# Missouri's Need for Risk Capital:

# An Assessment and Recommendations

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## Executive Summary

The continuous generation of entrepreneurial, high-tech start-up firms is critical to the creation of new, desirable jobs in Missouri. Unfortunately, a variety of measures indicate Missouri is falling behind other states. External private investment trends are showing serious relative decline. Out of the 50 states, Missouri ranks 37th in terms of entrepreneurial activity and 35th in the State New Economy Index, which measures state resources and performance in industries that depend on knowledge, technology, and innovation. An analysis of research inputs and outputs suggests that Missouri does a poor job of converting academic R&D dollars into high-quality entrepreneurial start-ups. For example, Missouri consistently ranks in the bottom 40 percent of states in terms of university start-ups per million dollars of academic R&D expenditures.

A review of state capital formation programs reveals that a number of states are investing heavily in basic research, applied research, and commercialization programs. Missouri, by contrast, is spending significantly less than other, benchmark states. In 2006 Missouri spent less than 10 cents per resident on capital formation programs. In contrast, six neighboring states spent an average of $2.79 per resident. In addition to this comparison with neighboring states, we also identified seven technologically-similar states that we believe constitute a more compelling benchmark for Missouri. These seven states spent an average of $2.94 per resident on capital formation programs in 2006. Clearly Missouri is spending much less than both neighboring states and technologically-similar states on capital formation programs. This lack of state investment should be cause for concern, because compelling examples exist of well-designed state investment programs that have spurred the initial growth of promising entrepreneurial ventures, thereby laying the foundation for increased levels of private venture investment with its enabling capital for manufacturing expansion and high-wage employment growth.

A review of academic research on new venture creation and capital formation, together with an analysis of capital formation programs in other states, suggests that Missouri's capital formation strategy should be guided by seven principles:

### 1. Missouri's capital formation strategy must recognize and respond to the competition Missouri faces from other states for private capital.

Neighboring and technologically-similar states are spending about $2.88 per resident on capital formation programs.[i,1] This number implies that, given Missouri's population of 5.84 million, the state should sustain spending of about $17 million per year on capital formation programs simply to maintain its current position relative to other states. We believe that Missouri's actual investment in capital formation dollars should be greater than $17 million annually if Missouri is to regain lost ground and remain competitive. The state has invested relatively little in capital formation programs during the last five years and needs to make up lost ground.

[i] The $2.88 figure is a weighted average of the $2.79 and $2.94 figures reported above. For calculation details see endnote 1.

**2. Missouri's capital formation strategy should focus on the pre-seed and seed stages of capital formation.**

Seven technologically-similar states are devoting over 90% of their capital formation budget to the research, pre-seed, and seed stages. Given Missouri's relatively poor performance in transforming research dollars into innovative outputs, Missouri's first priority should be capital formation programs designed to boost pre-seed and seed investments. Based on this priority and the data collected from technologically-similar states, it appears that Missouri should allocate at least 60% of its capital formation budget to pre-seed and seed capital investments.

**3. Missouri's capital formation strategy should leverage money from other sources.**

Missouri legislators have a responsibility to spend state dollars wisely, a responsibility that assumes special importance when budgetary constraints are tight. One of the most effective ways to increase the efficiency of capital formation programs is use state dollars to leverage additional funds from the private sector, the federal government, and non-profit institutions. One important way to leverage Missouri's investments in research and commercialization is to make the provision of state funds contingent on the receipt of additional funds from the private sector. Research suggests that the required match should be dependent on firm size. Missouri should also seek to partner with Illinois and Kansas in the creation of programs that target the St. Louis and Kansas City metropolitan areas.

**4. Missouri's capital formation programs should connect innovators, entrepreneurs, businesses, investors, scientists, and marketing experts.**

Research indicates that a key contributor to new venture success is entrepreneurial access to ideas and capital, as well as to technical, marketing, and managerial talent. Missouri should use its capital formation programs to foster the growth of entrepreneurial networks within the state. Possible suggestions include (1) making industry academic-industry collaboration a pre-condition for state investments and (2) requiring that industry experts, venture capitalists, academics, and other experts participate in the evaluation of competitive funding proposals.

**5. Missouri's capital formation strategy must be embedded in a strategy for stimulating the creation of high-quality start-ups in Missouri.**

State programs that increase the supply of venture capital, without increasing the number of high-quality start-ups, risk funneling money to new ventures with poor prospects for success. Missouri's capital formation programs must be accompanied by an innovation strategy designed to increase the number of high-quality start-ups in Missouri. To ensure success, this strategy must (1) focus on the state's existing knowledge base (both public and private), (2) serve clusters of local businesses, and (3) encourage the transformation of university research into Missouri-based entrepreneurial start-ups.

**6. Missouri must make a long-term commitment to both capital formation and innovation.**

Missouri is competing with other states to attract and retain talent, companies, and resources. One important aspect of this competition involves perceptions of Missouri's on-going commitment to innovation, capital formation, and entrepreneurship. Missouri should follow the example of other states and institutionalize its commitments to capital formation programs in order to protect these investments from changing economic conditions and political administrations.

**7. Missouri must measure the results of its capital formation programs.**

Missouri investments in innovation and capital formation are motivated by the desire to create high-quality jobs and drive economic growth. To ensure that capital formation programs are on track and to secure continued support for these programs, Missouri must establish metrics for evaluating the performance of its capital formation programs and monitor those metrics over time.

## I. Introduction

Innovation and entrepreneurship are widely recognized as keys to job creation and economic growth. To succeed in this competitive environment, states have established a wide variety of programs designed to increase the number of people who become entrepreneurs and to help these entrepreneurs create successful new ventures. Many of these programs are designed to ensure that entrepreneurs have access both to a steady supply of innovative ideas and to the capital needed to turn those ideas into high-growth businesses.

This paper examines Missouri's need for capital formation programs, by which we mean *programs designed to increase the availability of risk capital for research and entrepreneurial ventures.* Discussions of state investments in innovation typically distinguish among four types of risk capital. Research Capital funds basic research. Pre-Seed Capital supports applied research designed to develop new products. Seed Capital funds start-up firms in the process of establishing commercial operations, while Venture Capital is typically invested in rapidly-growing firms with positive revenue but negative profits.[2]

Our analysis is based on secondary data available from a number of sources, including surveys by the National Association of Seed and Venture Funds, the Association of University Technology Managers, and the National Science Foundation. The data suggest that, relative to other states, Missouri does a poor job of transforming R&D dollars into high-quality entrepreneurial start-ups. For example, Missouri ranks in the bottom 40 percent of states in terms of university start-ups per million dollars of academic R&D expenditures. In part, this deficiency may reflect a lack of early stage capital. Unfortunately, Missouri is spending less than other states to address this need. Missouri can address these deficiencies through new capital formation programs designed to increase the availability of pre-seed and seed capital.

Our discussion is organized as follows. Section II compares the level of entrepreneurial activity in Missouri, neighboring states, and states that might be considered technologically-similar to Missouri. Section III describes Missouri's existing capital formation programs. Section IV summarizes capital formation expenditures in related states, while Section V reports some preliminary evidence on the effectiveness of these programs. Section VI summarizes key insights from the academic literature on capital formation. Finally, Section VII presents seven research-based principles that should guide Missouri's capital formation strategy.

## II. Where is Missouri Now?

Entrepreneurial high-tech start-up firms are critical to the creation of new, desirable jobs in Missouri. Unfortunately, Missouri is falling behind. A variety of studies suggest that Missouri lags behind other states in the creation of entrepreneurial ventures. We begin by examining conclusions published in several widely-cited reports. We then examine the potential reasons for Missouri's performance in some detail.

Every year the Kauffman Foundation publishes the *Kauffman Index of Entrepreneurial Activity*, which ranks states based on "the percentage of non-business-owning adults who start a

business each month."[3] In 2006 Missouri ranked 37th out of 50 states, up from a 46th place ranking in 2005. Given the focus of the present study, the Kauffman Index is an imperfect measure, because it captures all business start-ups, including retail and service businesses that are not the focus of many capital formation programs. Nevertheless, the Kauffman Index provides a starting point for assessing Missouri's entrepreneurial activity.

A second Kauffman report provides a more focused perspective on variations in state entrepreneurial resources and activities. *The 2007 State New Economy Index* assesses state transitions to the New Economy, which the authors define as "a global, entrepreneurial and knowledge-based economy in which the keys to success lie in the extent to which knowledge, technology, and innovation are embedded in products and services."[4] Missouri ranks 35th on the State New Economy Index, down from 28th in 2002. The index itself is composed of several sub-indices, including one that assesses innovation capacity. Missouri ranks 30th on this sub-index, which is based on the five variables listed in Table 1.

**Table 1: Assessing Missouri's Innovation Capacity**

| Variable | Missouri's Rank |
|---|---|
| Patents | 33 |
| High-Tech Jobs | 31 |
| Scientists and Engineers | 32 |
| Patents | 33 |
| Industry Investment in R&D | 30 |
| Venture Capital | 26 |

A similar perspective comes from the *2007 Development Report Card for the States*, prepared by the Corporation for Enterprise Development (CFED). The *Report Card* grades the 50 states on Economic Vitality. Missouri's grade (a D) reflects Missouri's ranking on two dimensions: Competitiveness of Existing Businesses (Missouri ranked 40th) and Entrepreneurial Energy (Missouri ranked 26th). The Entrepreneurial Energy Index comprises various measures of high-tech company creation and job growth. An examination of the variables that compose this index reveals that Missouri ranked 29th in new companies per 1000 workers, 35th in Job Growth due to New Business, and 27th in Technology Industry Employment, expressed as a percentage of wage and salary jobs. (It should be noted that, although both the *Report Card* and the *New State Economy Index* were published in 2007, the rankings are based on data from earlier years. For example, in the CFED study, the variable "New Companies per 1000 Workers" is based on 2005 data, "Job Growth due to New Business" is based on data from 2002 and 2003, and "Technology Industry Employment" is based on 2004 data.[5])

A closer examination of key variables suggests that Missouri lags behind other states in the conversion of research inputs into innovative outputs. Table 2 lists Missouri's ranking among the 50 states on a number of key variables. Notice that Missouri consistently ranks 12th in NIH grants and either 15th of 16th in academic R&D.

**Table 2: Research Dollars in Missouri**
**(Table entries are Missouri's rankings among the 50 states)**

| Year | Academic R&D | Industrial R&D | Federal R&D Grants | NIH Grants |
|---|---|---|---|---|
| 2001 | 15 | 23 | 21 | 12 |
| 2002 | 15 | 23 | 21 | 12 |
| 2003 | 15 | 24 | 21 | 12 |
| 2004 | 16 | 23 | 9 | 12 |
| 2005 | 16 | NA | NA | 12 |

Note: NA denotes "Not Available."

Table 3 lists Missouri's ranking on a number of R&D outputs. With the exception of the SBIR data, the rankings in Table 2 are based on variables collected by the Association of University Technology Managers (AUTM) in annual surveys. These variables are defined as follows:

- *Invention Disclosures*: "the number of disclosures, no matter how comprehensive, that are made in the year requested and are counted by the institution;"
- *Licenses & Options*: "the number of license or option agreements that were executed in the year indicated for all technologies;" and
- *University Start-Ups*: the number of "companies that were dependent upon licensing the institution's technology for initiation."[6]

**Table 3: Research Outputs in Missouri**
**(Table entries are Missouri's rankings among the 50 states)**

| Year | Invention Disclosures | Licenses & Options | University Start-Ups | SBIR Grants Phase I |
|---|---|---|---|---|
| 2001 | 24 | 20 | 30 | 31 |
| 2002 | 21 | 19 | 29 | 29 |
| 2003 | 25 | 21 | 19 | 30 |
| 2004 | 20 | 19 | 27 | 28 |
| 2005 | 23 | 23 | 30 | 28 |

The Small Business Innovation Research (SBIR) program awards grants to small firms (under 500 employees) to enable them to pursue "problems and opportunities that could lead to significant commercial and public benefit if the research is successful." Phase I grants are six-month projects designed to "determine the scientific, technical and commercial merit, and feasibility of the idea or concept."[7] The value of SBIR grants received by firms within a state is one measure of high-quality entrepreneurial activity within that state.

An examination of Table 3 reveals that Missouri fares least well on output measures related to business creation. In all but one of the years listed in the Table, Missouri ranked 27$^{th}$ or lower in number of university start-ups, and 28$^{th}$ or lower in the dollar value of SBIR grants.

The assessment of Missouri's situation worsens when we measure output per input. The entries in Table 4 were computed by dividing university startups and SBIR grant data by

academic R&D dollars and using the resulting ratios to rank the states. These rankings clearly suggest that Missouri does a poor job of converting academic R&D dollars into high-quality entrepreneurial start-ups.[8]

**Table 4: University Start-Ups and SBIR Grants Adjusted For Academic R&D (Table entries are Missouri's rankings among the 50 states)**

| Year | Ratio of University Start-Ups to Academic R&D | Ratio of Dollar Value of SBIR Grants Phase I to Academic R&D | Ratio of number of SBIR Grants Phase I to Academic R&D |
|---|---|---|---|
| 2001 | 39 | 50 | 50 |
| 2002 | 38 | 46 | 44 |
| 2003 | 32 | 48 | 47 |
| 2004 | 37 | 40 | 41 |
| 2005 | 36 | 40 | 42 |

To gain additional perspective, we compared Missouri with seven "technologically-similar" states. To identify these states we considered (1) the number of technological workers in each state, (2) the amount of money spent within each state on academic R&D and industrial R&D, and (3) the amount of R&D dollars received from the federal government and from the National Institute of Health. Table 5 compares Missouri and these seven states on three different measures of R&D output.

**Table 5: Innovativeness in Missouri and Technologically-Similar States**

| | Total Patents (2006) | | University Start-Ups (2005) | | SBIR Grants: Phase I (2005) | |
|---|---|---|---|---|---|---|
| State | Number | Rank | Number | Rank | Dollars | Rank |
| Arizona | 1,893 | 17 | 10 | 17 | $7.59 | 16 |
| Indiana | 1,499 | 22 | 10 | 17 | $4.19 | 22 |
| Michigan | 4,179 | 5 | 13 | 13 | $11.16 | 11 |
| Minnesota | 3,268 | 10 | 1 | 39 | $6.41 | 18 |
| Missouri | 863 | 24 | 3 | 30 | $2.71 | 28 |
| North Carolina | 2,233 | 15 | 14 | 10 | $7.24 | 17 |
| Ohio | 3,295 | 9 | 14 | 10 | $19.63 | 8 |
| Wisconsin | 2,151 | 16 | 6 | 21 | $3.85 | 24 |

Note: Rank denotes rank order among all 50 states; SBIR Dollars are in millions.

Relative to these seven states, Missouri ranks last in total patents for 2006, next to last in the number of university start-ups, and last in the value of SBIR grants received.

A final measure of entrepreneurial start-up activity is the amount of venture capital (VC) raised by Missouri firms. Figure 1 uses data from www.pwcmoneytree.com to graph disbursements of venture capital in Missouri as a percentage of national disbursements. Notice that (1) the Midwest's share of VC disbursements has declined from 6% to 3.5% and (2) Missouri's share of Midwestern VC disbursements has declined from almost 19% to 9%.[9] Clearly Missouri's ability to compete for national and regional venture capital dollars has declined over the last nine years.

**Figure 1: Missouri and Midwestern Venture Capital Disbursements**
(millions of $)

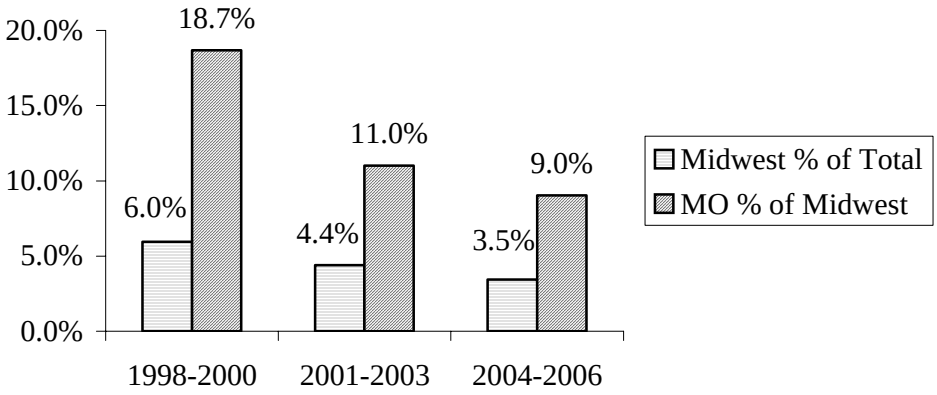
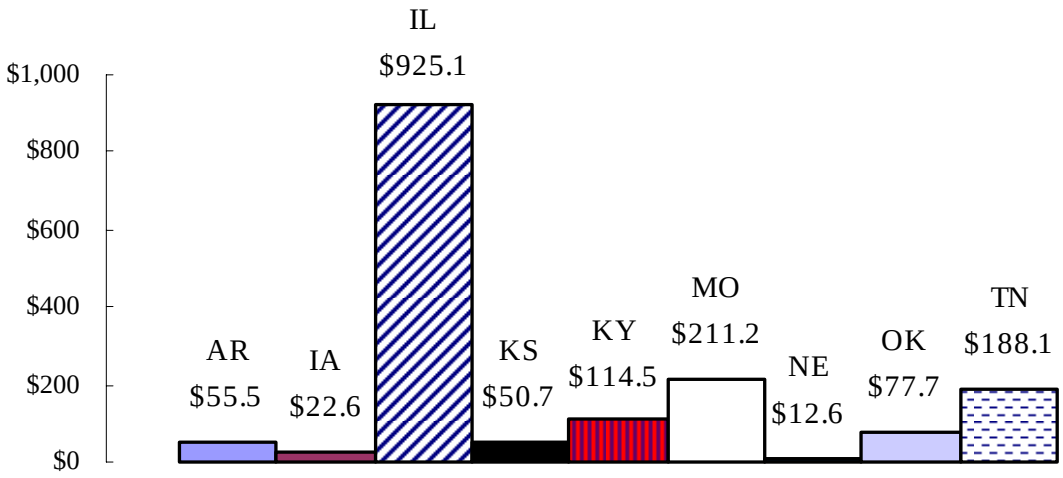


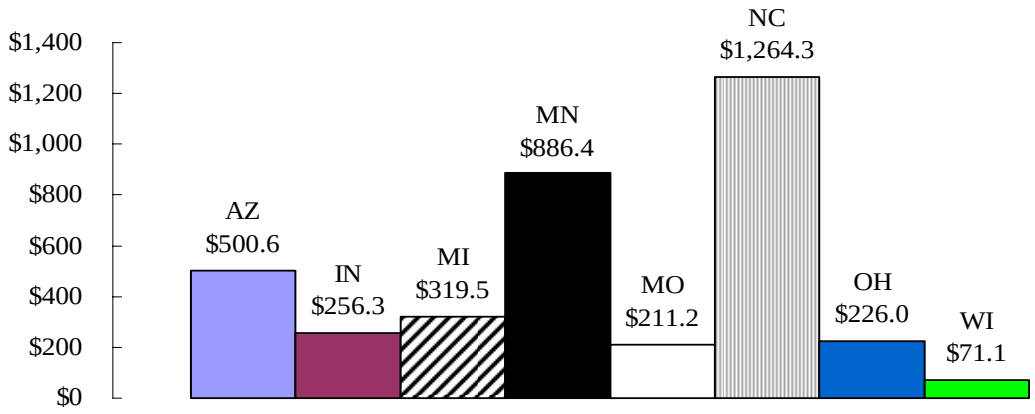

Figure 2 compares dollar VC disbursements in Missouri and neighboring states over the last three years. With one exception (Illinois), Missouri compares favorably with its neighbors:

**Figure 2: 2004-06 Total VC Disbursements in Missouri and Neighboring States**
(millions of $)




Concerns arise when Missouri is compared to states that have similar technological capabilities. Figure 3 compares dollar VC disbursements in Missouri and the seven "technologically similar" states examined in Table 5:

**Figure 3: 2004-06 Total VC Disbursements in Missouri and Technologically-Similar States**
(millions of $)




Three of these states (AZ, MN, and NC) attracted significantly more venture capital than Missouri from 2004-2006. The remaining states—especially Michigan and Ohio—have all made sizable long-term investments to improve their innovation capabilities (we discuss these investments below). If these investments are successful, Missouri will in all likelihood fall behind these states in the creation of successful new ventures and desirable jobs.

## III. What is Missouri Doing Now?

In recent years Missouri capital formation programs have primarily focused on tax credits.[10] A November 2005 report prepared for Governor Blunt identified four venture/seed capital programs that involve tax credits. These programs are listed in Table 6. At the time of the report all allowable tax credits available under these four programs had been allocated.[11]

**Table 6: Missouri Venture and Seed Capital Programs (2005)**

| | Funding (thousands of $) | | | Cumulative |
|---|---|---|---|---|
| **Program** | **FY 2004** | **FY 2005** | **Future Commitments** | **Cap Exhausted?** |
| Certified Capital Companies | $13,565 | $13,372 | $71,090 | Yes |
| Capital (Small Business Investment Company) Credit | $49 | $109 | $900 | Yes |
| Seed Capital Credit | $288 | $165 | $1,670 | Yes |
| New Enterprise Creation Credit | $3,259 | $2,505 | $2,128 | Yes |
| ***Totals*** | $15,291 | $8,791 | $248,983 | |

Currently Missouri makes $500,000 in tax credits available annually for contributions to "approved incubator sponsors."[12] In addition, the Missouri Technology Corporation has two programs that provide funds for start-up companies. The High Tech Small Business Incentive Program ($350,000 in loans scheduled for 2007) targets "high tech small businesses that receive federal SBIR/STRR grants." The Plant and Ag Biotech Seed Capital Co-Investment Fund

provides matching funds ($500,000 scheduled 2007) for investments by "early stage plant and ag biotech companies."[13]

In September 2007, Governor Blunt signed legislation that included expansions of the Missouri Quality Jobs and the New Markets Tax Credit programs.[14] Neither program focuses on the needs of high tech new ventures (though some of these ventures may benefit from the tax credits). Moreover, neither program addresses the needs of seed-stage companies.

## IV. What Are Other States Doing?

To determine what other states are doing to encourage capital formation, we began by reviewing data collected through a survey conducted by the National Association of Seed and Venture Funds (NASVF). The NASVF study, which was released in May 2006, analyzed responses from 44 states describing 151 capital formation programs. State commitments to these programs totaled approximately $5.8 billion, with $2.2 billion available at the time of the survey.[15]

Some of the states that responded to the NASVF survey do not provide relevant benchmarks for evaluating Missouri's Capital Formation programs. Two obvious examples are California and Massachusetts, which together accounted for about 53% of U.S. venture capital deals and 59% of venture capital disbursements in 2006.[16] To assess Missouri's programs we looked at both neighboring states and technologically-similar ones. Table 7 compares Missouri's capital formation expenditures with those of six neighboring states (two, Nebraska and Tennessee, did not respond to the NASVF survey).

**Table 7: Commitments to Capital Formation (CF) Programs in Technologically-Similar States**

| State | 2006 Population (millions) | NASVF: Multi-Year Commitments to CF Programs (millions) | Estimated 2006 Commitments to CF Programs (millions) |
|---|---|---|---|
| AR | 2.81 | $74.3 | $15.1 |
| IA | 2.98 | $199.8 | $24.2 |
| IL | 12.83 | $64.5 | $19.5 |
| KS | 2.76 | $7.0 | $3.5 |
| KY | 4.21 | $30.6 | $8.0 |
| MO | 5.84 | $10.0 | $0.0 |
| OK | 3.58 | $224.2 | $11.0 |

The third column of Table 7 lists the multi-year capital formation commitments reported in the NASVF study.[17] Notice that Missouri's capital formation expenditures are listed as $10 million. According to the NASVF web site, the $10 million figure is the cumulative cap on the Lewis and Clark Discovery Tax Credit Program, which is listed as "in development."[18] This program was not passed in 2006. When we delete this $10 million, Missouri's reported capital

formation expenditures are zero and therefore less than that of every neighboring state that responded to the NASVF survey.

The last column of Table 7 contains our estimates of commitments to capital formation programs in 2006. These estimates are based on our review of program descriptions listed on the NASVF web site. In most cases the NASVF indicated annual expenditures for each program. When a range was indicated, we used the midpoint of that range. (The Research Appendix provides detailed information on the state expenditures listed in Table 7). As one might expect, given our discussion of Missouri's expenditures, Missouri spent less on capital formation programs in 2006 than any of its neighbors who responded to the NASVF survey.

Table 8 contains comparable information for seven states that are technologically-similar to Missouri. Relative to Missouri, all of the states in Table 8 have committed significantly more to capital formation programs. In comparing the last two columns of this Table, it should be noted that we modified some of the NASVF data based on information from individual states. For example, the NASVF web site said that Indiana's 21st Century Research Fund budgeted $75 million for grants over two years, but we found that the state's actual grants during this period totaled $39 million. So we divided $39 million by two and credited the Fund with expenditures of $19.5 million in 2006.[2] We made a similar modification to grants under Ohio's Fuel Cell Initiative. We also added expenditures for two Ohio programs that were not listed the NASVF survey. We obtained numbers on the total value of the grants issued under these two programs in 2006 from Ohio's Third Frontier web site. (The Research Appendix provides detailed information on the state expenditures listed in Table 8.)

**Table 8: Commitments to Capital Formation (CF) Programs in Technologically-Similar States**

| State | 2006 Population (millions) | NASVF: Multi-Year Commitments to CF Programs (millions) | Estimated Commitments in 2006 to CF Programs (millions) |
|---|---|---|---|
| AZ | 6.17 | $20.0 | $4.0 |
| IN | 6.31 | $154.0 | $28.2 |
| MI | 10.10 | $153.1 | $35.4 |
| MN | 5.17 | NA | $8.3 |
| NC | 8.86 | $76.5 | $15.0 |
| OH | 11.48 | $578.1 | $47.5 |
| WI | 5.56 | $120.2 | $19.1 |
| MO | 5.84 | $10.0 | $0.0 |

Table 8 clearly indicates that, relative to technologically-similar states, Missouri spends much less on capital formation programs.

[2] The $28.2 million figure for Indiana in Table 8 includes investments from two other state programs.

## V. What Results Have Other States Experienced?

The mere fact that other states are spending money does not mean that they are spending that money wisely. Unfortunately, most state capital formation programs are new, and not enough time has passed to properly evaluate the long-run impact of those programs on jobs and state economies. However, several states have attempted to assess the short-run impact of their programs.

For example, since the Georgia Research Alliance was created in the early 1990s, the state has invested $400 million in order to attract talent, build the state's research infrastructure, and facilitate technology transfer. This investment has enabled the state to attract $2 billion in federal and private investments and resulted in the creation of 120 companies and over 5,000 jobs.[19]

Maryland has contributed $27.8 million to the Maryland Industrial Partnership Program (MIPS), which was created in 1987. Corporations have contributed an additional $115.6 million. The four best-selling products created under MIPS have created over 2,600 jobs and generated 2006 revenues of $12.1 billion.[20]

In 2000 Arizona voters approved a sales tax increase to fund a 20-year, $1 billion commitment to three state universities for research, technology transfer, and work force development. In 2002 Arizona State University received $15.6 million, which was allocated to six initiatives. ASU spent about half of this money in FY 2002, and generated over $14 million in grants and matching dollars.[21]

In 2003 Minnesota created the Minnesota Partnership for Biotechnology and Medical Genomics, a state partnership with the Mayo Clinic and the University of Minnesota (the state contributed $2 million, while the other two partners contributed $1 million each). Subsequent state funding included $21.7 million in bonds for a building expansion, along with $15 million in FY 2005-06 ($9 million of which was dedicated to R&D projects).[22] A January 2007 study reported Minnesota's initial investment of $17 million had enabled the Partnership to attract $25 million in external funding and led to the publication of 44 scientific papers.[23] The report contained no estimates of job or revenue creation (although an Appendix summarizes the job and revenue projections from an earlier report prepared in 2004).

The Georgia and Maryland programs provide the strongest evidence regarding the potential benefits of capital formation programs. Because the Arizona and Minnesota programs are relatively new, it is too early to measure the impact of these programs on new venture and job creation. However, both programs illustrate the potential to leverage state investments by attracting funds from the federal government, the private sector, and non-profit institutions.

## VI. Insights from Academic Research

To better understand Missouri's capital formation options, we reviewed three streams of academic research. The first stream, summarized in Figure 4, examines the determinants of new

venture success. These determinants can be loosely summarized into five categories: the market environment, the legal environment, firm characteristics, the management team, and the external resources available to the venture. As one might expect, research has emphasized the role of capital (both public and private) in new venture success. In addition, these studies have examined state policy variables that influence new venture success.

A key insight from this literature is the importance of networks that provide entrepreneurs with access to ideas, capital, and business partners, as well as to technical, marketing, and managerial expertise. Research emphasizes that access to these resources through entrepreneurial networks is a key determinant of new venture success. One recent literature review concluded that "the entrepreneurs' personal and social networks maybe are the most important strategic resources of entrepreneurs for the start-up firm."[24]

A second stream of research, summarized in Figure 5, has focused on the collection and disbursements of risk capital by venture capitalists. A key insight from this literature is that venture capital levels depends on the supply and demand for venture capital. The supply of venture capital reflects the state of the economy, returns to alternative investments, and the state of the venture capital industry.

The demand for venture capital reflects both the state of the economy and the number of high-quality entrepreneurial start-ups, which is a function of the number of new venture opportunities. The importance of high-quality start-ups was emphasized by Gompers and Lerner, who wrote: "Our analysis suggests that an important factor for the increase in venture capital is probably an increase in the number of high-quality start-ups. The greater number of good firms leads to more demand for venture capital."[25]

Government programs can affect both the supply and demand for venture capital. For example, states can make funds available for venture capital investment, influencing the supply of venture capital. In addition, states make pre-seed investments that influence the number of high-quality entrepreneurial start-ups.

A third, overlapping stream of research examines the rationale for government involvement in capital formation. The fundamental argument for government programs involves spillovers, which are most easily illustrated in the context of R&D funding. A spillover occurs when one firm benefits from the R&D spending of another. Because private firms are unlikely to capture all of the benefits of R&D spending, private R&D expenditures will be less than the socially-optimal level. To compensate, governments can supplement private R&D expenditures with public funds. Josh Lerner argues that the spillover problem is greatest for small firms such as entrepreneurial start-ups, which have fewer resources to protect and capitalize on their intellectual property. This is one rationale for government-funded programs that target small firms.[26]

**Figure 4: Determinants of New Venture Success**

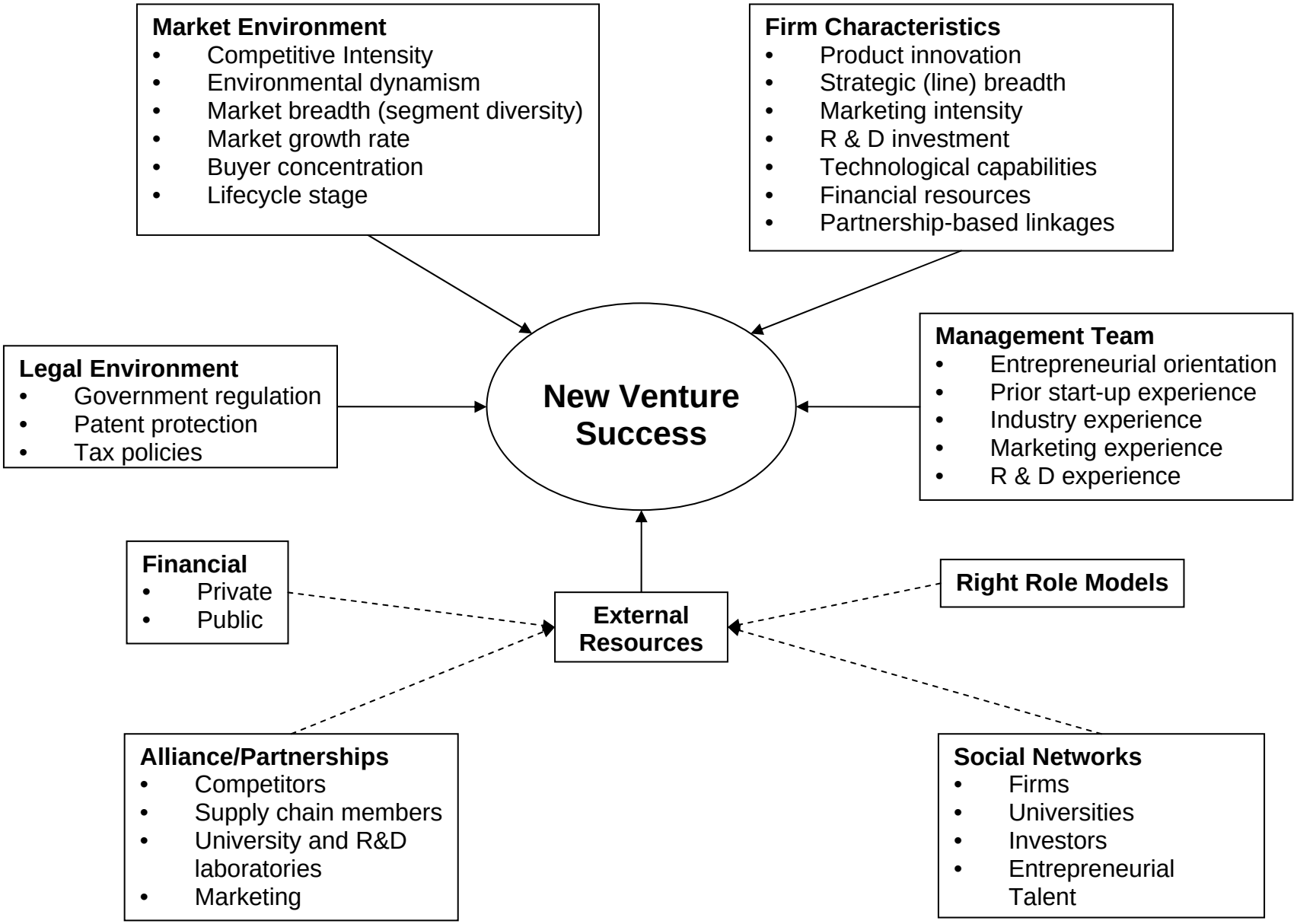
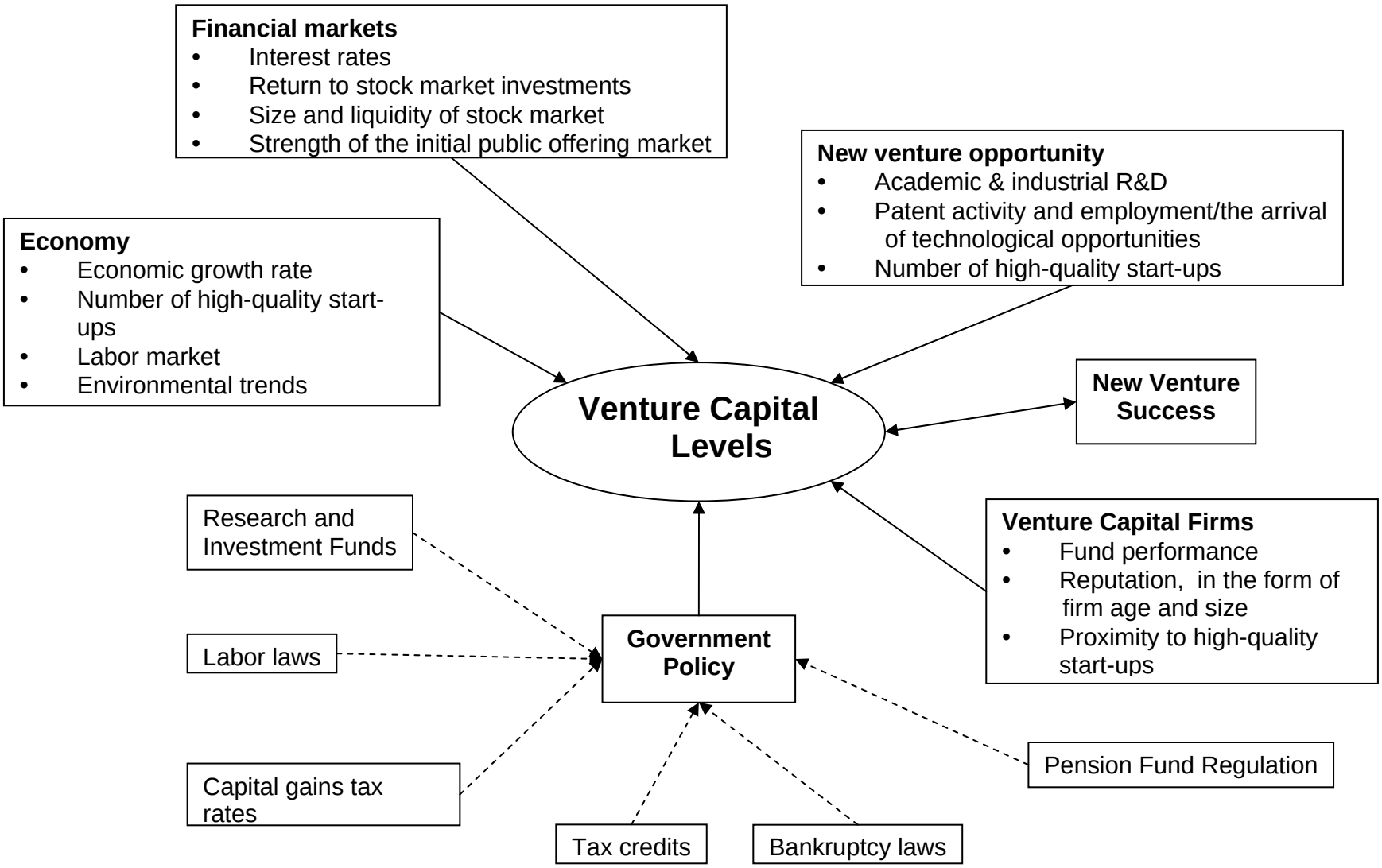


**Figure 5: Determinants of Venture Capital Levels**



A second potential benefit of some government programs arises from the information problems confronting potential investors in new ventures. When information is difficult to obtain, investors may interpret government funding as "certification" of the quality of an entrepreneurial venture. Lerner argues that this outcome is most likely when (1) new ventures are technologically-intensive and (2) the government officials making the funding decisions have specialized technical knowledge relevant to those ventures.[27]

The potential benefits of public investment are offset by three potential problems. First, in an effort to improve their own performance, some firms may advocate program alternatives that benefit their own bottom lines at the expense of state objectives like economic growth and new job creation. There is anecdotal evidence to justify this concern. For example, in 1987 fourteen U.S. semiconductor companies formed Sematech, a joint R&D consortium that received Federal government subsidies of $100 million per year. One study concluded that Sematech reduced industry R&D expenditures by $300 million per year. In effect, the Sematch program resulted in an annual transfer of $100 million from taxpayers to the 14 semiconductor companies and their shareholders.[28]

Similar problems can arise with tax credit programs. For example, last year Oklahoma acted to close a loophole in several tax incentive laws designed to encourage investments in start-up firms. According to the *Daily Oklahoman*:

> Some investors took advantage of the loophole by using borrowed money to obtain tax credits that were 200 percent or more of the amount they invested. In the worst cases of abuse, the borrowed money never went into the projects and was used solely to boost the amounts of the tax credits.[29]

A second problem identified by Lerner is more subtle. Politicians and administrators often want to claim credit for successful program and initiatives. This desire may result in programs that benefit firms with high prospects for success, even when those firms have little need for government funds.[30] A final problem arises from inefficient program designs, which may in part result from the first problem (attempts by beneficiaries to shape programs to serve their own ends).

## VII. Implications for Missouri

This literature review, together with an analysis of capital formation programs, suggests that Missouri's capital formation program should be guided by seven principles. The first three principles reflect our analysis of capital formation programs in related states. The last four principles are based on academic research, but are also reflected in the capital formation practices of other states.

1. **Missouri's capital formation strategy must recognize and respond to the competition Missouri faces from other states for private capital.**

We have shown that, relative to Missouri, neighboring states are committing substantially more money to capital formation programs. Table 9 uses the data from Table 7 to compute per-capita capital formation spending in six neighboring states:

**Table 9: Per Capita Capital Formation (CF) Commitments**

| State | 2006 Population (millions) | 2006 Commitments to CF Programs (millions) | 2006 CF Commitments per Capita | Implied Missouri Budget (millions) |
|---|---|---|---|---|
| AR | 2.81 | $15.1 | $5.37 | $31.2 |
| IA | 2.98 | $24.2 | $8.12 | $47.4 |
| IL | 12.83 | $19.5 | $1.52 | $8.9 |
| KS | 2.76 | $3.5 | $1.27 | $7.4 |
| KY | 4.21 | $8.0 | $1.90 | $11.1 |
| OK | 3.58 | $11.0 | $3.07 | $18.0 |
| ***Average*** | 4.86 | $13.60 | $2.79 | $16.3 |

(Note that this Table excludes Nebraska and Tennessee, which did not respond to the 2006 NASVF survey). The per-capita expenditure numbers in the 4th column range from a low of $1.27 (Kansas) to a high of $8.12 (Iowa). The average expenditure across the six states is $2.79 per resident.

The last column of Table 9 reports the level of capital formation spending required for Missouri to achieve parity (on a per-capita basis) with each of these six states. For example, to be comparable with Arkansas, Missouri would need to spend $31.2 million. This number was obtained by multiplying Missouri's population (5.84 million) by Arkansas's per-capita capital formation commitments ($5.37). The remaining numbers in the last column were calculated in a similar fashion. The last number in this column ($16.3 million) is the capital formation spending required for Missouri to achieve parity (on a per-capita basis) with the average per-capita commitment ($2.79) in these six states. (Note that the $2.79 figure is a weighted average, computed by dividing the total capital commitment of $13.60 million by the total six-state population of 4.86 million).

Table 10 contains a similar analysis of the seven technologically-similar states previously analyzed in Table 8. The weighted average per-capita formation expenditure across these seven states is $2.94. If we multiply this number by Missouri's population, we obtain an implied budget of about $17 million, which is slightly higher than the figure obtained by analyzing the six neighboring states listed in Table 9.

| Table 10: Per Capita Capital Formation (CF) Commitments | | | | |
|---|---|---|---|---|
| **State** | **2006 Population (millions)** | **2006 Commitments to CF Programs (millions)** | **2006 Commitments per Capita** | **Implied Missouri Budget (millions)** |
| AZ | 6.17 | $4.0 | $0.65 | $3.79 |
| IN | 6.31 | $28.2 | $4.47 | $26.10 |
| MI | 10.10 | $35.4 | $3.51 | $20.49 |
| MN | 5.17 | $8.3 | $1.61 | $9.39 |
| NC | 8.86 | $15.0 | $1.69 | $9.90 |
| OH | 11.48 | $47.5 | $4.14 | $24.16 |
| WI | 5.56 | $19.1 | $3.44 | $20.09 |
| ***Average*** | 7.66 | $22.50 | $2.94 | $17.17 |

We believe that the Missouri's actual investment in capital formation dollars should be greater than $17 million annually. Our primary concern is that Missouri has invested very little in capital formation programs during the last two years, while our analysis suggests the state should have invested $34 million. Missouri needs to make up lost ground. In addition, increasing the number of high-quality start-ups in Missouri may require additional programs that address Missouri's relatively poor performance in converting R&D dollars into innovative outputs.

**2. Missouri's capital formation strategy should focus on the pre-seed and seed stages of capital formation.**

Academic research points to the number of high-quality entrepreneurial start-ups in a state as a key determinant of venture capital levels. In our discussion of research inputs and outputs, we concluded that Missouri compares favorably with technologically-similar states in terms of academic R&D and federal R&D dollars, but lags behind in the conversion of R&D dollars into promising new ventures. These facts suggest Missouri should focus its capital formation strategy on investments designed to transform basic research into marketable products and services that benefit Missouri.

To provide a benchmark for Missouri policymakers, Table 11 summarizes the ways in which neighboring states allocated their capital formation dollars in 2006.

**Table 11: State Capital Formation Expenditures in Neighboring States by Stage and Program**

| | Stage of Capital Formation | | | | | |
|---|---|---|---|---|---|---|
| **Program** | **Research** | **Pre-Seed** | **Seed** | **Venture** | **Mezzanine** | ***Sum*** |
| Loans | | $0.05 | $3.33 | $3.33 | $3.33 | $10.05 |
| Grants | $0.50 | $0.05 | $0.50 | | | $1.05 |
| Tax Credits | | $5.50 | $14.37 | $14.82 | $10.00 | $44.69 |
| Investments | $1.33 | $2.50 | $3.50 | $18.67 | | $26.00 |
| ***Sum*** | $1.83 | $8.10 | $21.70 | $36.82 | $13.33 | $81.79 |

The allocation of capital formation dollars by stage is somewhat crude, because a number of programs target multiple stages (for example, the pre-seed and seed stages). In these cases we allocated program dollars equally among the multiple stages. Using this rule, we find that about 45% of capital formation dollars in neighboring states target the venture capital stage, while 36% target the pre-seed and seed stages.

Table 12 contains a similar analysis of capital expenditures in the technologically-similar states examined above:

**Table 12: State Capital Formation Expenditures in Technologically-Similar States by Stage and Program**

| | Stage of Capital Formation | | | | | |
|---|---|---|---|---|---|---|
| **Program** | **Research** | **Pre-Seed** | **Seed** | **Venture** | **Mezzanine** | ***Sum*** |
| Loans | $4.17 | $4.17 | $4.17 | | | $12.50 |
| Grants | $60.25 | $19.07 | $17.07 | $2.57 | | $98.95 |
| Tax Credits | | $5.50 | $27.41 | $6.11 | $1.06 | $40.08 |
| Investments | | | $5.90 | | | $5.90 |
| ***Sum*** | $64.42 | $28.73 | $54.54 | $8.68 | $1.06 | $157.43 |

Relative to the neighboring states in Table 11, the technologically-similar states in Table 12 are far more focused on the early stages of capital development. This difference is clear when we convert the numbers in these two Tables to percentages, as in Table 13:

**Table 13: Targets of Capital Formation Programs**

| **Program** | **Neighboring States** | **Technologically-Similar States** |
|---|---|---|
| **Research** | 2.2% | 40.9% |
| **Pre-Seed & Seed** | 36.4% | 52.9% |
| **Venture** | 45.0% | 5.5% |
| **Mezzanine** | 16.3% | 0.7% |

As this Table shows, the seven technologically-similar states are devoting over 90% of their capital formation budget to the research, pre-seed, and seed stages. Given Missouri's relatively poor performance in transforming research dollars into innovative outputs, Missouri's first priority should be capital formation programs designed to boost pre-seed and seed investments.

Based on this priority and the data collected from technologically-similar states, it appears that Missouri should allocate at least 60% of its capital formation budget to pre-seed and seed capital investments.

### 3. Missouri's capital formation strategy should leverage money from other sources.

Missouri legislators have a responsibility to spend state dollars wisely, a responsibility that assumes special importance when budgetary constraints are tight. One of the most effective ways to increase the efficiency of capital formation programs is to use state dollars to leverage additional funds from the private sector, the federal government, and non-profit institutions. As noted above, the Georgia Research Alliance and the Maryland Industrial Partnership have been particularly successful in this endeavor. Other examples include:

- The Industry-University Cooperative Research Program (IUCRP), which is a partnership among the State of California, state universities, and the private sector. Begun in 1996, the IUCRP has investments totaling $281 million and the capacity for continued growth of $60 million per year.[31] The program "encourages California-based companies to pursue breakthrough research in UC laboratories." A 2002 report stated that each dollar of state funds was matched by $1.57 (on average) from industry and 68 cents from UC."[32]
- Ohio's Biomedical Research and Commercialization Program (BRCP), which awards grants to support biomedical and biotechnology research that are collaborative efforts between Ohio's companies, universities, and non-profit research organizations.[33]

Leveraging private R&D dollars appears particularly important for Missouri. In our discussion of research inputs, we concluded that Missouri compares favorably with technologically-similar states in terms of academic R&D and federal R&D dollars. However, Missouri fares less well in an analysis of private R&D dollars. Table 14 compares 2004 industrial R&D expenditures in Missouri and the seven technologically-similar states analyzed in earlier Tables.

**Table 14: Private R&D in Missouri and Technologically-Similar States**

| State | Private R&D (2004, millions of $) | High-Tech Workers (2004, thousands) | Private R&D per 1000 High-Tech Workers |
|---|---|---|---|
| Arizona | $2,570 | 110.8 | $23.2 |
| Indiana | $4,208 | 68.2 | $61.7 |
| Michigan | $15,170 | 178.0 | $85.2 |
| Minnesota | $5,199 | 125.2 | $41.5 |
| Missouri | $2,151 | 86.5 | $24.9 |
| North Carolina | $4,565 | 134.6 | $33.9 |
| Ohio | $5,516 | 151.2 | $36.5 |
| Wisconsin | $2,645 | 77.8 | $34.0 |

With the exception of Arizona, every state in this Table is spending at least 30% more than Missouri on private R&D per high-tech worker.

One important way to leverage Missouri's investments in research and commercialization is to make the provision of state funds contingent on the receipt of additional funds from the private sector. The work of Lerner suggests that the required match should be dependent on firm size. As an example of this principle, Connecticut's Yankee Ingenuity Technology Competition requires that large companies (over 50 employees) match the amount of money requested in their grant proposals (at least 50% of the match must be in cash), while small companies are simply required to make a "substantial" contribution."[34]

A second important way to leverage Missouri's investments involves partnerships with neighboring states. Entrepreneurial activity in the St. Louis metropolitan area benefits both Missouri and Illinois. Similarly, entrepreneurial activity in the Kansas City area benefits both Missouri and Kansas. Missouri should look for opportunities to partner with these states in the creation of capital formation programs that focus on these metropolitan areas. These programs should be designed to build on the existing strengths of each state in research and commercialization.

**4. Missouri's capital formation programs should connect innovators, entrepreneurs, businesses, investors, scientists, and marketing experts.**

A key component of the model of new venture success in Figure 4 involves entrepreneurial access to ideas and capital, as well as to technical, marketing, and managerial talent. Recognizing the importance of these links, a number of states have created specific programs designed to connect entrepreneurs with scientists, investors, managerial talent, and other experts. In addition to these kinds of programs, Missouri should use its capital formation program to foster the growth of entrepreneurial networks within the state. This can be done in several ways. First, as suggested above, at least some of Missouri's capital formation programs should make academic-industry collaboration a pre-condition for state investments.

Second, the state can require that industry experts, venture capitalists, academics, and other experts participate in the evaluation of competitive funding proposals. This requirement should help the state ensure that the best projects receive funding; however, if implemented properly, this requirement can also help build the kind of networks that foster entrepreneurial success. For example, as part of the proposal selection process, the state can require formal presentations to reviewers. Opening these presentations to the public would increase visibility and further enhance their network-building potential.

**5. Missouri's capital formation strategy must be embedded in a strategy for stimulating the creation of high-quality start-ups in Missouri.**

Academic studies of capital formation have emphasized that capital formation is a function of both the supply and demand for risk capital. When the demand for venture capital is fixed, policy-driven increases in the supply of venture capital result in the funding of projects with lower expected rates of return. In the worst case scenario, these incremental projects have serious flaws that limit their potential for success. As S. Venkataramen, editor of the *Journal of Business Venturing*, explained:

> Often governments attempt to break their economy's vicious cycle through a single solution, the most common of which is to inject risk capital. These funds are often distributed through small business development centers, and several regions and countries have even attempted "public" venture capital funds. However, if only risk capital is injected, it flows straight to low-quality entrepreneurship.[35]

The clear implication is that any capital formation program must be accompanied by an innovation strategy designed to increase the number of high-quality start-ups in Missouri. The characteristics of such programs have been addressed in other studies,[36] but two merit mention here.

First, Missouri's innovation strategy must be focused. Research indicates that successful innovation strategies build on a state's existing knowledge base (both public and private) and serve clusters of local businesses.[37] As Venkataraman (p. 164) explained, sustained regional success:

> … often comes when it is based on some idiosyncratic or special ingredient that the regions have to offer the world. Such idiosyncrasy may be based on the regions' core competence, natural resource, or some other source of idiosyncratic advantage.[38]

Second, studies of high-tech entrepreneurship have emphasized the roles of universities in generating high-quality entrepreneurial start-ups.[39] The evidence presented earlier suggests that Missouri has powerful research capabilities (the state consistently ranks around 15$^{th}$ in academic R&D), but lags other states in the conversion of academic R&D dollars into entrepreneurial start-ups. Missouri's innovation strategy must identify and address the reasons for this failure. Possible explanations for the failure include a lack of skilled entrepreneurial talent (a possibility Missouri is already addressing through entrepreneurial training programs at state universities), an inability to retain entrepreneurial talent, and underdeveloped entrepreneurial networks for linking entrepreneurs with high-potential ideas. The state should also ensure that (1) university researchers have incentives to participate in technology commercialization and (2) state university goals for technology transfer are aligned with the economic-growth and job-creation goals of the state.

**6. Missouri must make a long-term commitment to both capital formation and innovation.**

Missouri is competing with other states to attract talent, companies, and resources. In particular, the state faces a challenge in attracting managerial talent (and retaining home-grown talent), in part because of the perception that seed and venture capital is easier to obtain outside of Missouri. An on-going commitment to innovation, capital formation, and entrepreneurship is an important step toward changing this perception. The importance of a long-term commitment was emphasized by *Investing in Innovation*, which stated:

> Wise states avoid a flip-flop approach to their R&D investments. They strategically erect structures that will survive new administrations intent on making change for change's

sake. They institutionalize the idea of long-term investment so that it can survive economic downturns.[40]

In addition to institutionalizing state investments, it is also important to ensure that the allocation of those investments across capital formation programs is driven, not by political pressure, but by the state's innovation strategy.

Over the last few years, Missouri's investments have been inconsistent, while other states have made long-term commitments. For example:

- In 2001 Arizona voters approved a sales tax increase to fund a 20-year, $1B investment in research, technology transfer, and workforce development at three state universities;
- in 2002 Ohio created the *Third Frontier Initiative*, with $1.6 billion in state funding over 10 years;[41] and
- In 2006 Michigan created the 21st Century Jobs Fund, with $2 billion in state funding over 10 years.[42]

In light of these and similar programs in other states, Missouri needs to do more to signal its on-going commitment to innovation and high-quality entrepreneurship.

**7. Missouri must measure the results of its capital formation programs.**

Like most states, Missouri investments in innovation and capital formation are designed to create high-quality jobs and drive economic growth. The academic literature has identified several reasons why state programs may not have their intended effects. To ascertain the effectiveness of state programs and to secure continued support for these programs, Missouri must establish metrics for evaluating the performance of its capital formation programs and monitor those metrics over time. The NASVF reached a similar conclusion from its survey of state programs, saying: "The best programs establish outcome measures from the beginning, keep track of program results, and evolve according to changes in conditions."[43]

Unfortunately, the length of the technology commercialization cycle means that full assessment of the economic impact of state investments will require many years. To ensure that programs are on the right track the state must also track intermediate measures of success that gauge innovation potential, the effectiveness of innovation processes, and capital formation.[44] The goal of the measurement process should be to detect problems early so that the state can make the adjustments necessary to achieve its long-term objectives.

## Endnotes

[1] The $2.88 figure is computed by dividing 2006 commitments to capital formation programs in neighboring and technologically-similar states ($36.10 million) by the population in those states (12.52 million). Please see the body of the report (Tables 9 and 10) for statistics from individual states.
[2] Strommer, Susan P. and George Lipper, *Seed and Venture Capital: State Experiences and Options*, NASVF, May 2006, downloaded from http://www.nasvf.org/nasvf/web.nsf/pages/seedventurereportmay2006nasvf.html.
[3] Fairlie, R. W. (2007), Kauffman Index of Entrepreneurial Activity: State Report 2007. Kansas City: Ewing Marion Kauffman Foundation, p. 2.
[4] Robert D. Atkinson and Daniel K. Correa, *The 2007 State New Economy Index*. The quote is from p. 3; Missouri's overall ranking is from p. 13; Missouri's ranking on the innovation capacity index is on p. 45, and the variables in Table 1 are from pp. 14 and 15. The report was downloaded from http://www.kauffman.org/pdf/2007_State_Index.pdf.
[5] Woo, Lillian, James Nguyen, Dave Buchholz, William Schweke, and Jerome Uher (2007), *2007 Development Report Card for the States*, Washington, D.C.: Corporation for Enterprise Development. Retrieved from http://www.cfed.org.
[6] Association of University and Technology Managers, "Terms and Definitions Used in AUTM STATT," downloaded from http://www.autmsurvey.org/statt/statt_definitions.cfm.
[7] SBIR program description, downloaded from http://www.nsf.gov/eng/iip/sbir/program.jsp#ProgGoals.
[8] The ratios behind the rankings in Table 4 are computed as output measure in a given year divided by R&D expenditures in the same year. This is a crude input-output measure, because there is obviously a lag between R&D expenditures and innovative outputs. A better measure would account for the lag between expenditures and outputs; however, determining the appropriate lag is a complex issue (especially given that the lag varies from project to project). The author is currently involved in a research project that directly addresses the lag between expenditures and outputs.
[9] As defined in *the MoneyTree Report*, the Midwest consists of Illinois, Missouri, Indiana, Kentucky, Ohio, Michigan, and western Pennsylvania. See https://www.pwcmoneytree.com/MTPublic/ns/nav.jsp?page=definitions#geography.
[10] We were unable to identify a single source that provided a comprehensive overview of Missouri's capital formation programs. Consequently, we relied on several different sources, including conversations with state officials, to identify relevant Missouri programs.
[11] *Report on Missouri Incentive Programs*, Missouri Department of Economic Development, November 22, 2005. The numbers in Table 2 are from Appendix A. Downloaded from the DED website at: http://ded.mo.gov/upload/incentivesreviewreportnov22finala.pdf.
[12] "Small Incubator Tax Credit," downloaded from http://www.missouridevelopment.org/Business%20Solutions/Financial%20and%20Incentive%20Programs/Tax%20Incentives/Small%20Business%20Incubator%20Tax%20Credit.aspx.
[13] These two programs are managed by the Missouri Technology Corporation. The quotes are from a MTC document.
[14] Matt Blunt, "Strengthening Missouri's Growing Economy," *US States News*, September 7, 2007; see also Tim Barker and Matthew Franck, "St. Louis Poised to Win Big," *St. Louis Post-Dispatch*, August 31, 2007. p. A1.
[15] *Highlights of the 2006 State Venture Capital Program Study*, National Association of Seed and Venture Funds, May 2006. Downloaded from http://www.nasvf.org/nasvf/web.nsf/fbaad5956b2928b086256efa005c5f78/1412e8744c1c500c862572ad00019ab5/$FILE/NASVF%20State%20Venture%20Capital%20Program%20Study%20Highlights.pdf.
[16] The source of these percentages is https://www.pwcmoneytree.com.
[17] The numbers in column four were taken from a Table entitled "State Commitments to Current Capital Programs." The file is available at http://www.nasvf.org/nasvf/web.nsf/pages/statevcprogramsnasvfresearch.html.
[18] http://www.nasvf.org/nasvf/05ngasurvey.nsf/($All)/1E76D818FDE62C398625714E00502DCF.
[19] See the Georgia Research Alliance web site: http://www.gra.org/backgroundhistory.asp.
[20] *Investing in Innovation*, Pew Center on the States, July 2007, p. 37.
[21] Morrison Institute, *Seeds of Prosperity: Public Investment in Science and Technology Research*, 2003, pp. 6, 41.
[22] Press release, "Minnesota Partnership Awarded $25 Million; State endorses continued funding," May 31, 2007, retrieved from http://www.minnesotapartnership.info/pressreleases/2007-0531/; see also http://www.minnesotapartnership.info/about/factsheet.cfm.

[23] Impact Economics, *The Minnesota Partnership for Biotechnology and Medical Genomics Impact Progress Report*, July 2007, pp. 9, 12. The *Report* also emphasizes the Partnership's research-to-patent ratio, but it is hard to put much stock in this ratio given the small number of reported patents (3) resulting from Partnership funding. The *Report* is available at http://www.minnesotapartnership.info/upload/partnership_impact_update_report.pdf.
[24] Lechner, Christian, Michael Dowling, and Isabell Welpe (2006), "Firm Networks and Firm Development: The role of the relational mix," *Journal of Business Venturing*, 24 (4), p. 517.
[25] Gompers, Paul A. and Jay Lerner, "What Drives Venture Fundraising?," *Brookings Proceedings on Economic Activity-Microeconomics* 149-92 (1998), p. 189.
[26] Josh Lerner, "When Bureaucrats Meet Entrepreneurs: The design of effective 'public venture capital'' programmes," *The Economic Journal*, 112 (February), pp. F73-F84.
[27] Josh Lerner, "When Bureaucrats Meet Entrepreneurs: The design of effective 'public venture capital'' programmes," *The Economic Journal*, 112 (February), pp. F73-F84.
[28] Irwin, Douglas A. and Peter J. Klenow, "High-Tech R&D Subsidies: Estimating the effects of Sematech," *Journal of International Economics*, 40 (3-4), pp. 323-328.
[29] Randy Ellis, "Henry OKs Bill to Plug Loophole," *The Daily Oklahoman*, June 8, 2006.
[30] Josh Lerner, "When Bureaucrats Meet Entrepreneurs: The design of effective 'public venture capital'' programmes," *The Economic Journal*, 112 (February), pp. F73-F84.
[31] http://ucdiscoverygrant.org/about/introduction.htm.
[32] *Industry-University Cooperative Research Program Performance Report*, 1996 – 2002, downloaded from http://ucdiscoverygrant.org/about/reports.htm.
[33] Biomedical Research and Commercialization Program program description, downloaded from http://www.ohiochannel.org/your_state/third_frontier_project/program.cfm?program_id=80251.
[34] Yankee Ingenuity Technology Competition application instructions, downloaded from http://ctinnovations.com/docs/YankeeApplication%20and%20cover%20for%20web.doc.
[35] Venkataraman, Sankaran (2004), "Regional Transformation through Technological Entrepreneurship," *Journal of Business Venturing*, 19:153-167, p. 162.
[36] For a recent discussion, see in *Investing in Innovation*, a July 2007 report from the Pew Center on the States and the National Governor's Association.
[37] *Investing in Innovation*, Pew Center on the States, July 2007, p. 21.
[38] Venkataraman, Sankaran (2004), "Regional Transformation through Technological Entrepreneurship," *Journal of Business Venturing*, 19:153-167, p. 164.
[39] Venkataraman, Sankaran (2004), "Regional Transformation through Technological Entrepreneurship," *Journal of Business Venturing*, 19:153-167, p. 163.
[40] *Investing in Innovation*, Pew Center on the States, July 2007, p. 47.
[41] http://www.ohiochannel.org/your_state/third_frontier_project/about.cfm.
[42] *Investing in Innovation*, Pew Center on the States, July 2007, p. 17.
[43] Strommer, Susan P. and George Lipper, *Seed and Venture Capital: State Experiences and Options*, NASVF, May 2006, p. 2; downloaded from http://www.nasvf.org/nasvf/web.nsf/pages/seedventurereportmay2006nasvf.html.
[44] For examples of possible metrics, see *Investing in Innovation*, Pew Center on the States, July 2007, pp. 57-65.