The Economic Impact of Connecticut Innovations' Portfolio on the Connecticut Economy (FY1995 -FY2008)

Prepared for Connecticut Innovations, Inc.

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DECD

Executive Summary

Connecticut Innovations, Inc. (CI) is a quasi-public authority[1] created in 1989 to promote statewide high-technology businesses through strategic, early-stage investments. Its mission is to provide seed-stage and equity investments in emerging technologies such as bioscience, information technology, photonics, energy, environmental systems, and other research and development (R&D) enterprises.

In 2008, CI commissioned the Department of Economic and Community Development (DECD) to assess the economic impact of CI's investments in its portfolio companies from FY 1995 through FY 2008; key findings include:

- **CI Creates Jobs –** CI's investments grew Connecticut jobs by an average of 1,610 jobs each year from 1995 through 2008.
- **CI Contributes to State Tax Revenues –** The cumulative, net state revenue[2] generated by CI's investment activity exclusively exceeds $209 million. This represents an average increase of $14.9 million in net state revenues every year.
- **CI Brings Additional Outside Investment Into Connecticut –** Connecticut's cumulative investment in CI of $106 million leveraged an additional $1 billion over the period studied from CI's investment partners. As a result, Connecticut's gross state product increased cumulatively by $3.6 billion and by $258.5 million on average each year.

Job Creation

Despite two significant downturns in the economy from 1995 through 2008, CI's investments grew Connecticut jobs by an average of 1,610 jobs each year. This breaks down into 563 direct jobs and 1,046 indirect and induced jobs representing an average, long-term jobs multiplier of 2.86. That is, CI's investments generated 1.86 additional jobs in the

[1] CGS § 32-32 et seq. established CI to provide the capital entrepreneurs need to research, develop, and market new technologies. The OLR Research Report 2005-R-0772 describes the roles of each Connecticut quasi-public agency.

[2] Net state revenue is revenue from all domestic sources less state expenditure for all uses including debt service from bond issues to capitalize CI.

Connecticut economy for each direct job it created though its investment and consultative activity.

Increased Tax Revenues

The DECD analysis shows that the cumulative, net state revenue[3] generated from the economic activity attributable to CI's investments exclusively exceeds $209 million. This represents an average annual increase of $14.9 million in net state revenue as a result of CI's investment – **$1.97 in net state revenue for each dollar CI invested.** In other words, were it not for CI's early stage investments in its portfolio of companies over the period FY 1995 through FY 2008, Connecticut's coffers would be nearly $15 million poorer each year. Today, CI's net assets stand at $90 million that will in turn generate further revenues and job growth at a pivotal time in Connecticut's economy.

Attracting Outside Investment to Connecticut

From FY 1995 through FY 2008, CI invested $152 million in a portfolio of 84 companies of which $106 million originated from state bond funds (the remainder consisted of investment returns). CI's programs have become self-funded through returns on their investments that are reinvested in new portfolio companies and that support new technology initiatives. Connecticut's modest, cumulative investment of $106 million leveraged an additional $1 billion over the period from CI's investment partners. In other words, for each dollar the State of Connecticut invested, CI and its investment partners leveraged $9.43.

As a result of CI's investment activity from FY 1995 through FY 2008, Connecticut's gross domestic product increased cumulatively by $3.6 billion and by $258.5 million on average each year. In other words, f**rom FY 1995 through FY 2008, for each dollar CI invested, Connecticut's gross domestic product increased $23.80.** Similarly, CI's cumulative investment of $152 million over 14 fiscal years generated net new economic activity that produced $2.17 billion in cumulative personal income.

[3] Net state revenue is revenue from all domestic sources less state expenditure for all uses including debt service from bond issues to capitalize CI.

Introduction

Connecticut Innovations (CI) is a quasi-public authority created in 1989 to promote statewide high-technology businesses through strategic investments. CI has made seed-stage and equity investments in emerging technologies such as bioscience, information technology, photonics, energy, environmental systems, and other research and development (R&D) enterprises. Initially capitalized with state bond issues, CI's programs have become self-funded through returns on their investments. Investment returns are reinvested in new portfolio companies and support new technology initiatives.

In particular, CI has deployed more than $187.5 million between 1995 and 2008 of which $124.9 million was invested in 90 Connecticut companies, while $20.5 million was invested in other technology initiatives such as scholarships, the BioBus, the Test Bed Program, and the Yankee Ingenuity Technology Competition (see footnote 2). In addition, $33 million has been deployed to create more than 350,000 square feet of laboratory space.

In 2008, CI commissioned the Department of Economic and Community Development (DECD) to assess the economic impact of CI's *direct* investments in its portfolio companies from FY 1995 through FY 2008. In 2003, Nexus Associates, Inc. (Nexus) examined the economic and fiscal impacts of CI's portfolio of investments from FY 1995 to FY 2002. While different in scope, the two studies complement each other.

CI Funds: Sources and Uses

CI received its first capital infusion in July 1987 of $7.4 million for its Venture Capital Program followed by $34 million in October 1994 for high tech loans, and $47.8 million in August 1995 for its Royalty Financing Program. Of the $89.3 million in total Venture Capital Program capitalization, $17.5 million was returned to the state during FY2003 through FY2005. For its bioscience facilities program, CI received state bond allocations of $5 million in July 2000 and $10 million in December 2000, July 2001 and March 2002 for a total allocation of $35 million. None of the latter was deauthorized or returned to the state.

For most of its portfolio companies, CI provided equity or near-equity investments. The investments originated from six different funds. The funds and the uses to which they are targeted appear in Table 1 and are briefly described below. The Venture Capital Program consists of three funds: The Eli Whitney Fund, the Connecticut BioSeed Fund and the Seed Investment Fund.

Table 1: Connecticut Innovation Funds and Uses

Name of Fund	Use of Funds	Amount Invested FY1995-FY2008 (in millions)
Eli Whitney Fund (EW)	Working Capital	$120.2
Emerging Enterprises (EE) Fund	Working Capital	$4.432
Seed Investment (SD) Fund	Working Capital	$1.5
CT BioSeed Fund (BS)	Working Capital	$2.4 (since FY1998)
Connecticut Technology Partnership (CTP/FTP) Program	Working Capital	$2.621 (FY1995 through FY2000)
BioScience Facilities Fund (BF)	Construction	$33 (since FY1998)
Total Investment (millions)		$164.153

The Eli Whitney Fund (EW)

Between FY1995 and FY2008, the Eli Whitney Fund, the largest of CI's several funds, invested $120.2 million in 80 companies, leveraged over $1 billion in private capital, and achieved 39 successful investment exits (see footnote 2). As of January 2009, with a current portfolio of 38 companies, 33 of them having received Eli Whitney investments, CI reported an overall gross internal rate of return (IRR) of 24.10% through FY 2008 (footnote 2).

The Eli Whitney Fund provides early-stage funding primarily in the bioscience, energy and environmental systems, information technology, and photonics (applied optics) sectors.

Additionally, CI provided mentoring, management, and marketing support to its portfolio firms. In most instances, CI's investment in a company results in it serving on the board of the company, or receiving a board observer role. The Eli Whitney Fund typically invests up to $1 million as a single investor or with others to help Connecticut-based early-stage technology companies bring innovations and products to market. The fund primarily buys company stock (a CI equity investment). In addition to providing working capital, the fund provides for salary, benefits, and other initial operating costs, but not for construction.

Emerging Enterprises (EE) Fund

This program was a joint venture with a then existing major commercial bank. Under the EE program, as capital contributions were needed they were funded 75 percent by CI, and 25 percent by the bank. The entity known as Emerging Enterprises, Limited Partnership (EE) would then pursue portfolio investments of its own, though EE was simultaneously controlled and managed by CI. For example, the EW Fund (an exclusive CI fund) might make a portfolio investment (the CI contribution) while EE would raise capital independently. The program invested in initial and follow-on rounds of financing for early stage, technology growth enterprises with significant proprietary innovations or other unique and sustainable competitive advantages. EE assisted twelve companies, some for several years. EE was similar to the EW Fund in that both programs would focus on the funding of working capital needs exclusively.

The Seed Investment (SD) Fund

Through the Seed Investment Fund, CI provides working capital to technology entrepreneurs, filling a critical funding "gap" at the early, seed stage of a company's development. Companies may request funding of up to $500,000, to be structured using equity or near-equity instruments. In effect, this fund makes venture capital available to non-bioscience companies in Connecticut that meet certain investment criteria and are in a "pre-Series A" stage of development (before the first round of funding is raised). The fund leverages additional working capital from other investors to help companies grow in accordance with their plans. There are clients that successfully deployed their seed rounds from this fund and

then effectively used that support to attract additional funding - either from CI or other investors - to expand their businesses. Such companies may qualify to receive follow-on investments through CI's Eli Whitney Fund, as well as facilities financing for expansion through CI's BioScience Facilities Fund (BF) described below.

In 1998, CI recognized the unique financing needs of the bioscience sector and as a result created both the Connecticut BioSeed and the BioScience Facilities Funds.

The Connecticut BioSeed Fund (BS)

With this fund, CI offers financial assistance to emerging bioscience companies enabling them to develop ideas and attract "Series A" funding. The fund provides working capital (gap financing and seed capital) to meet the initial financial needs of fledgling Connecticut bioscience companies, until they can attract institutional investors.

This fund was created to accelerate growth of start-up biotech enterprises in the state with equity investments of up to $500,000. This fund is not for construction, but helps particular firms endeavoring to solve unmet needs in such industries as pharmaceuticals, genomics, molecular science, and bio-medical engineering. Since 1998, CI has invested $2.4 million from this fund to grow the successful biotech firms of tomorrow.

The BioScience Facilities Fund (BF)

This fund provides for the construction of laboratory space exclusively. The BioScience Facilities Fund provides financial solutions to qualified biotechnology companies already in Connecticut, or to firms thinking about moving to the state. Firms may apply for this funding for the construction of wet laboratory and related space. The Fund has been instrumental in assisting the startup and expansion of several Connecticut biotech companies.

Since the Fund's inception in 1998, CI has invested $33 million to facilitate the construction of more than 320,000 square feet of new laboratory and related space in the state, which includes 10,600 square feet of newly constructed transitional wet laboratory space in New Haven's Science Park. Opened in 2003, this space is available for rent from CI on a short- or

long-term basis; it consists of two separate suites and provides a turnkey laboratory solution for emerging biotech companies.

The BF Fund supports small, high-technology companies by funding new or improved laboratory facilities. BF funding is structured as equity (preferred stock), convertible debt, or debt with warrants depending on individual circumstances of the deal. The fund is similar to the EW Fund but supports construction of laboratory space for bioscience firms.

DECD Study Methodology

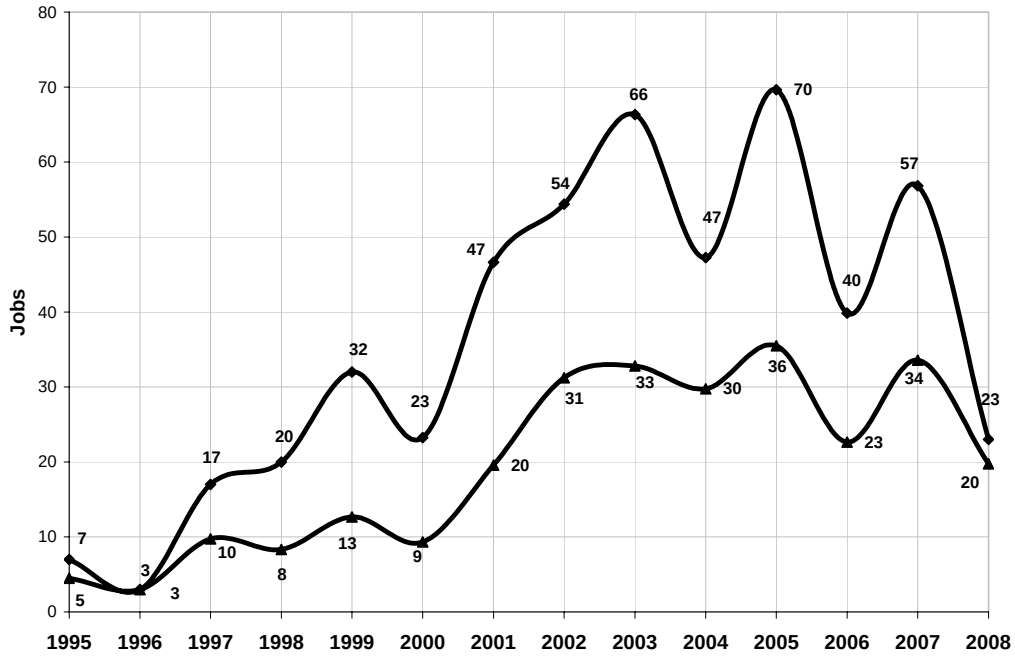
For purposes of this analysis during the study period from FY1995 through FY2008, CI's portfolio contained 84 firms for which it provided employment and revenue data to DECD.[4] A survey of each firm (reproduced in Appendix A) supplemented CI's quantitative data. Combined, these data provide a dynamic picture of the time profile of CI's funding and the resulting employment, sales, and net income of the portfolio firms.

DECD surveyed 84 firms some of which were not active, out of business, acquired, could not be contacted, or failed to respond. Thirty-six CI portfolio firms (42%) responded to the survey (however, not all firms answered each question). Figure 1 shows the impact of CI's involvement on employment for each firm answering the relevant question regarding its employment change with and without CI's assistance. Except for 1996 in which there was no discernible change, employment *with* CI investment exceeds employment *without* it. This indicates CI has had a measurable impact on job creation.

Moreover, over the study period, responding firms reported their revenues "*without* CI" and "*with* CI" that on average, increased from $2,405,951 "*without* CI" to $5,783,860 "*with* CI, representing a 140% increase.

[4] A representative sample of CI's current portfolio appears at http://www.ctinnovations.com/portfolio/Connecticut%20Innovations%20Portfolio%20List.pdf.

Figure 1: Average Employment With and Without CI Assistance, DECD Survey



Source: DECD survey.

We draw as well on the 2003 Nexus Associates study that contains a firm survey that although broader in scope, contains useful information in its survey responses. In particular, the Nexus survey collected the number of employees hired in each of the 42 out of 55 responding firms (76%) as a result of CI's investment in each year between 1995 and 2002. This data is helpful in corroborating the current DECD survey results. A summary of the Nexus study findings appears in Appendix B. Figure 2 shows the average gain in employment with CI's assistance in the Nexus study. The differences between DECD and Nexus average employment gains may reflect the stages of growth of firms in the portfolios at the time the surveys were administered, as well as the higher proportion of firms answering the Nexus survey regarding its employment change with and without CI's assistance.

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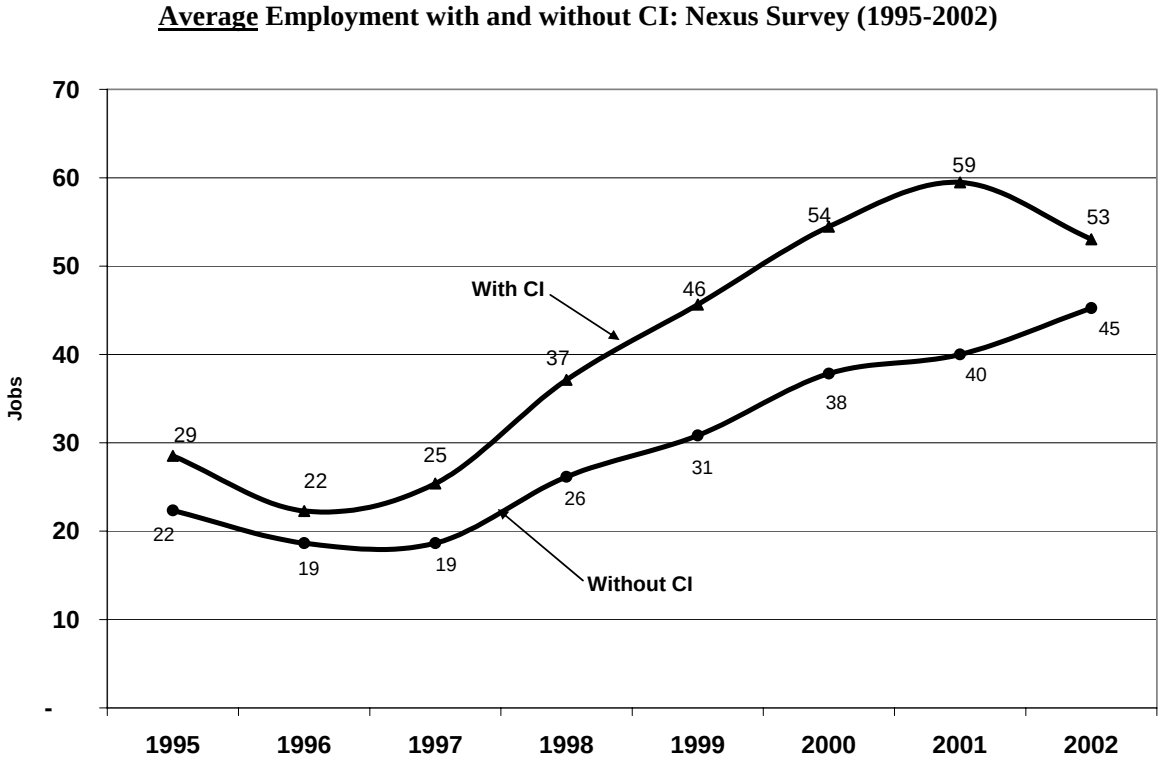
Figure 2: Average Employment With and Without CI Assistance, Nexus Survey



Source: Nexus and the authors' calculations.

In the DECD survey, CI's portfolio companies were asked what CI provided in addition to financing. Of those responding from among four services offered and an "other" category, the companies most frequently checked "management consulting" (71%), and "strategic planning" (78%) services. Undoubtedly, these nonpecuniary services afforded CI portfolio companies additional growth potential.

As did Nexus, DECD performs a "counterfactual" analysis because CI's investments appear in the baseline forecast contained in Regional Economic Models, Inc. (REMI) Policy Insight™ model[5] of Connecticut. The Nexus and DECD REMI micro-simulations estimate CI's portfolio impact by *removing* the changes in employment estimated for each portfolio company in the year that the employment change occurred. It is not clear that Nexus scaled

[5] See Appendix C as well as http://www.remi.com/uploads/File/Documentation/Policy_Insight_9-5_Model_Documentation.pdf.

their responses to the entire portfolio of 55 firms from the 42 responses. It is also important to note that some CI portfolio companies might have ramped up their employment and sales without CI's assistance or sought (and received) funding from other sources. However, DECD takes the firms' estimates of the employment difference before and after CI's contribution in addition to the deployment of working capital and construction spending as a reasonable measure of the magnitude of CI's portfolio impact exclusive of complementary investments.

The Nexus approach is a plausible (though conservative) representation of the economic and fiscal impact because their methodology did not account for the investments for procuring employment services, accounting services, inventory, equipment (that is, for working capital) or facilities (that is, construction spending). Nexus used the reported changes in employment to drive the economic and fiscal impacts exclusively.

DECD Approach

Nexus Associates and the Department of Economic and Community Development conducted their studies using the REMI model. The sources of funding are important for estimating in what industries there are direct inputs. Knowing the type of assistance, in what amount, in what years, and in which industries provides direct effects (inputs) to REMI that in turn produce the total impact results for each year of the analysis period (in this case 1994 through 2008). The total impact is the sum of the direct, indirect and induced impacts. The indirect impact represents the business-to-business spending to acquire inputs to the primary firm's production process. The induced impact represents the subsequent rounds of affected (direct and indirect) workers spending their wages in the region.

In particular, to determine the economic and fiscal impacts of CI's investments, we trace the path of the funds provided to the firms in which CI invested. We assume companies receiving equity or near-equity investments used them to acquire plant and equipment, purchase inputs, hire and train workers, relocate their operation, and/or apply for patents. That is, we assume firms used the funds for working capital, physical and human capital, and

to protect their intellectual capital. We further assume that the duration of the economic and fiscal effects of working capital fade away in the course of a year, while the effects of investment in plant and equipment last ten years or until they depreciate to zero absent refurbishment or replacement. We assume investment in human capital lasts as long as the firm remains in business in Connecticut and is not acquired. The uses to which firms receiving assistance put the funds are largely determined by constraints of the funds themselves.

If CI funds support lab space, the appropriate REMI modeling concept is new commercial and institutional building construction. If the funds provided working capital, we assume the firms' purchased goods and services from the 'Professional and Technical Services' sector. This mimics reality in that firms receiving working capital funds would purchase inventory and equipment, recruit and train workers, or hire consultants to set up accounting and HR functions and similar activities.

Finally, we assume CI's investments allow the firm receiving it to hire workers it would not otherwise have been able to do. We know from the Nexus and DECD surveys that there were net new jobs created due to CI's funding exclusive of other investments. Undoubtedly, investment from other sources and growing product sales allowed additional hiring. We use the reported incremental employment due to CI's assistance as a direct effect in REMI and suppress induced fixed capital investment because we assume the facilities and equipment sufficient to support the new workers is accounted for in the CI working capital and facilities investment, and/or through private investment.

In contrast to the Nexus approach that only used the change in each portfolio company's employment due to CI's investment to drive the REMI model, the DECD study uses this and the firm's procurement of professional and technical goods and services including construction of lab facilities afforded by the specific CI funds investing in the firm. Using a counterfactual approach in which the direct effects are subtracted from the baseline forecast of the Connecticut economy, CI's impact is simulated by changing net new employment or certain economic activity (e.g., construction and scientific, technical and professional,

business services). The modeling procedure relies on reported changes in employment and funded activity for firms responding to the survey. For firms not responding to the survey and those responding but not answering the question about employment changes due to CI's investment, we estimate the average change in employment for firms responding in each year and scale this to the number of firms active in each year. We thus obtain a portfolio level of net new employment due to CI investment. This is a crucial assumption that may not be realistic because it assumes that each firm in the portfolio that did not report its change in employment due to CI's investment experienced the same employment change as the small number that did. We then distribute this net new employment to each industry containing firms active in the portfolio each year according to the relative magnitude of the investment in each industry each year of the study period.

REMI produces the total impact on the state economy as a consequence of the direct impacts of employment and spending changes. Many, if not all, CI portfolio companies were/are start-up businesses, and did not exist before CI's investment, therefore we assume the investments added net new jobs and/or fixed capital.

REMI Modeling Strategy

We measure the economic impact of CI's investments using the amount of the investment that purchases goods and services from the Professional and Technical Services sector, the net new employment created by CI's investment exclusively, and, the construction afforded by lab facilities investment. The data for each company contains the amount of the investment by year and the funds from which it came. This determines whether the funds produced lab space (construction) or working capital in each year. DECD classifies companies by the NAICS code of the industry in which they are situated. Investments from the BioScience Facilities (BF) fund, which supports wet lab construction or renovation, enter into the REMI model for each year in which they occurred as construction of commercial and institutional buildings.

Although significant capitalization occurred prior to 1995, CI reports employment and revenue for firms in its portfolio from 1995 through 2008. The industries in which CI made investments and their North American Industry Classification (NAICS) codes appear in Table 2. That is, the CI portfolio of companies is embedded in these industries. For example, embedded in the chemical manufacturing sector (NAICS 325) are pharmaceutical firms such as Achillion Pharmaceutical, Alexion Pharmaceuticals, and Cara Therapeutics, among others. The professional and technical services sector (NAICS 54171) encompasses firms that perform research and development in the physical, engineering, and life sciences. In subsector 541711, firms conduct biotechnology research and experimental development. Biotechnology research and experimental development involves the study of the use of microorganisms and cellular and biomolecular processes to develop or alter living or non-living materials. This research and development in biotechnology may result in development of new biotechnology processes or in prototypes of new or genetically-altered products that may be reproduced, utilized, or implemented by various industries. In subsector 541712, firms conduct research and experimental development (except biotechnology research and experimental development) in the physical, engineering, and life sciences, such as agriculture, electronics, environmental, biology, botany, computers, chemistry, food, fisheries, forests, geology, health, mathematics, medicine, oceanography, pharmacy, physics, veterinary and other allied subjects. Examples of firms in these subsectors include Affomix Corporation, Cirrata, Inc., Hepaticus, i-Mark, and Metaserver, among others.

Table 2: Industries in which CI Invested: 1995-2008

Industry	NAICS Code	Amount Invested 1995-2008
Prof, tech services	541	$44,407,724
Publishing, except Internet	511	$22,264,266
Chemical mfg	325	$19,246,600
Computer, electronic prod mfg	334	$17,173,416
Internet services, data proc, other	518	$8,246,041
Miscellaneous mfg	339	$7,416,750
Electrical equip, appliance mfg	335	$7,396,923
Retail trade	454	$5,773,423
Machinery mfg	333	$3,858,335
Ambulatory health care services	621	$3,351,206
Wholesale trade	423	$1,300,000
Motor vehicle mfg	3363	$750,000
Transp. equip mfg. except motor vehicles	3369	$700,000
Administrative, support services	561	$499,500
Total		$151,837,143

Source: CI and the authors' calculations.

The positive effects of CI's investment are offset by the debt service the State of Connecticut incurred by issuing bonds to capitalize its operation. We assume the state does not increase taxes to service debt; rather it reduces and/or reallocates spending to accommodate debt service payments. In addition, firms receiving CI loans incurred debt service that increased their production costs. The magnitude and timing of these payments vary over the study period and DECD incorporated them into the REMI model accordingly.

We assume state bonds have a 20-year term and an interest rate of 5.3%. Government spending is adjusted in the model to reflect state bond obligations. Moreover, we take into account the terms of each CI loan that range from five to 15 years with interest rates from 6.0% to 8.5%, and calculate an exact repayment schedule for each loan that increases the firm's production cost for the term of the loan.

Economic Impact Results

DECD performs the microsimulation at the state level using REMI. Table 4 reports the net benefits of CI's investments over the study period. We express net benefits in terms of key economic and fiscal variables. State revenue represents revenue from all domestic sources (e.g., sales, income, excise and property taxes and fees). State expenditure represents spending for all uses. Net state revenue is the difference of the two. Total employment consists of direct, indirect and induced employment attributable to CI's direct job creation. State gross domestic product represents the value added of all goods and services produced in the state in a given year. Personal income represents income from all sources for Connecticut residents.

The economic and fiscal variables in Table 4 represent changes from the baseline or forecast of the Connecticut economy due to CI's investments (exclusively) over the study period (1995-2008). Thus, the second column accumulates the changes in each year, while the third column averages the changes over the study period. These are the cumulative and average (net) contributions of the portfolio of investment expressed in 2008 dollars.

Table 4: REMI RESULTS

FISCAL SUMMARY (2008 $)	**1995-2008 Total**	**1995-2008 Avg.**	**1995-2008 NPV***
State Revenue	$206,824,478	$14,773,177	$125,164,597
State Expenditure	-$2,499,405	-$178,529	-$6,773,838
Net State Revenues	$209,323,883	$14,951,706	$131,938,436
ECONOMIC SUMMARY			
Employment			
Total Employment	22,538 job-years	1,610 jobs	
Direct Employment	7,864 job-years	562 jobs	
Indirect and Induced Employment	14,674 job-years	1,048 jobs	
Employment Multiplier		2.87	
State Gross Domestic Product (2008 $)	$3,618,293,865	$258,449,562	$2,292,869,854
Personal Income (2008 $)	$2,173,894,893	$155,278,207	$1,383,540,654

* A discount rate of 5% was used to calculate NPV.
Source: REMI and the authors' calculations.

The second column of Table 4 presents the cumulative employment contributions of the portfolio of investment expressed in job-years (a job year is one full time job for one year). State expenditures decline over the period because the general increase in employment over the study period due to CI investment reduces state liabilities for unemployment insurance, workers' compensation and retirement benefits despite the increased demand for public services that new workers create. In addition, we assume state spending decreases dollar for dollar as debt service increases.

The CI portfolio had a significant ***net*** economic impact in the FY1995-FY2008 study period creating 1,610 jobs in all sectors (that is, total employment) on average each year of the 1995-2008 study period, and adding $258.4 million to the state's Gross Domestic Product (SGDP) on average each year for the study period. Net state tax revenues (revenues from all domestic sources less all state expenditure) increased on average over the same period by $14.9 million. Of particular note, the cumulative CI investment of $151.8 million (refer to Table 2) over the study period produces a cumulative gain in state tax revenues of $209.3 million indicating a positive benefit to the state. The implied, average, long-run employment multiplier is 2.87 is quite reasonable and respectable given the high value-added jobs that CI's investments afford.

Conclusion

DECD finds that CI's investments leveraged considerable benefit for the Connecticut economy by funding many firms that grew and provided employment opportunities and tax revenues that would otherwise not exist. CI has and continues to make a significant contribution to the Connecticut economy. The results over the 1995-2008 study period show that CI's investments:

- Helped boost total employment 202.3 % among the portfolio companies;
- Expanded state jobs by an annual average of 1,610, or 22,538 job years;
- Raised state tax revenue by $209.3 million (138%) of CI's investment for an annual average contribution in net tax revenue of $15 million;
- Increased state GDP by $3.6 billion, or an annual average of $258.4 million;
- Produced an average annual gain in total state personal income of $155.3 million; with a net present value (NPV) of $1.38 billion;
- Benefited state residents by promoting technologically advanced start-ups that are likely to offer future opportunities for job and output growth.

Appendix A: DECD Survey Instrument

Survey for Connecticut Innovations Portfolio Impact Study

Company Name_____ Contact_____
Phone: _____ Email _____.

1. Describe your company's operations. In what markets do you primarily sell?
   _____
   _____
   _____
   _____
   _____

2. What are the major industries from which your company purchases its inputs? Please list input (e.g., reagents) share in order of purchasing volume by location of vendor.

Connecticut		Domestic U.S.		International	
[e.g., paper, 12%]		[paper, 88%]			
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

3. If your company had not been able to obtain CI assistance (check all that apply),
   - Its speed of development would have been slower _____
   - Its scope would have been reduced _____
   - Its success would have been significantly lower _____
   - Its ability to create new products would have been significantly lower _____
   - It would have been established in another state _____
   - It would have gone out of business _____
   - It would have moved out of Connecticut _____
   - It would have to sell its technology to firm(s) outside Connecticut _____
   - It could have raised the same amount of capital form other sources _____

4. Has CI provided services in addition to financing?
   - Technical Assistance _____
   - Management Consulting _____
   - Accounting Services _____
   - Strategic Planning _____
   - Other _____

5. What is your estimate of the employment and revenue that would have occurred at your firm absent CI's investment? Please provide the number of jobs and revenue for each year since CI's initial involvement until it ceased.

	Employment		Revenue	
	With CI	Without CI	With CI	Without CI
1995	_____	_____	_____	_____
1996	_____	_____	_____	_____
1997	_____	_____	_____	_____
1998	_____	_____	_____	_____
1999	_____	_____	_____	_____
2000	_____	_____	_____	_____
2001	_____	_____	_____	_____
2002	_____	_____	_____	_____
2003	_____	_____	_____	_____
2004	_____	_____	_____	_____
2005	_____	_____	_____	_____
2006	_____	_____	_____	_____
2007	_____	_____	_____	_____
2008	_____	_____	_____	_____

Thank you for your help with this project. Please respond by December 5, 2008.

The information you provide will be protected from public disclosure to the fullest extent possible under the Freedom of Information Act and C.G.S. 32-40 (c).

Appendix B: Nexus Associates Study (2003)

Nexus drew the following conclusions for the economic impact of CI's portfolio:

- CI enabled portfolio firms to obtain needed capital;
- Firms believe assistance has made a difference, even firm survival;
- Prior venture capital funding reduced the perceived role of CI assistance;
- CI's investments resulted in 5,580 of added job-years and $510 million more GSP; CI added $32 million to state tax revenue, though taxpayers annually incurred interest costs of the 20-year bonds that were issued at CI's creation;
- CI invested more than $100 million in 55 active firms from 1995 to 2002 with 80 percent in information technology and bioscience;
- About 60 percent existed for two years or less before CI made its investment;
- Investments are concentrated among five firms that account for 30 percent of the total investment; CI participated as a co-investor in most deals; and,
- For two-thirds of the companies, CI was the first venture capital investor.

APPENDIX C: THE REMI MODEL

The Connecticut REMI model is a dynamic, multi-sector, regional economic model developed and maintained for the Department of Economic and Community Development by Regional Economic Models, Inc. of Amherst, Massachusetts. This model provides detail on all eight counties in the State of Connecticut and any combination of these counties. The REMI model includes the major inter-industry linkages among 466 private industries, aggregated into 67 major industrial sectors. With the addition of farming and three public sectors (state and local government, civilian federal government, and military), there are 70 sectors represented in the model for the eight Connecticut counties.[♣]

The REMI model is based on a national *input-output* (I/O) model that the U.S. Department of Commerce developed and continues to maintain. Modern input-output models are largely the result of groundbreaking research by Nobel laureate Wassily Leontief. Such models focus on the inter-relationships between industries and provide information about how changes in specific variables—whether economic variables such as employment or prices in a certain industry or other variables like population affect factor markets, intermediate goods production, and final goods production and consumption.

The REMI Connecticut model takes the U.S. I/O "table" results and scales them according to traditional regional relationships and current conditions, allowing the relationships to adapt at reasonable rates to changing conditions. Listed below are some salient structural characteristics of the REMI model:

- REMI determines consumption on an industry-by-industry basis, and models real disposable income in Keynesian fashion, that is, with prices fixed in the short run and GDP (Gross Domestic Product) determined solely by aggregate demand.

[♣] The seminal reference is George I. Treyz (1993), Regional Economic Modeling: A Systematic Approach to Economic Forecasting and Policy Analysis, Kluwer Academic Publishers, Boston.

- The demand for labor, capital, fuel, and intermediate inputs per unit of output depends on relative prices of inputs. Changes in relative prices cause producers to substitute cheaper inputs for relatively more expensive inputs.
- Supply of and demand for labor in a sector determine the wage level, and these characteristics are factored by regional differences. The supply of labor depends on the size of the population and the size of the workforce.
- Migration—that affects population size—depends on real after-tax wages as well as employment opportunities and amenity value in a region relative to other areas.
- Wages and other measures of prices and productivity determine the cost of doing business. Changes in the cost of doing business will affect profits and/or prices in a given industry. When the change in the cost of doing business is specific to a region, the share of the local and U.S. market supplied by local firms is also affected. Market shares and demand determine local output.
- "Imports" and "exports" between states are related to relative prices and relative production costs.
- Property income depends only on population and its distribution adjusted for traditional regional differences, *not* on market conditions or building rates relative to business activity.
- Estimates of transfer payments depend on unemployment details of the previous period, and total government expenditures are proportional to population size.
- Federal military and civilian employment is exogenous and maintained at a *fixed* share of the corresponding total U.S. values, unless specifically altered in the analysis.
- Because each variable in the REMI model is related, a change in one variable affects many others. For example, if wages in a certain sector rise, the relative prices of inputs change and may cause the producer to substitute capital for labor. This changes demand for inputs, which affects employment, wages, and other variables in those industries. Changes in employment and wages affect migration and the population level that in turn affect other employment variables. Such chain-reactions continue in time across all sectors in the model. Depending on the analysis performed, the nature of the chain of events cascading through the model economy

can be as informative for the policymaker as the final aggregate results. Because REMI generates extensive sectoral detail, it is possible for experienced economists in this field to discern the dominant causal linkages involved in the results.

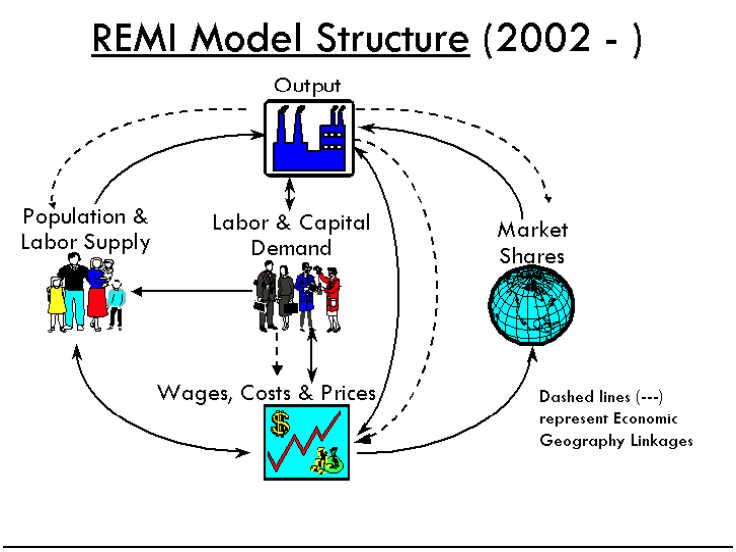
The REMI model is a structural model, meaning that it clearly includes cause-and-effect relationships. The model shares two key underlying assumptions with mainstream economic theory: *households maximize utility* and *producers maximize profits*. In the model, businesses produce goods to sell to other firms, consumers, investors, governments and purchasers outside the region. The output is produced using labor, capital, fuel and intermediate inputs. The demand for labor, capital and fuel per unit output depends on their relative costs, because an increase in the price of one of these inputs leads to substitution away from that input to other inputs. The supply of labor in the model depends on the number of people in the population and the proportion of those people who participate in the labor force. Economic migration affects population size and its growth rate. People move into an area if the real after-tax wage rates or the likelihood of being employed increases in a region.

Supply of and demand for labor in the model determine the real wage rate. These wage rates, along with other prices and productivity, determine the cost of doing business for each industry in the model. An increase in the cost of doing business causes either an increase in price or a cut in profits, depending on the market supplied by local firms. This market share combined with the demand described above determines the amount of local output. The model has many other feedbacks. For example, changes in wages and employment impact income and consumption, while economic expansion changes investment and population growth impacts government spending.

Model Overview

Figure C-1.1 is a pictorial representation of the model. The Output block shows a factory that sells to all the sectors of final demand as well as to other industries. The Labor and Capital Demand block shows how labor and capital requirements depend on both output and their relative costs. Population and Labor Supply are shown as contributing to demand and to wage determination in the product and labor market. The feedback from this market shows that economic migrants respond to labor market conditions. Demand and supply interact in the Wage, Price and Profit block. Once prices and profits are established, they determine market shares, which along with components of demand, determine output.

Figure C-1.1



The REMI model brings together the above elements to determine the value of each of the variables in the model for each year in the baseline forecasts. The model includes each inter-industry relationship that is in an input-output model in the Output block, but goes well beyond the input-output model by including the relationships in all of the other blocks shown in Figure C-1.1.

In order to broaden the model in this way, it is necessary to estimate key relationships econometrically. This is accomplished by using extensive data sets covering all areas of the country. These large data sets and two decades of research effort have enabled REMI to simultaneously maintain a theoretically sound model structure and build a model based on all the relevant data available. The model has strong dynamic properties, which means that it forecasts not only what will happen, but also when it will happen. This results in long-term predictions that have general equilibrium properties. This means that the long-term properties of general equilibrium models are preserved without sacrificing the accuracy of event timing predictions and without simply taking elasticity estimates from secondary sources.

Understanding the Model

In order to understand how the model works, it is critical to know how the key variables in the model interact with one another and how policy changes are introduced into the model. To introduce a policy change, one begins by formulating a policy question. Next, select a baseline forecast that uses the baseline assumptions about the external policy variables and then generate an alternative forecast using an external variable set that includes changes in the external values, which are affected by the policy issue.

Figure C-1.2

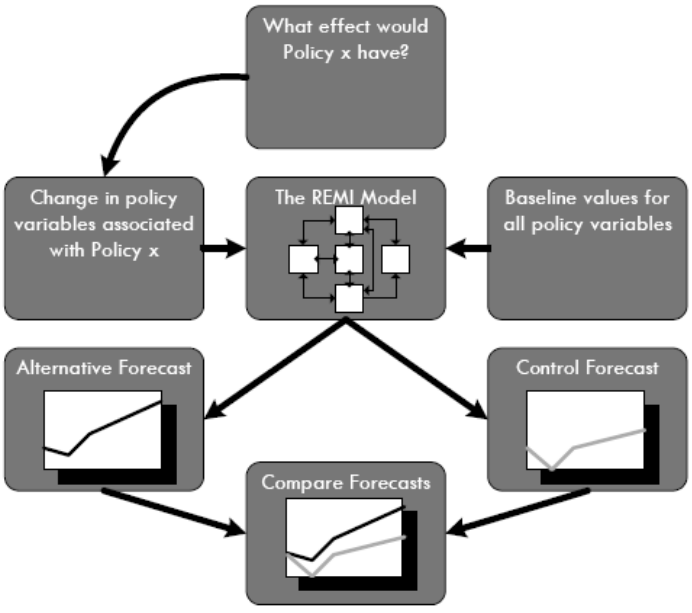


Figure C-1.2 shows how this process would work for a policy change called Policy X. In order to understand the major elements in the model and their interactions, subsequent sections examine the various blocks and their important variable types, along with their relationships to each other and to other variables in the other blocks. The only variables discussed are those that interact with each other in the model. Variables determined outside of the model include:

- Variables determined in the U.S. and world economy (e.g., demand for computers).
- Variables that may change and affect the local area, but over which the local area has no control (e.g., an increase in international migration).
- Variables that are under control of local policy (e.g., local tax rates).

For simplicity, the last two categories are called policy variables. Changes in these variables are automatically entered directly into the appropriate place in the model structure. Therefore, the diagram showing the model structure also serves as a guide to the organization of the policy variables (see Figure C-1.3).

Output Block

The Output Block variables are:

- State and Local Government Spending
- Investment
- Exports
- Consumption
- Real Disposable Income

These variables interact with each other to determine output and depend on variable values determined in other blocks as follows:

Variables in the Output Block	Variables Outside of the Output Block that are Included in its Determinants

State and Local Government Spending	Population
Investment	Optimal Capital Stock (also the actual capital stock)
Output	Share of Local Market (The proportion of local demand supplied locally, called the Regional Purchase Coefficient)
Exports	The Regional Share of Interregional and International Trade
Real Disposable Income	Employment, Wage Rates and the Consumer Expenditure Price Index

Labor and Capital Demand Block

The Labor and Capital Demand block has three types of key variables:

- Employment - determined by the labor/output ratio and the output in each industry, determined in the Output block.
- Optimal Capital Stock - depends on relative labor, capital and fuel costs and the amount of employment.
- Labor/Output Ratio - depends on relative labor, capital and fuel costs.

Simply put, if the cost of labor increases relative to the cost of capital, the labor per unit of output falls and the capital per unit of labor increases.

Population and Labor Supply Block

The model predicts population for 600 cohorts segmented by age, ethnicity and gender. This block also calculates the demographic processes - births, deaths and aging. The model deals with different population sectors as follows:

- Retired Migrants are based on past patterns for each age cohort 65 and over.

- International migrants follow past regional distributions by country of origin.
- Military and college populations are treated as special populations that do not follow normal demographic processes.
- Economic migrants are those who are sensitive to changes in quality of life and relative economic conditions in the regional economies. The economic variables that change economic migration are employment opportunity and real after-tax wage rates.

This block allows the determination of the size of the labor force by predicting the labor force participation rates for age, ethnicity and gender cohorts, which are then applied to their respective cohorts and summed. The key variables that change participation rates within the model are the ratio of employment to the relevant population (labor market tightness) and the real after-tax wage rates.

Wage, Price and Profit Block

Variables contained within the Wage, Price and Profit block are:

- Employment Opportunity
- Wage Rate
- Production Costs
- Housing Price
- Consumer Price Deflator
- Real Wage Rate
- Industry Sales Price
- Profitability

The wage rate is determined by employment opportunity and changes in employment demand by occupation for occupations that require lengthy training. The housing price increases when population density increases. The Consumer Expenditure Price Index is based on relative commodity prices, weighted by their share of U.S. nominal personal consumption expenditures. The model uses the price index to calculate the real after-tax wage rate for potential migrants that includes housing price directly, while the price index

used to deflate local income uses the local sales price of construction. Wage rates affect production costs, as well as other costs, and they in turn determine profitability or sales prices, depending on whether the type of industry involved serves mainly local or external markets. For example, a cost increase for all local grocery stores results in an increase in their prices, while an increase in costs for a motor vehicle factory reduces its profitability of production at that facility but may not increase their prices worldwide.

Market Shares Block

The Market Shares Block consists of:

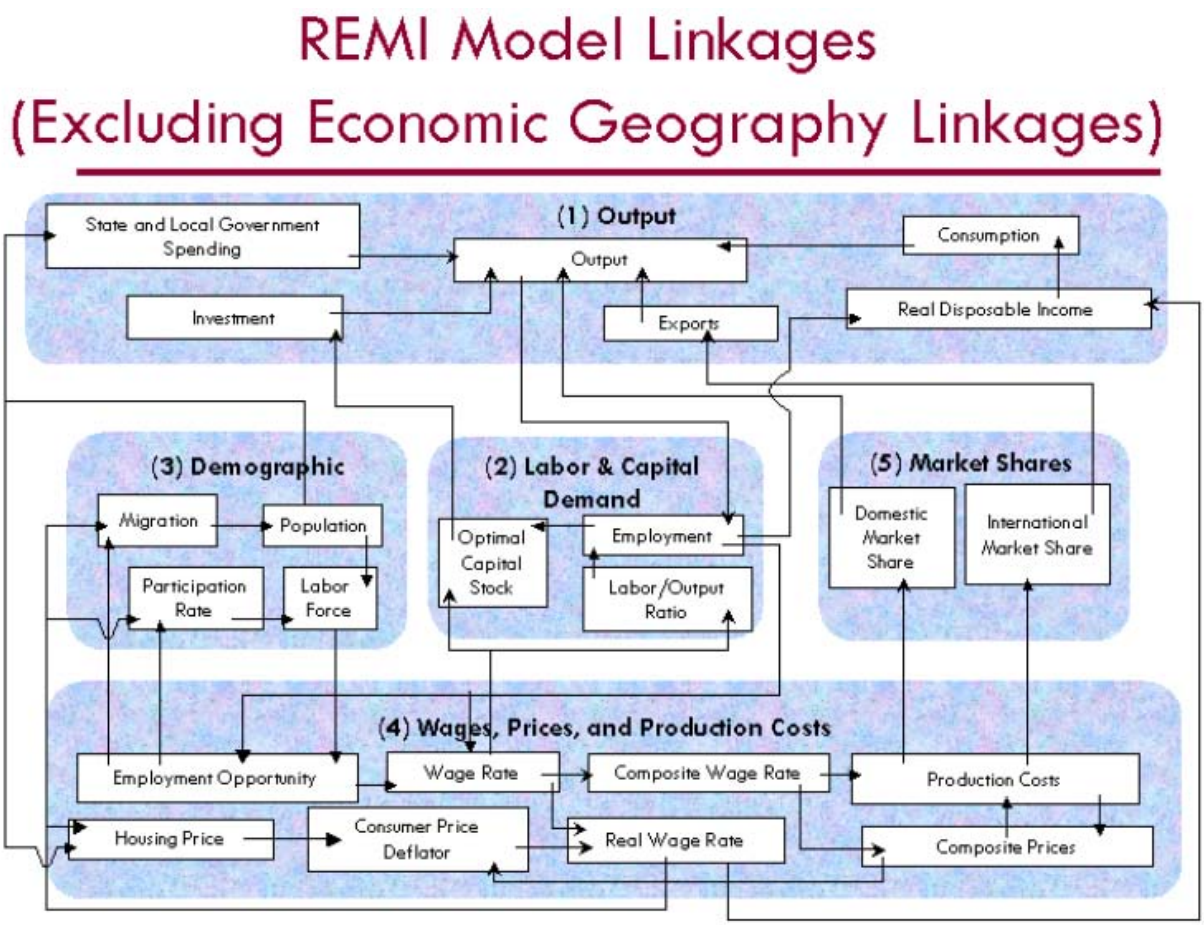
- Share of Local Market
- Share of External Market

An increase in prices leads to some substitution away from local suppliers toward external suppliers. In addition, a reduction in profitability for local factories leads to less expansion of these factories relative to those located in areas where profits have not decreased. These responses occur because the U.S. is a relatively open economy where firms can move to the area that is most advantageous for their business.

The Complete Model

Figure C-1.3 illustrates the entire model and its components and linkages. This diagram is helpful in understanding the complex relationships shared by variables within the various blocks discussed above, as well as their relationships to variables in other blocks.

Figure C-1.3


REMI Model Linkages
(Excluding Economic Geography Linkages)
(1) Output
State and Local Government Spending
Output
Consumption
Investment
Exports
Real Disposable Income
(3) Demographic
Migration
Population
Participation Rate
Labor Force
(2) Labor & Capital Demand
Optimal Capital Stock
Employment
Labor/Output Ratio
(5) Market Shares
Domestic Market Share
International Market Share
(4) Wages, Prices, and Production Costs
Employment Opportunity
Wage Rate
Composite Wage Rate
Production Costs
Housing Price
Consumer Price Deflator
Real Wage Rate
Composite Prices