. Connolly (personal communication, June 16, 1997); U.S. Patent and Trade Office (http://patents.uspto.gov); Day and Curry (1997); A. Curry (personal communication, 8/4/1997); U.S. Bureau of the Census (http://www.census.gov); C. Crockett, the Gazelle Group, Inc. (personal communication, 7/3/1997); U.S. Small Business Administration (http://www.sbaonline.sba.gov/INV/tables/table13.html#13).

## APPENDIX B
## Frontier Function Estimation

The estimation is based on the following assumptions about the distributions of the two error terms:

$$\Omega = |\omega| \text{ and } \omega \sim N[0, \sigma_\Omega^2]$$

$$\text{and } \epsilon \sim N[0, \sigma_\epsilon^2]$$

**TABLE 1**
**Frontier Regression Model (maximum likelihood estimates)**

| | |
|---|---|
| Constant | 0.774 |
| | (1.31) |
| Ideas and innovations (*I*) | 0.410*** |
| | (2.64) |

| | |
|---|---|
| Human capital (*H*) | 0.453 |
| | (1.49) |
| $I \times H$ | 0.207 |
| | (1.62) |
| Financial capital (*F*) | 0.346 |
| | (1.45) |
| $F^2$ | –0.849E-01 |
| | (–0.85) |
| $\sigma_\epsilon / \sigma_\Omega$ | 1.204 |
| | (1.17) |
| $\sqrt{\sigma^2_\Omega \quad \sigma^2_\epsilon}$ | 1.334*** |
| | (4.19) |

NOTE: The beat coefficient is calculated as $\sigma(s_x/s_y)$, where $\sigma$ is the actual coefficient and $s$ refers to the standard deviation of the independent ($x$) and dependent ($y$) variables. Log likelihood = –73.35; $\sigma^2(\Omega)$ = 0.727, $\sigma^2(\epsilon)$ = 1.053 (variance components).
***$p \leq .01$ (two-tailed).

## NOTES

1. In addition, under federal devolution, more and more decision-making authority is being delegated to the states.

2. We focus on states rather than metropolitan statistical areas or consolidated metropolitan statistical areas for two primary reasons. First, some of the variables used in the regression were available (at a reasonable cost) only at the state level. Second, although there may be important intrastate differences—for example, the entrepreneurial climate in Buffalo, New York City, and Rochester may differ measurably—we use states as proxies for functional economic units because we are interested primarily in the role of state government in fostering statewide entrepreneurial activity, including activity within rural areas that would be excluded in a metropolitan statistical area–level analysis.

3. We of course recognize that this residual has embedded in it both the true error term and what is essentially an omitted variable that measures state climate (see the earlier discussion about the Solow residual), but in the absence of a clear measure of climate, we argue that this approach provides us with an indication of the potential benefit of additional work to measure the effect of entrepreneurial climate in different states.

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