Creating a Sustainable Health Research Industry in Northern Ontario

Appendix I: Methodology for Economic Modeling

Northern Ontario
School of Medicine

Methodology for Economic Modelling

The model used to determine the potential results of each scenario is called ObserverSym™ . This is a computational environment that consists of several modules (population, economic private sectors and economic public sectors) which together simulate the possible population and economic outcomes given each scenario. To do this, each module uses a Monte Carlo method in which a generator chooses a possible next step at each point in time randomly from an appropriate distribution of all possibilities (Distributions which are tested using a standard Kolmogorov-Smirnov procedure). A Metropolis-Hastings algorithm is applied which at each time t generates a random walk using a proposed density and a method for rejecting proposed combinations that are not reflected in the information contained by history. That is given an initial value at time t the algorithm accepts or rejects (in which case the process is repeated) the next value. The process is repeated many times resulting in a Markov chain in which the last value is independent of the initial (in theory, given sufficiently many trials). The appropriate statistics are computed (central tendency and spread). As the number N of individual trials increases, the solution will converge at a rate which is proportional to $1/\sqrt{N}$. Such slow convergence is typical of the Monte Carlo scheme and as a result requires increasingly powerful computational resources.

A part of the challenge of properly representing the economic impact of each scenario is the identification and quantification of the sources of change that a scenario will engender across both the Northern Ontario home economy and its host economy (in this case Ontario).

ObserverSym™ is based upon a causally connected network that is derived from Canadian national accounting for income-based gross domestic product and expenditure-based gross domestic product, which are connected with one another through inputs and connecting functions that are derived from Canadian and Ontario gross domestic product time series histories with adjustments made for known Northern Ontario differences.

Such economic causal networks are used in conjunction with an understanding of each scenario structure, in order to derive the economic impacts of the proposed existence of each scenario.

A part of the challenge of properly representing the economic impact of each scenario is the identification and quantification of the sources of change that a scenario will engender across both the Northern Ontario home economy and its host economy (in this case Ontario). The primary source of change was determined to be the injection of new capital into the health sciences industry which falls under the “Scientific, professional and technical services” industry type. Some capital expenditure would also be invested in construction of physical infrastructure.

The primary focus adopted by this analysis for the measurement of economic impact is the impact of each scenario upon employment and real gross domestic product growth rates.

Given the nature of the initiative is to partially change the way certain Northern Ontario economic agents co-operate, traditional economic analysis of assuming a constant state of affairs is considered inadequate. This appendix outlines the methodology therefore adopted.

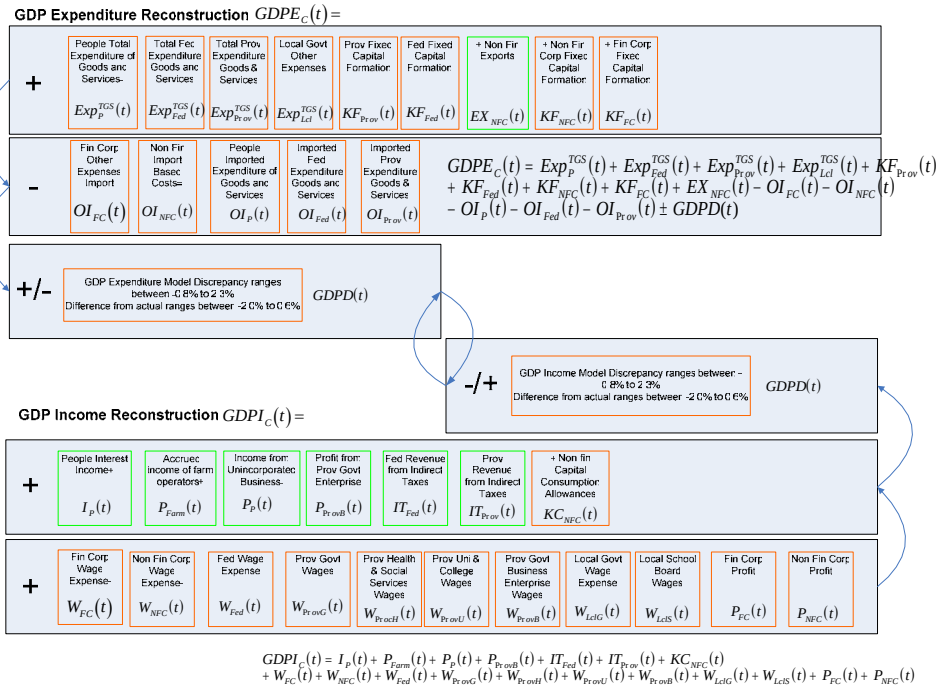
The cause and effect equations that these factors presuppose are highly interrelated and therefore cannot be treated independently. The primary focus adopted by this analysis for the measurement of economic impact is the impact of each scenario upon employment and real gross domestic product growth rates.

The system of national economic accounting in Canada provides for two different, but consistent, estimates of gross domestic product for each historical year, namely expenditure-based GDP estimates and income-based GDP estimates.

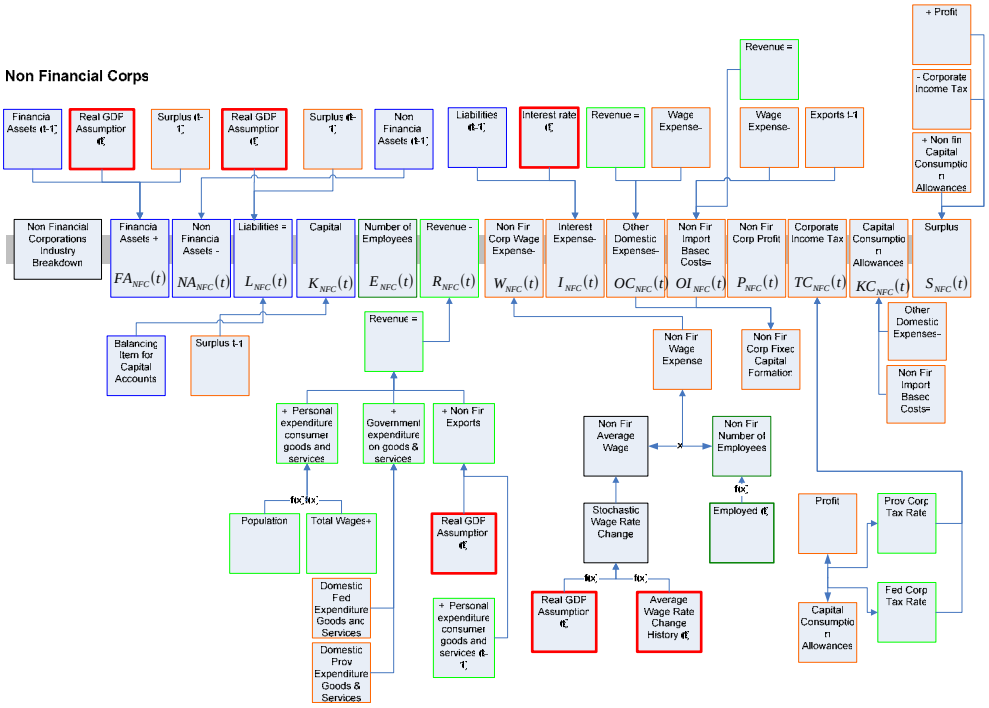
Expenditure based GDP estimates break gross domestic product down into categories of final purchases of goods and services, which includes personal expenditure on consumer goods and services, government current expenditure on goods and services, government and business investment spending. The sum of these components of the summary expenditure account is referred to as final domestic demand. To move from final domestic demand to GDP, the value of physical change in inventories and net exports of goods and services (that is, exports minus imports) are added.

Income based GDP estimates show earnings accruing to labour and capital, generated as part of the production process. This measure includes wages, salaries and supplementary labour income, corporation profits before taxes, interest and miscellaneous investment income, the accrued net income of farm operators from farm production, net income of non-farm unincorporated business (including rent), and the inventory valuation adjustment. Together these six aggregates add up to Net Domestic Income at Factor Cost. GDP at Factor Cost is derived by adding capital consumption allowances, and GDP at Market Prices is calculated by adding indirect taxes (such as sales and excise taxes) less subsidies (such as payments to farmers).

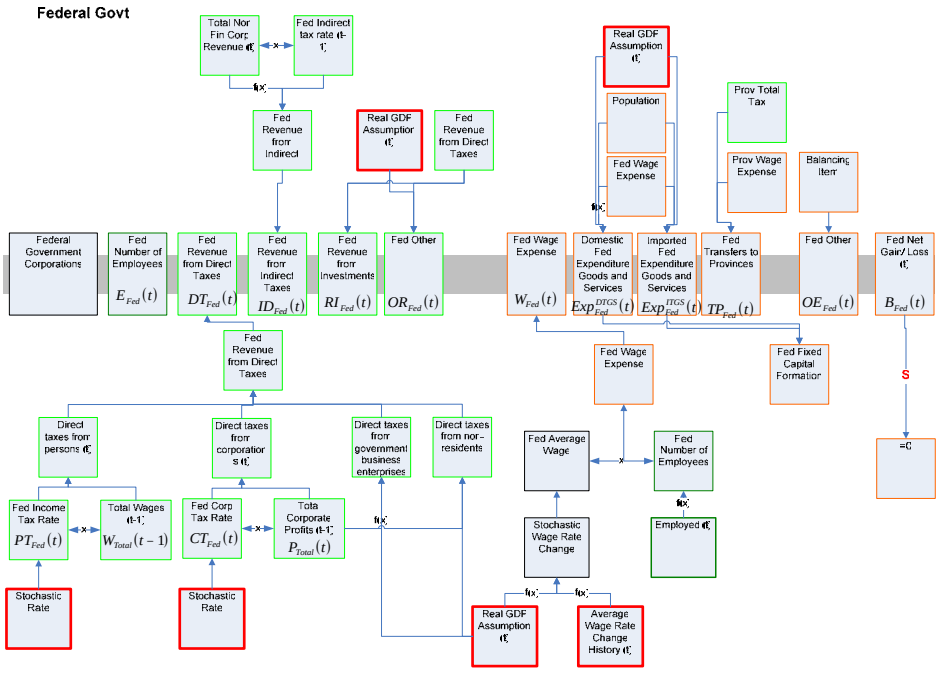
Specifically, ObserverSym™ simulates both income based and expenditure based gross domestic product using the following decomposition:



This decomposition is augmented with an estimation of the balance sheets that generated the different GDP components so as to yield the initial simulation change variable, being capital. An example of this for a non financial corporation is provided as follows:

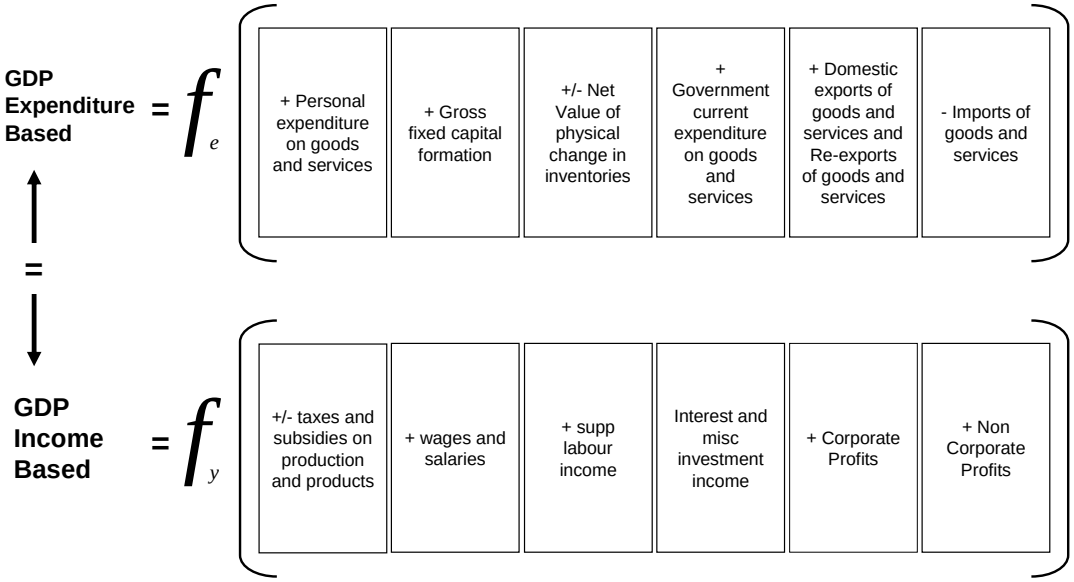


Given that economic agents are connected to each other by the exchange of goods and services, other economic agents types are similarly connected by the same methodology. An example of how the Federal Government is:



The components of expenditure based GDP and income based GDP are presented as additive (that is the function symbols in the above diagram represent an additive operation). For the purposes of illustrating method, a generalised version of the accounting identities represented by these methods is diagrammatically described as follows:

Key Business Outputs: GDP Expenditure Based



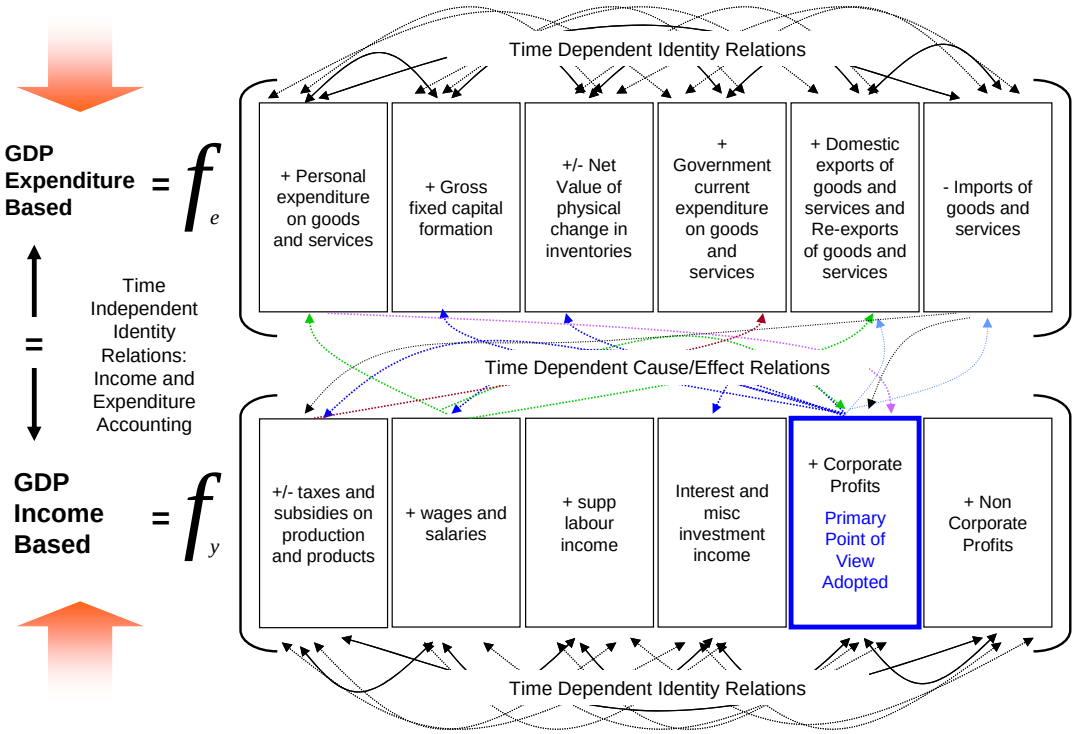
Key Business Inputs: GDP Income Based

To capture the dynamics of GDP and its components, the functions that connect each of the GDP components both time independently and time dependently are required to be identified.

The result of the additive format of GDP is that information provided is a static account (time independent) of the components of GDP. The dynamics necessary for temporal simulation of such components and GDP itself are therefore not captured.

To capture the dynamics of GDP and its components, the functions that connect each of the GDP components both time independently and time dependently are required to be identified. The true consumption/production functions that govern the time evolution of GDP and its components are difficult, if not impossible to observe. Rather, approximations are derived from historical time series information that allows for the identification of a set of potential consumption/production functions. This then allows for the first step of an economic causal network to be formulated, as generally diagrammatically described as follows:

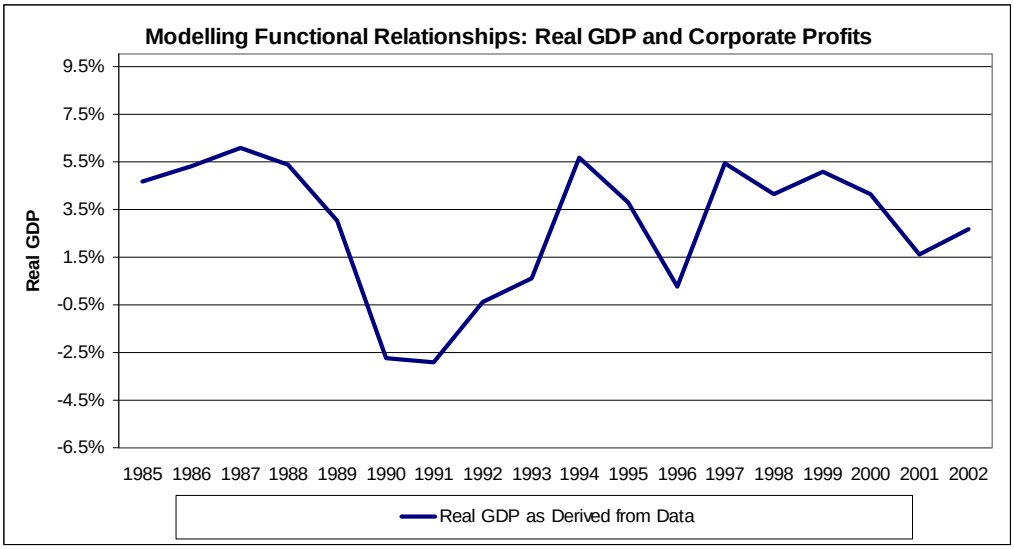
Key Business Outputs: GDP Expenditure Based



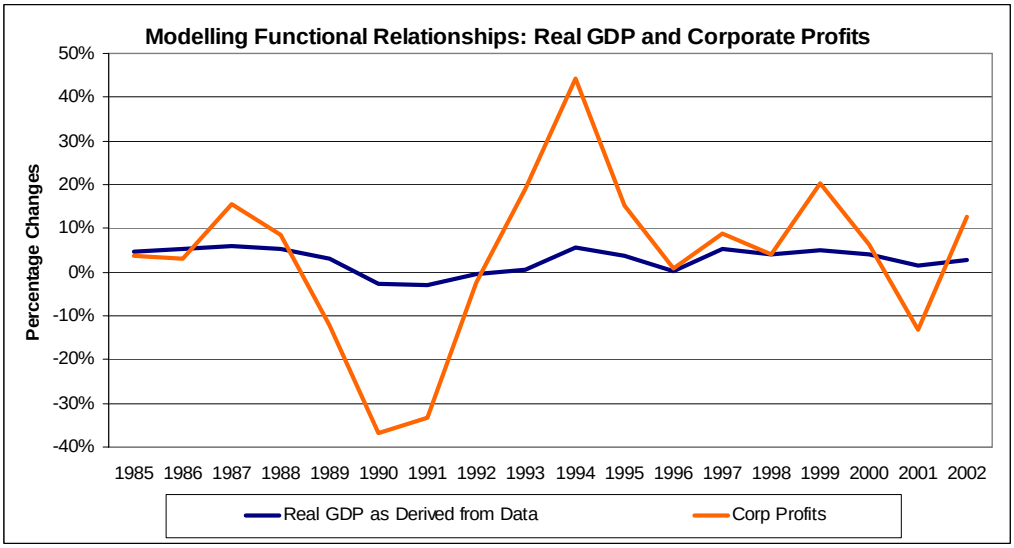
Key Business Inputs: GDP Income Based

Here the corporate profit component is highlighted to provide an example of how a change in a variable will propagate through the causal networks. Although corporate profits are linked to several factors such as wages, taxes and miscellaneous investment income, we will consider only a subset of the relationship between corporate profits and GDP.

The next step is to derive the potential functional connections that can be made between corporate profits and GDP. The historical trend in real GDP is indicated by the following graph:



When changes in corporate profits are added to the graph, the outcome is:



Using functional regression techniques, a set of algebraic equations (using historical rates of change of corporate profits as an input) is fitted to real GDP changes. For the purposes of modelling, RiskAnalytica does not use any algebraic equations with an R-squared of less that 70%. R-squared is the coefficient of determination which is a number between 0 and 1 that indicates how good the model fits the data. An R-squared of 1 is a perfect fit.

For corporate profits in this case, regression shows that a four factor model reaches the required R-squared criteria. The following sample models are produced for example purposes that express real GDP changes as corporate profit changes:

Model X (Real GDP Change) R-squared of 85.4% =

$$0.0009 \times e^{-3.26 \times C_{t-1}} - 0.03.e^{-2.9 \times C_t} + 0.0027 \times \frac{1}{1 - 0.209 \times e^{3.9 \times C_{t-3}}} - 0.01 \times e^{-4.2 \times C_{t-2}} + 0.07$$

Model Y (Real GDP Change) R-squared of 94.7% =

$$-0.03 \times e^{-3.06 \times C_t} + 0.007 \times \frac{1}{1 - 0.395 \times e^{-3.3 \times C_{t-3}}} + 0.005 \times \ln(-0.4396 + C_{t-2}) - 0.011 \times \ln(0.1214 + C_{t-1}) + 0.04$$

Model Z (Real GDP Change) R-squared of 94% =

$$0.11 \times \sin(0.4599 + C_t) + 0.048 \times \sin(0.4599 + C_{t-3}) + 0.013 \times \ln(-0.4047 + C_{t-2}) - 0.01 \times \ln(0.0221 + C_{t-1}) - 0.06$$

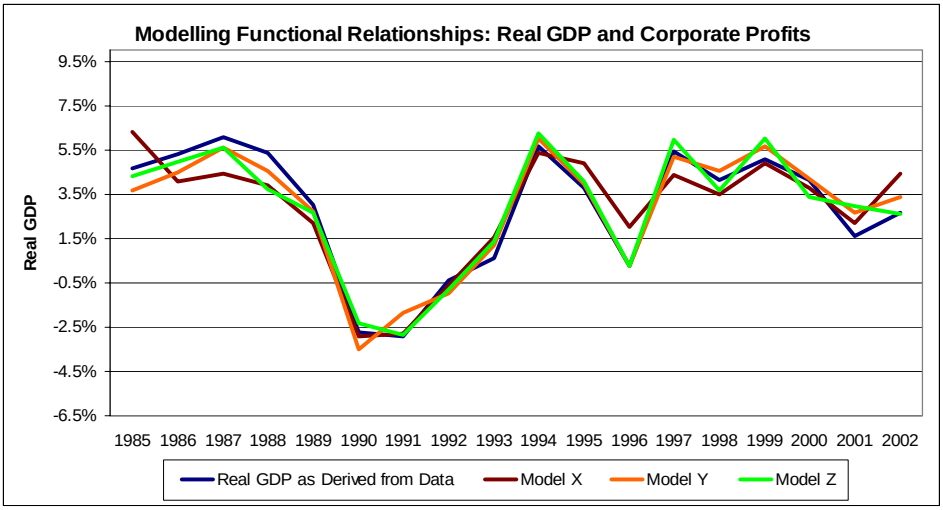
where:

C_t is the rate of change of corporate profits for the year of real GDP estimation.
C_{t-1} is the rate of change of corporate profits for the previous year of real GDP estimation.
C_{t-2} is the rate of change of corporate profits for the previous second year of real GDP estimation.
C_{t-3} is the rate of change of corporate profits for the previous third year of real GDP estimation.

Note: While several mathematical regression techniques can be used to generate equations that fit trends in data (such as exponential, logarithmic, logistic, etc), term polynomials are avoided[1]. This is due to experience with such a class of functions as, while they can be manipulated to accurately fit data, the accuracy is confined to within the data used (models are usually more accurate near the mid-point values of the independent variables). By using term polynomials as a basis of identifying consumption/production function, the danger is that such functions can have drastic motions outside of the range of the data used. For this reason, given the analysis seeks to build simulation models that are forward looking (that is outside the data time lines and ranges), term polynomial functions are not used for simulation purposes.

The model outputs are charted against real GDP changes as follows:

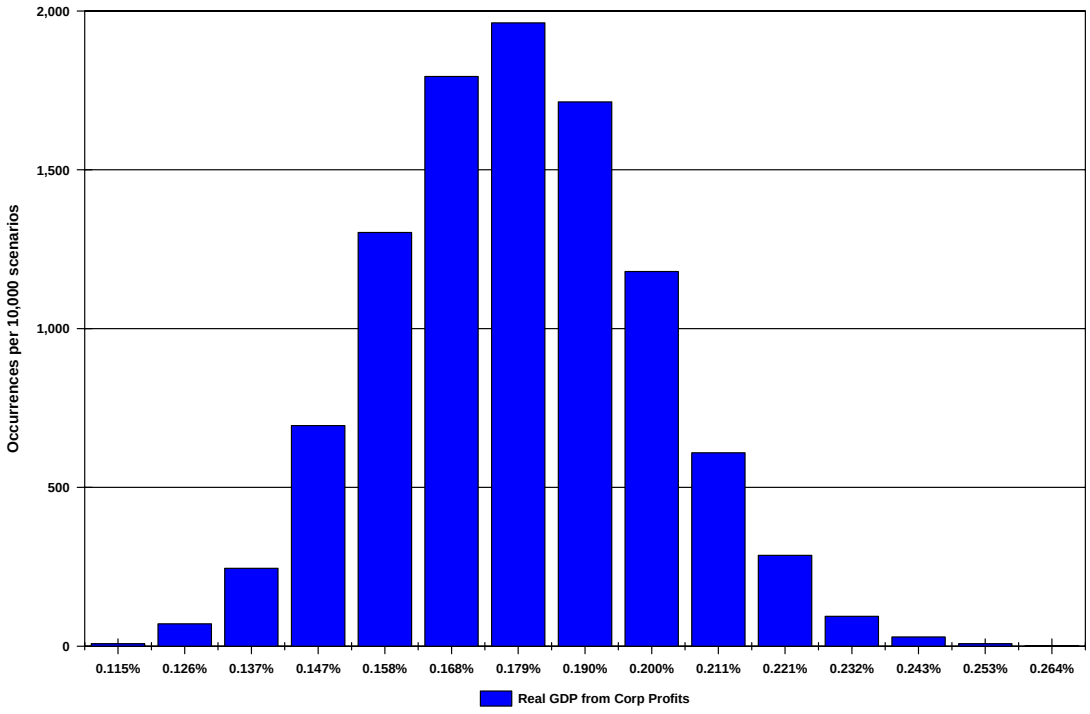
[1] A term polynomial has the form of $y = m_n.x^n + m_{n-1}.x^{n-1} + \ldots + m.x + b$



Functional connection between corporate profits and real GDP is only a small subset of the total set of functional connections derived for the factors at the beginning of this appendix.

Such functional connection between corporate profits and real GDP is only a small subset of the total set of functional connections derived for the factors at the beginning of this appendix. However, one can begin to appreciate by way of this simple example how real GDP impacts can be mapped to corporate profits and an impact measured by the way each functional connection (model, x, y and z) response to a change in corporate profits.

The measure of change of corporate profits is also not static, as has been shown in section 4 of this report. By combining the sets of functional connections with the varying nature of the measured change in corporate profits over the 2005 to 2014 period, a simulated total contribution of increasing corporate profits is then generated (using only model x, y and z), is represented by the following probability distribution:



Derivation of a Base Case

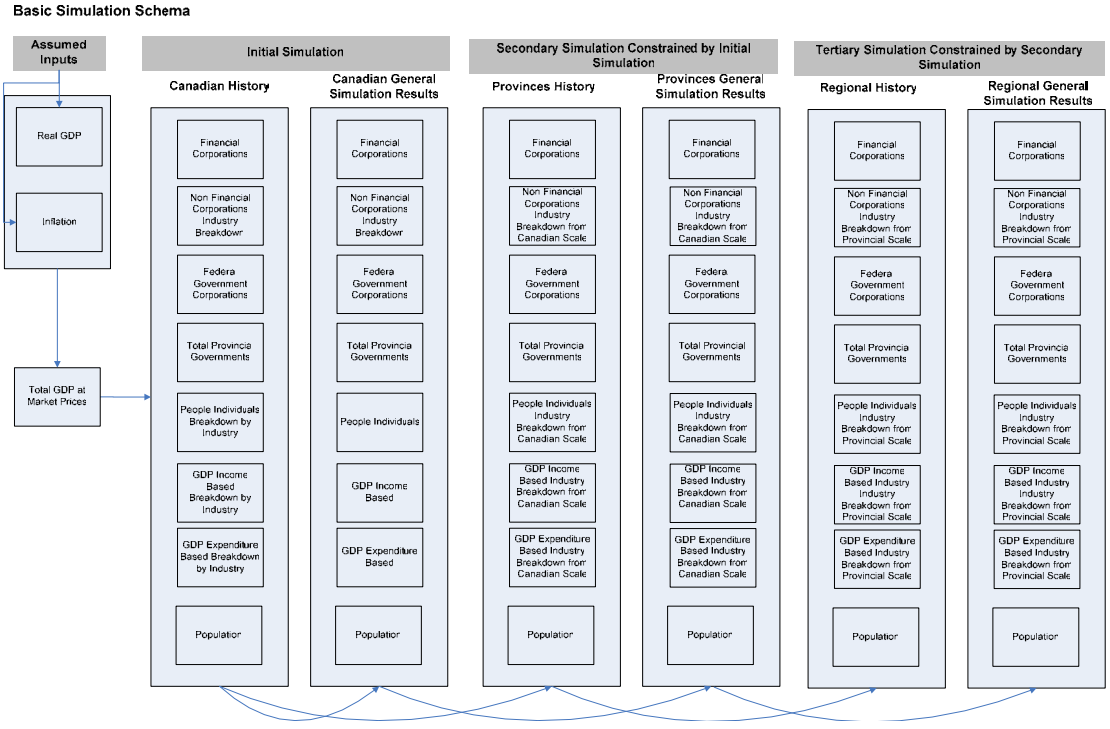
A based case is required to act as a gauge or ruler from which different proposed scenarios can be measured.

A based case is required to act as a gauge or ruler from which different proposed scenarios can be measured. The deviation of a base case for Northern Ontario begins at the highest systematic level available. Given the analysis is limited to primarily what is made available by Statistics Canada, the highest systemic level is set to the Canadian economy. Simulations are then performed to determine the macro-economic relationships over time for the Canadian economy.

The next task is to then establish how the Ontario economy, which is a subset of the Canadian economy, contributes to the simulation results of the Canadian economy. An Ontario economic simulation is performed using the Canadian simulation results as a constraint. This procedure uses the Metropolis-Hastings algorithm which is applied at each time t and generates a random walk using a proposed density and a method for rejecting proposed combinations that are not reflected in the Canadian simulations performed previously.

The final task of establishing a based case for Northern Ontario is to then establish how the Northern Ontario economy, which is a subset of the Ontario and Canadian economy, contributes to the simulation results of the Ontario (first order) and Canadian (second order) economies. A Northern Ontario economic simulation is performed using the Ontario and Canadian simulation results as a constraint. Again this procedure uses the Metropolis-Hastings algorithm.

A simplified overview of the procedure is illustrated as follows:

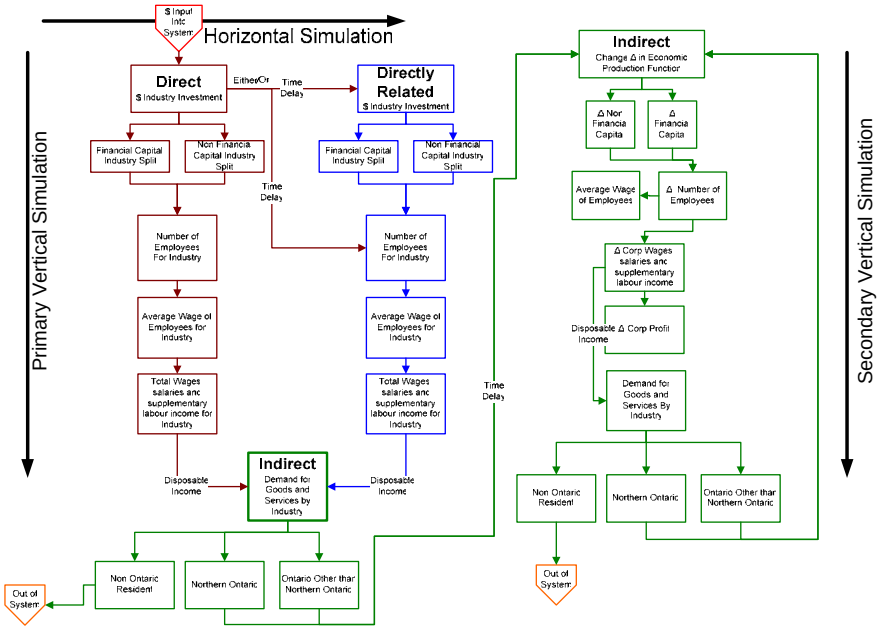


The ObserverSym™ analytical framework allows for several different non-linear transformations to be conducted as part of a sequence of simulations.

An example of this is the way in which the scenario schema is established across horizontal and vertical lines of simulation. The analysis conducted in this report begins with an investment, which then propagates to the different economic variables horizontally and vertically as indicated in the following diagram:

The analysis conducted in this report begins with an investment, which then propagates to the different economic variables horizontally and vertically.

Scenario Schema



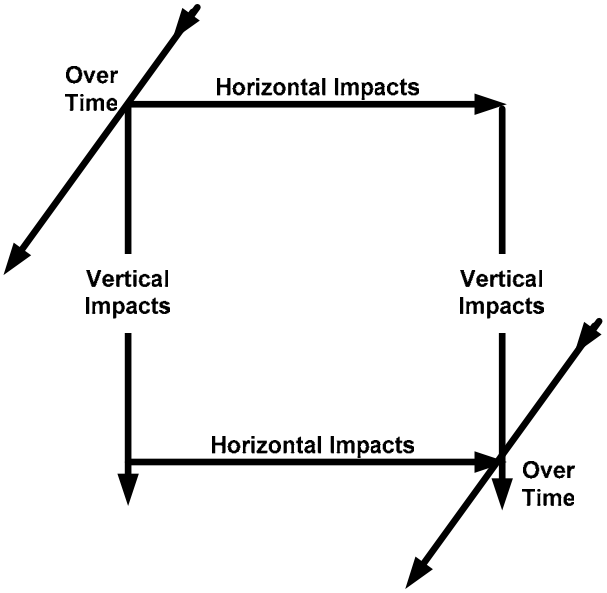
The vertical indirect impact takes into account the spending cycles that are instigated by new capital investment as indicated. The horizontal indirect impact takes into account the investment cycles that are instigated by new capital investment.

This diagram shows the direct investment impact (the industry where the investment is initially made), and the horizontal and vertical indirect investment impacts. The vertical indirect impact takes into account the spending cycles that are instigated by new capital investment as indicated. The horizontal indirect impact takes into account the investment cycles that are instigated by new capital investment as indicated.

The primary benefit of simulating horizontal and vertical impacts is the ability:

- to gain an understanding of how industries and capital investment are interrelated;
- to model a more complete and higher resolution of what capital investment does to an economy beyond the more traditional approaches of applying capital and income multiplier metrics.

The following diagram shows a simplified representation of how vertical and horizontal impacts are combined temporally:


Over
Time
Horizontal Impacts
Vertical
Impacts
Vertical
Impacts
Horizontal Impacts
Over
Time

Base Case

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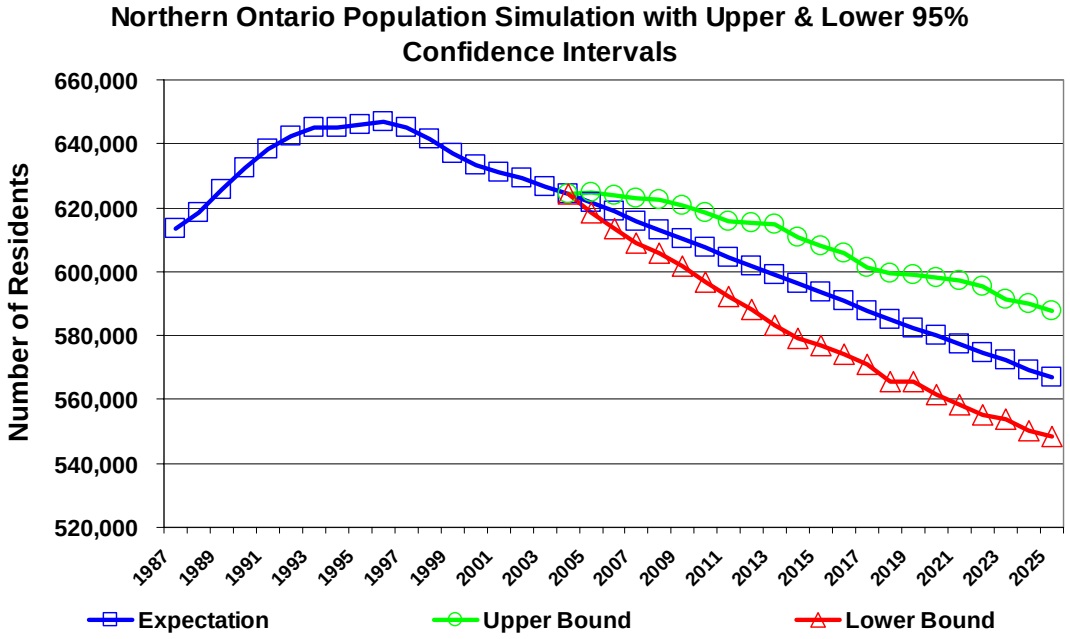
The population possibilities for Northern Ontario are computed and subdivided into risk and reward regions. The demarcation between risk and reward regions is established by the maximum density of the simulation results, and the motivation of the region. The maximum density could be interpreted as the central tendency of the all the population possibilities as weighted by probability. Here we call such a central tendency the "gauge expectation" as it is used as a measure of whether a possible scenario is risk or reward given a particular motivation.

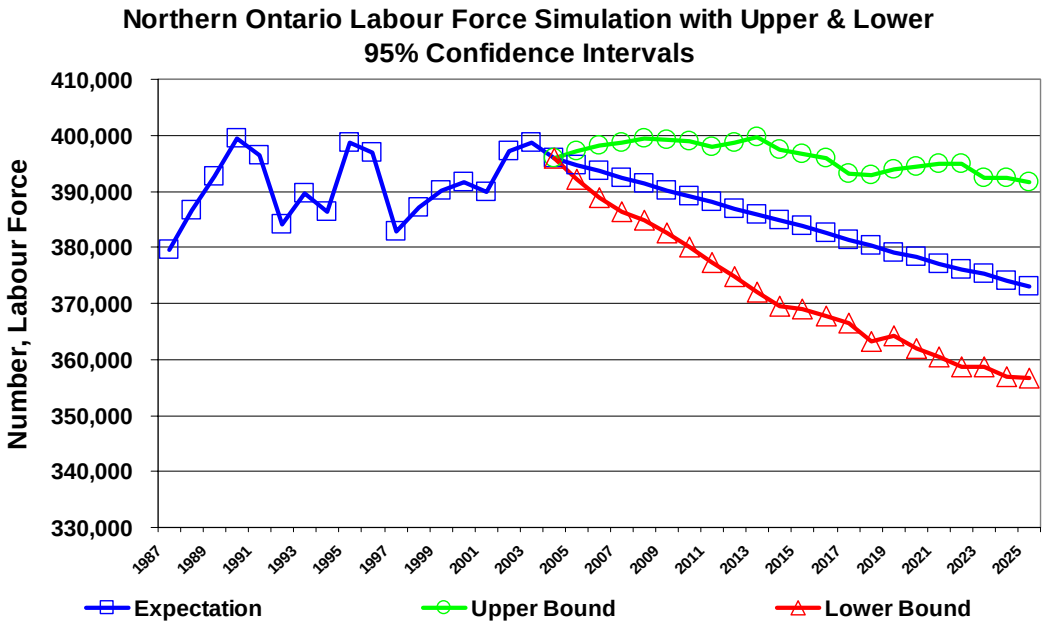
The motivation of the region is assumed to be the maximisation of the population base. As a result, a drop in the population below the gauge expectation (blue) is considered a risk to the Northern Ontario economic perspective, and an increase in the population above the gauge expectation (blue) is considered a reward to the Northern Ontario economic perspective. The results of simulation are as follows:



The results show a decline in the population of Northern Ontario over the simulation period, being from 2004 to 2025.

Labour Force simulations are conducted in the same way, with the results being:

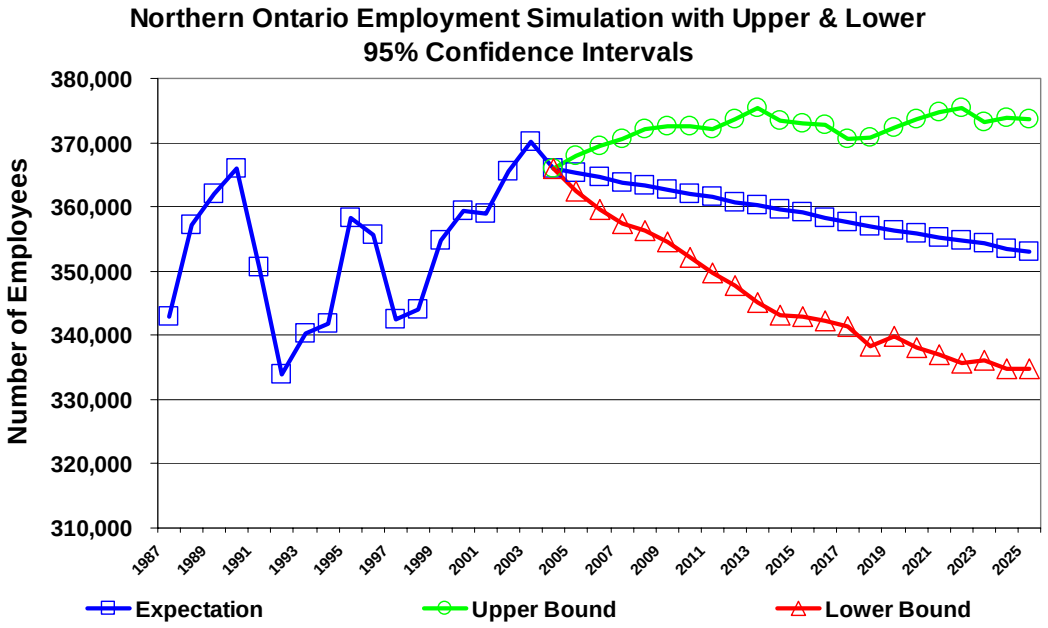
Labour force results show a resilience of the Northern Ontario economy to change with the declining population structure, indicating a population base that is increasing its participation rate to enter the work force.



The labour force results show a resilience of the Northern Ontario economy to change with the declining population structure. This is indicative of a population base that is increasing its participation rate to enter the work force.

Employment simulations are conducted in the same way, with the results being:

Employment results show a resilience of the Northern Ontario economy to change with the declining population and labour force structure, indicating that the labour force is prepared to change its skill base, improve efficiencies and take up unemployment slack.



Despite the resilience of the labour force and the employment base to resist a falling population profile, the ability to resist is not unlimited.

Again the employment results show a resilience of the Northern Ontario economy to change with the declining population and labour force structure. This is indicative of a labour force that is prepared to change its skill base, improve efficiencies and to take up unemployment slack.

A key issue that emerges however is that despite the resilience of the labour force and the employment base to resist a falling population profile, the ability to resist is not unlimited. In this way, a future path that tracks into the risk regions as indicated will accelerate the reduced ability of the region to manage economic decline. A future path that tracks into the reward regions as indicated will decelerate the reduced ability of the region to manage economic decline and potentially change the momentum in favour of regional economic managers to build a new foundation upon which economic resources are attracted to the region.

A future path that tracks into the reward regions will decelerate the reduced ability of the region to manage economic decline and potentially change the momentum in favour of regional economic managers to build a new foundation upon which economic resources are attracted to the region.

This issue raises the importance and the economic simulated result behaviour of the proposed scenarios in this report.

Assumptions:

- Strategies are assumed to be successful. This implies that strategies are well managed and the employment resources are available.
- Northern Ontario responds similar to the effect of Ontario capital boosts after adjusting for differences in industry and size mix.
- Funds spent on buildings are spent with Northern Ontario based companies.
- Strategies are in conjunction with the development of the medical school.
- The amount of capital available for productive use for depreciates at a rate between 10% to 15% per year.
- Capital investment is fully utilised throughout a year, from the beginning of each year. There is no idle capital
- Investment cycle years, for each scenario, are averaged from the multiple component initiatives that make up each scenario and are weighted towards the more capital-intensive initiatives. For each initiative, we estimated the investment cycle based on the nature of the finance for that initiative. For example: Grant funding was assigned a value of 3 years, venture capital was assigned a value of 5 years, etc.
- There are no significant recessions or industry closures throughout the simulation period.
- Profit is earned on capital equal to the cost of capital. That is capital funds itself.
- The relationship between the Northern Ontario economy's ability to generate gross domestic product and the Ontario economy's ability to generate gross domestic product is stable.
- Spending cycles from wages are between 3 and 5 years, and the retention of wage spending is similar to that of Ontario.
- Wage percentages for each scenario are averaged from the multiple component initiatives that make up each scenario. For each initiative, we estimated capital expenditure and operating costs. Wages made up between 20-40% of capital expenditure, depending if it was equipment procurement or construction. Wages make up 70

Momentum will be created by capital invested, as well scenarios will be leveraged through awareness campaigns

to 80% of operating costs as these are predominantly laboratories or other institutions staffed by highly qualified personnel in which human resources are the bulk of operating costs.

- There is momentum created by capital invested. That is, capital spent in one year will encourage capital expenditure is subsequent years.
- There is a marketing/awareness campaign associated with each scenario to economic agents outside of the Northern Ontario economy. That is, the scenarios will be leveraged through awareness campaigns.
- The relative ability of Northern Ontario to take advantage of each scenario. That is rank each scenario providing reasons for the rank. It is assumed that Northern Ontario is equally able to take advantage of each scenario.
- Interest rate remains stable throughout the simulation period.

Industries:

Agriculture, forestry, fishing and hunting; Mining and oil and gas extraction; Utilities; Construction; Manufacturing; Wholesale trade; Retail trade; Transportation and warehousing; Information and cultural industries; Finance, insurance, real estate and renting and leasing; Professional, scientific and technical services; Administrative and support, waste management and remediation services; Educational services; Health care and social assistance; Arts, entertainment and recreation; Accommodation and food services; and Public Administration.

Scenarios

Medical School

While the medical school is a pre-existing project, its impact upon the statistical history is not yet realised. For this reason, the medical school is treated as a scenario that is incremental to the base case.

The capital assumptions, wage expenditure assumptions, gauge expected employment results, real economic growth gauge expected results and net present value from investment for the Northern Ontario economy are tabulated below:

Results of Economic Analysis **Northern Ontario**
Scenario: Build Medical School

	Total Capital Investment	Percentage Feeding Through to Direct Wages	Northern Ontario Total Employment	Northern Ontario Real Economic Growth	Northern Ontario Economic NPV After Investment	Northern Ontario Cummulative Rate of Economic Return
2005	$22,000,000	70%	151	0.041%	-$9,253,383	-42%
2006	$22,000,000	70%	372	0.061%	-$11,540,435	-27%
2007	$22,000,000	70%	646	0.076%	-$8,988,845	-15%
2008	$22,000,000	70%	940	0.082%	-$4,524,967	-6%
2009	$22,000,000	70%	1,202	0.074%	-$2,417,995	-3%
2010	$22,000,000	70%	1,447	0.069%	-$1,527,749	-1%
2011	$22,000,000	70%	1,676	0.065%	-$1,536,517	-1%
2012	$22,000,000	70%	1,901	0.064%	-$1,474,644	-1%
2013	$22,000,000	70%	2,140	0.068%	-$381,303	0%
2014	$22,000,000	70%	2,400	0.074%	$2,192,821	2%
2015	$22,000,000	70%	2,655	0.072%	$4,425,703	3%

Total Net Present Value	**$4,425,703**
PV Economic Costs	**-$146,429,008**
PV Economic Gains	**$150,854,712**

Given the way in which simulation is performed horizontally and vertically, the employment and real gross domestic product growth results are typically slow to respond initially, with the effects of compounding from subsequent spending and investment cycles having progressively larger impacts through time.

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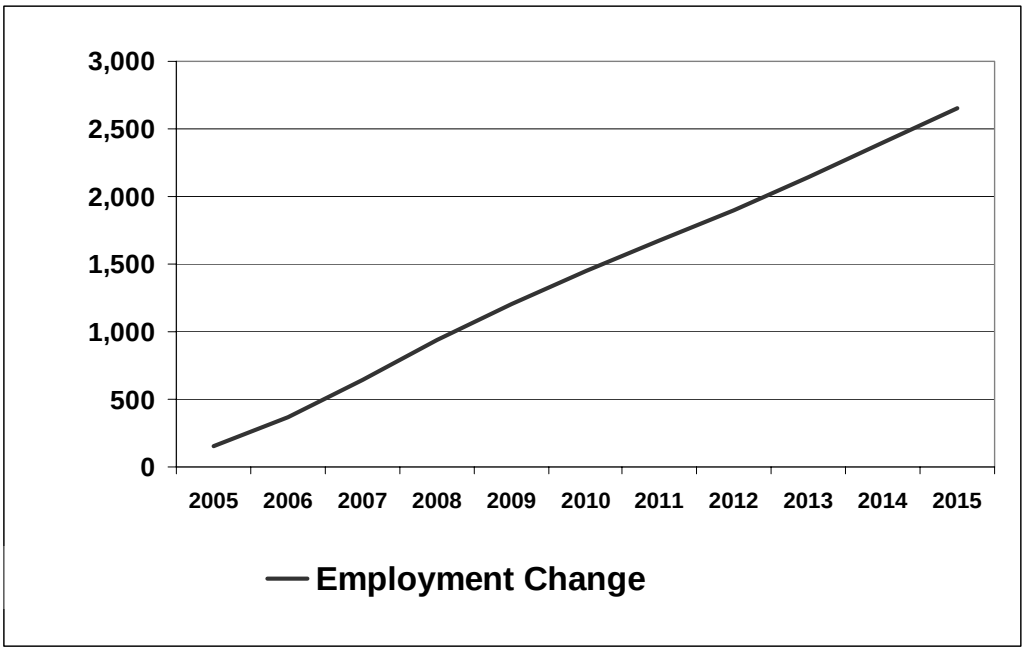
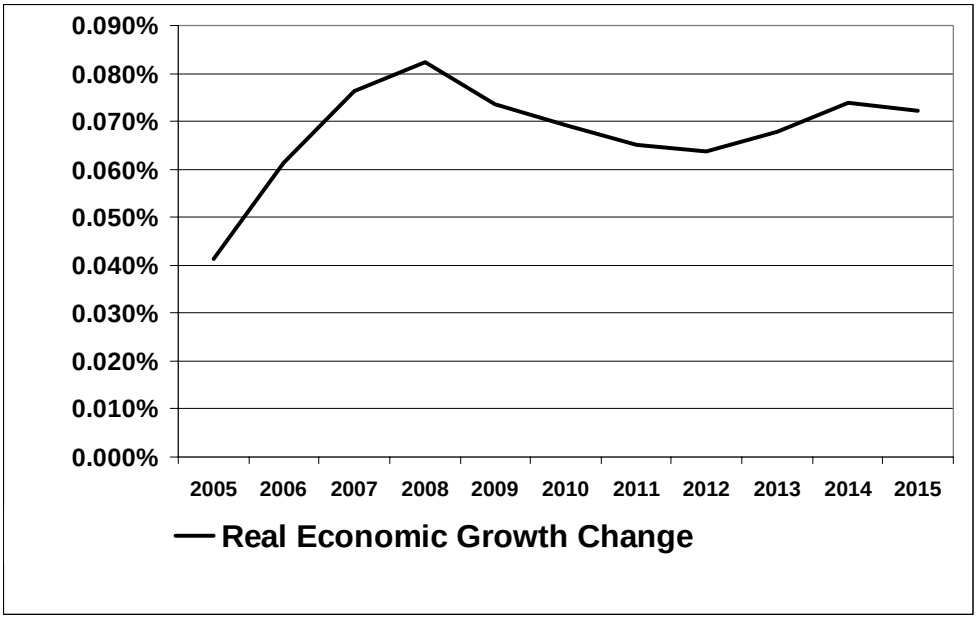


This chart shows the total employment trend resulting from the scenario.

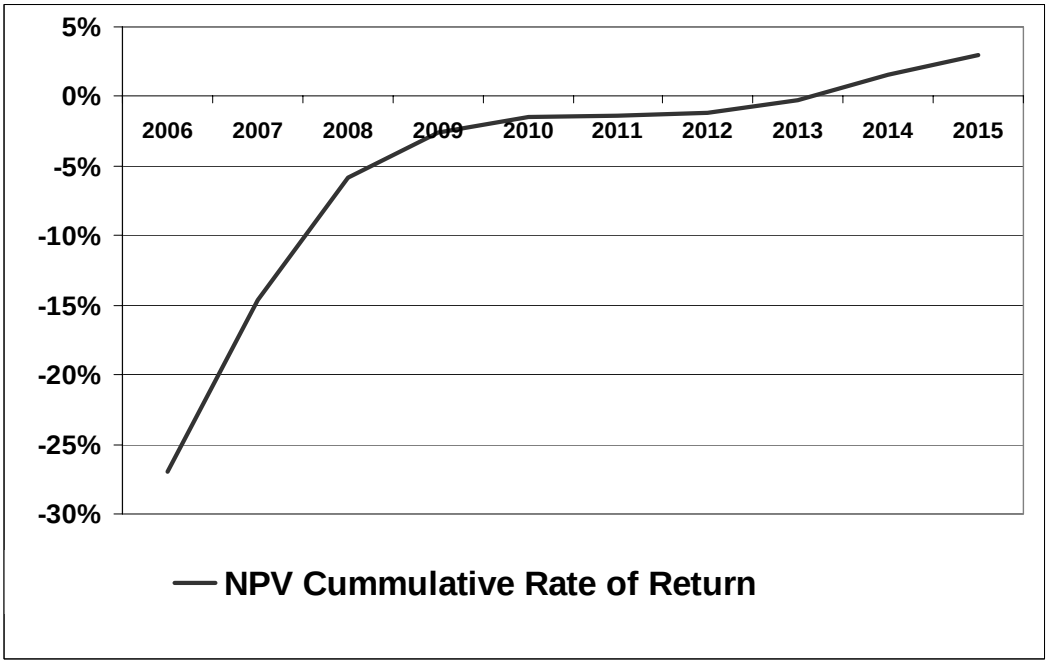
The employment results are robust indicating a strong platform from which other initiatives can be based.



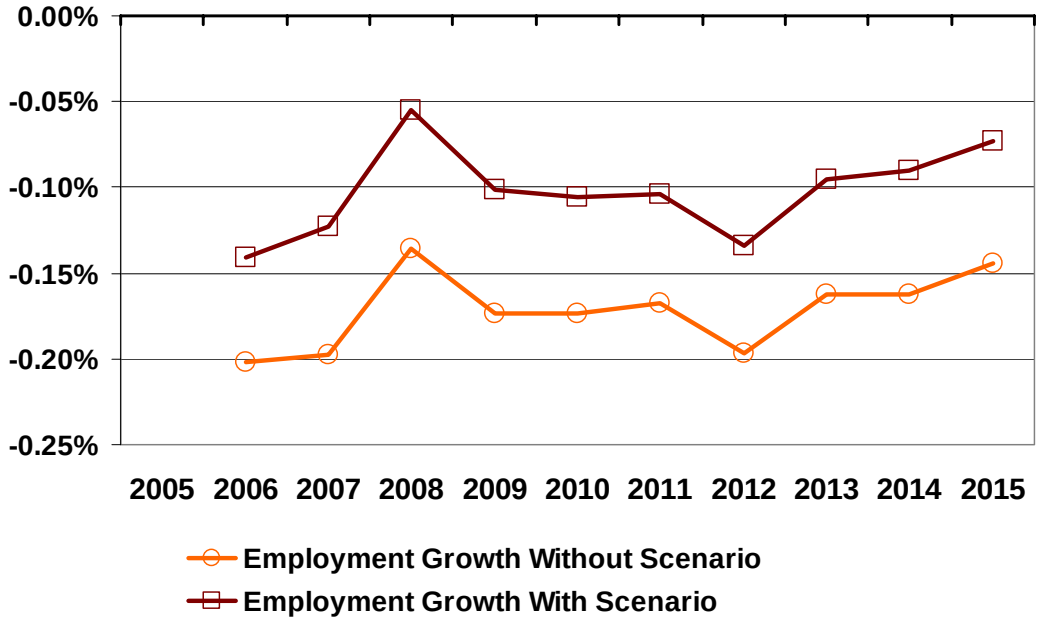
The net present value result of this scenario is expected at $4.4 million for the Northern Ontario economy as a whole, the positive results do not occur until 2013.

This chart shows the change in real GDP for Northern Ontario each year, and does not include a compounding for pervious years. That is a change in a particular year is in addition to the changes in previous years.

The financial performance is cyclical as indicated by these two charts. While the net present value result of this scenario is expected at $4.4 million for the Northern Ontario economy as a whole, the positive results do not occur until 2013. This reflects the slow-moving value-added nature with a risk period that extends from 2005 to 2012.



This chart shows the net rate of return for the Northern Ontario economy adjusted for time value for each year taking into account all previous years.



The scenario elevates the expected employment growth/decay rate proportionally throughout the simulation period.

This chart shows the base case projected employment growth and the employment growth that is expected to be exhibited with the success of the scenario. This chart shows how the scenario elevates the expected employment growth/decay rate proportionally throughout the simulation period.

The Health Research Grid scenario assumes the implementation of the medical school scenario and the results show the incremental results (in addition to) over and above the medical school results.

Health Research Grid

This scenario assumes the implementation of the medical school scenario and the results show the incremental results (in addition to) over and above the medical school results.

The capital assumptions, wage expenditure assumptions, gauge expected employment results, real economic growth gauge expected results and net present value from investment for the Northern Ontario economy are tabulated below:

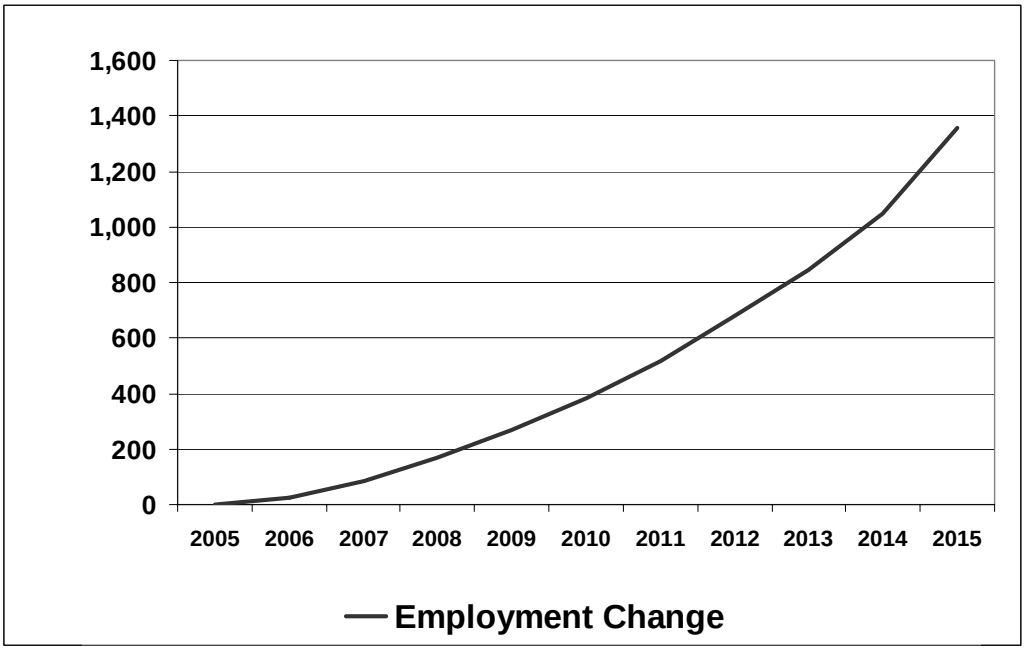
Results of Economic Analysis **Northern Ontario**
Scenario: Health Research Grid

	Total Capital Investment	Percentage Feeding Through to Direct Wages	Northern Ontario Total Employment	Northern Ontario Real Economic Growth	Northern Ontario Economic NPV After Investment	Northern Ontario Cummulative Rate of Economic Return
2005	$0	0%	0	0.000%	$0	
2006	$4,225,000	63%	22	0.006%	-$2,219,444	-54%
2007	$10,400,000	44%	83	0.017%	-$6,846,725	-50%
2008	$11,300,000	35%	171	0.024%	-$9,639,161	-42%
2009	$10,800,000	35%	267	0.027%	-$10,825,929	-35%
2010	$14,800,000	33%	381	0.032%	-$13,729,217	-33%
2011	$15,050,000	43%	518	0.038%	-$14,823,601	-30%
2012	$8,050,000	53%	679	0.046%	-$8,949,554	-17%
2013	$9,050,000	53%	845	0.047%	-$3,869,190	-7%
2014	$9,050,000	53%	1,050	0.058%	$3,178,432	5%
2015	$9,050,000	53%	1,358	0.087%	$15,571,846	25%

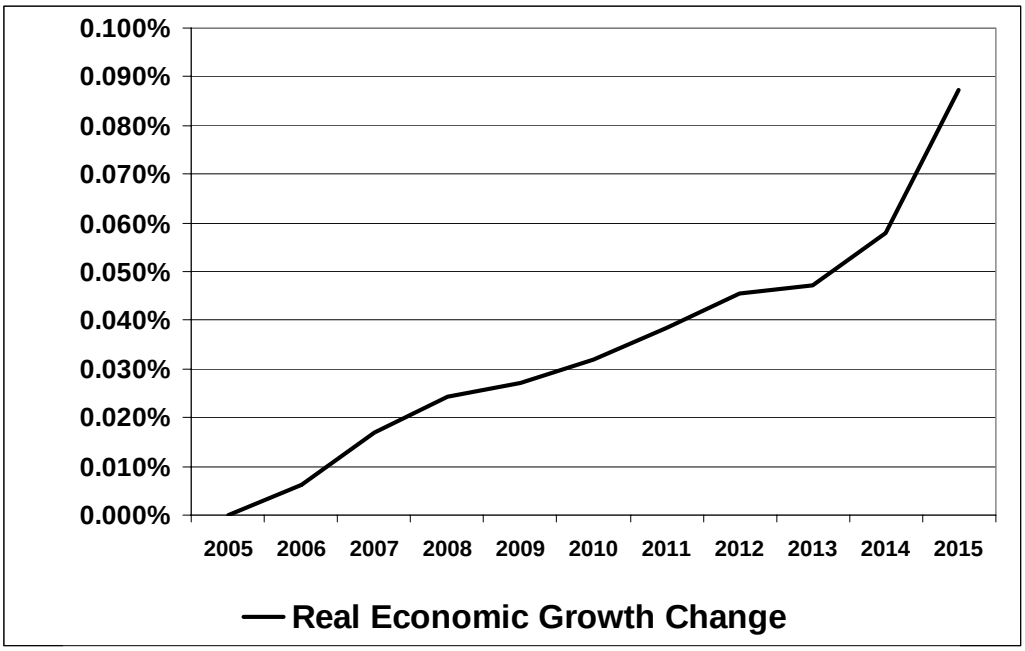
Total Net Present Value	**$15,571,846**
PV Economic Costs	**-$61,581,869**
PV Economic Gains	**$77,153,715**

This scenario is a slow starter requiring the effects of compounding from subsequent spending and investment cycles to progressively larger impacts through time.

This scenario is a slow starter requiring the effects of compounding from subsequent spending and investment cycles to progressively larger impacts through time. While being a slow starter, the scenario shows significant potential for stable reward.

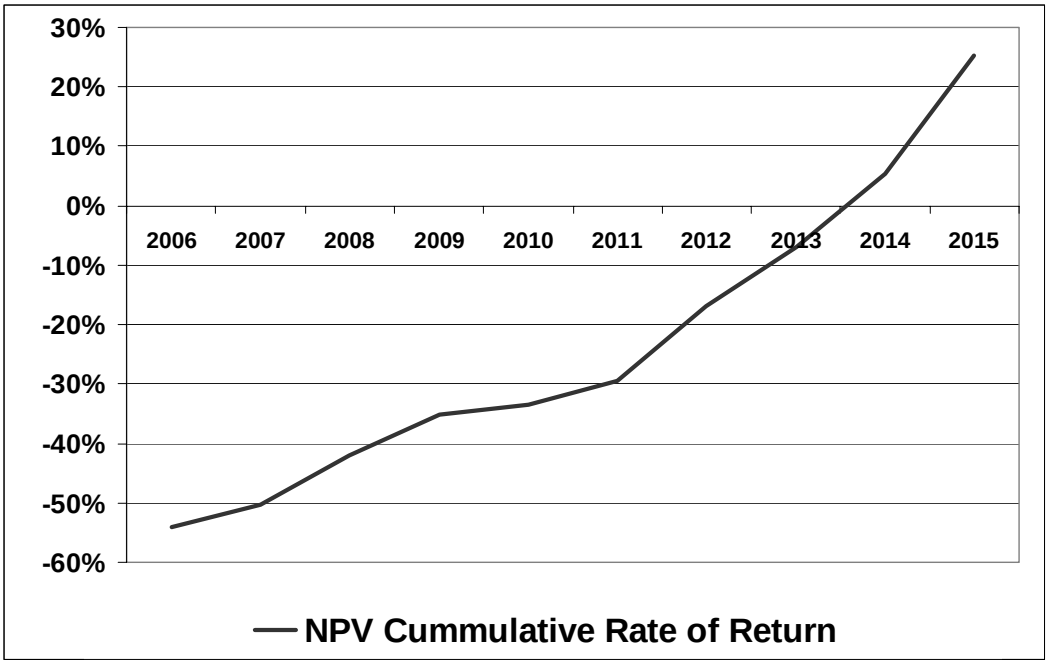


This chart shows the total employment trend resulting from the scenario. Notice how the scenario is non-linear and accelerates through the simulation period.

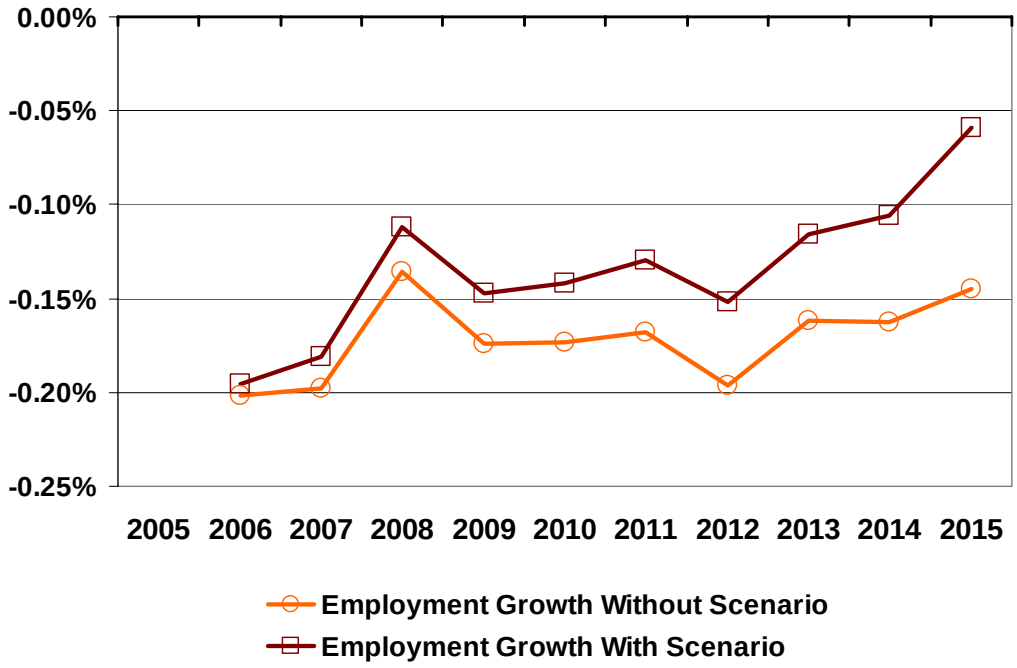


While the net present value results of this scenario is expected at $15.6 million for the Northern Ontario economy as a whole, the positive results do not occur until 2014.

This chart shows the change in real GDP for Northern Ontario each year, and does not include a compounding for previous years. That is, a change in a particular year is in addition to the changes in previous years. This chart shows how the scenario generates strong real GDP growth from 2009 onwards. While the net present value results of this scenario is expected at $15.6 million for the Northern Ontario economy as a whole, the positive results do not occur until 2014. This reflects the risk associated with this scenario which, if managed appropriately, is expected to result in commensurate rewards.



This chart shows the net rate of return for the Northern Ontario economy adjusted for time value for each year taking into account all previous years. With the large reward potential from a relatively lower investment base, there is risk.



This scenario progressively adds employment potential to the economy as time passes.

This chart shows the base case projected employment growth and the employment growth that is expected to be exhibited with the success of the scenario. This scenario progressively adds employment potential to the economy as time passes.

This scenario assumes the implementation of the medical school scenario and the results show the incremental results (in addition to) over and above the medical school results.

Dispersed Networked Health Research

This scenario assumes the implementation of the medical school scenario and the results show the incremental results (in addition to) over and above the medical school results.

The capital assumptions, wage expenditure assumptions, gauge expected employment results, real economic growth gauge expected results and net present value from investment for the Northern Ontario economy are tabulated below:

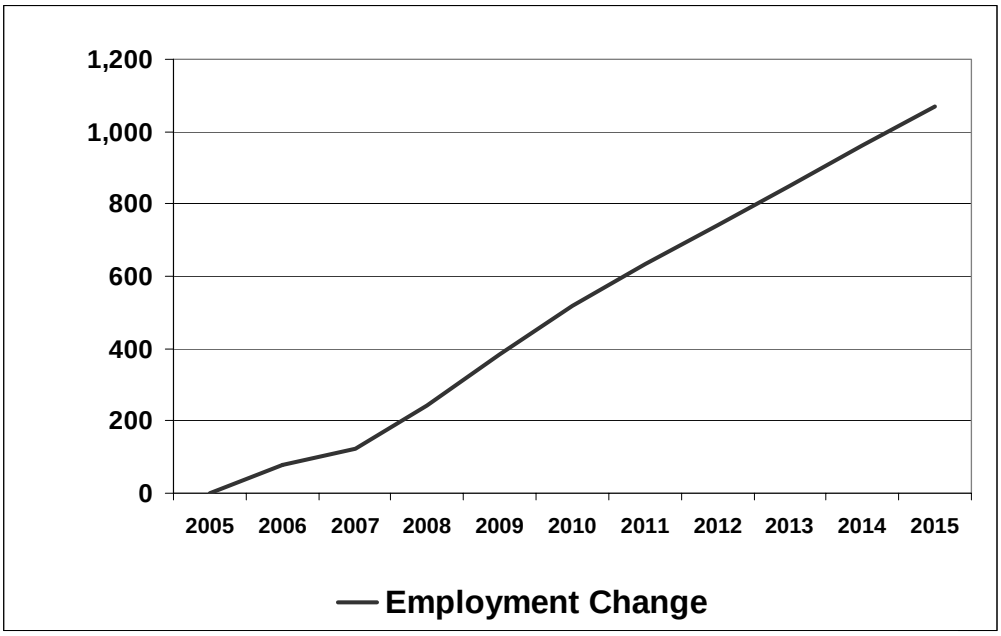
Results of Economic Analysis **Northern Ontario**
Scenario: Dispersed Networked Health Research

	Total Capital Investment	Percentage Feeding Through to Direct Wages	Northern Ontario Total Employment	Northern Ontario Real Economic Growth	Northern Ontario Economic NPV After Investment	Northern Ontario Cummulative Rate of Economic Return
2005	$0	0%	0	0.000%	$0	
2006	$6,900,000	50%	77	0.021%	-$247,070	-4%
2007	$14,400,000	55%	123	0.013%	-$9,819,279	-50%
2008	$15,950,000	64%	244	0.034%	-$13,939,964	-42%
2009	$21,850,000	54%	386	0.040%	-$20,778,664	-42%
2010	$11,850,000	100%	518	0.037%	-$19,391,705	-34%
2011	$6,345,961	100%	634	0.033%	-$14,943,180	-26%
2012	$5,747,806	100%	741	0.030%	-$10,885,729	-18%
2013	$4,667,390	100%	849	0.031%	-$6,352,419	-11%
2014	$3,568,143	100%	962	0.032%	-$1,133,431	-2%
2015	$2,145,287	100%	1,071	0.031%	$4,334,655	8%

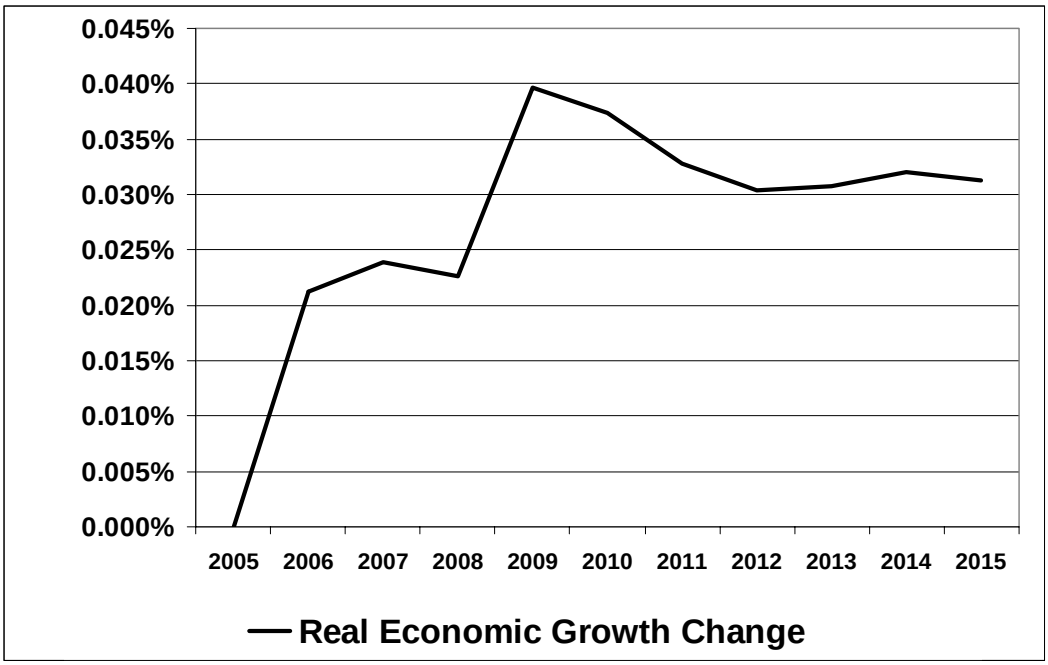
Total Net Present Value	**$4,334,655**
PV Economic Costs	**-$56,529,213**
PV Economic Gains	**$60,863,868**

This scenario shows a strong ability to generate long term returns for less capital investment, but it takes a significant amount of time for the scenario to pay back in net present value terms.

This scenario shows a strong ability to generate long term returns for less capital investment. This flip side is the risk associated with the scenario as it takes a significant amount of time for the scenario to pay back in net present value terms.



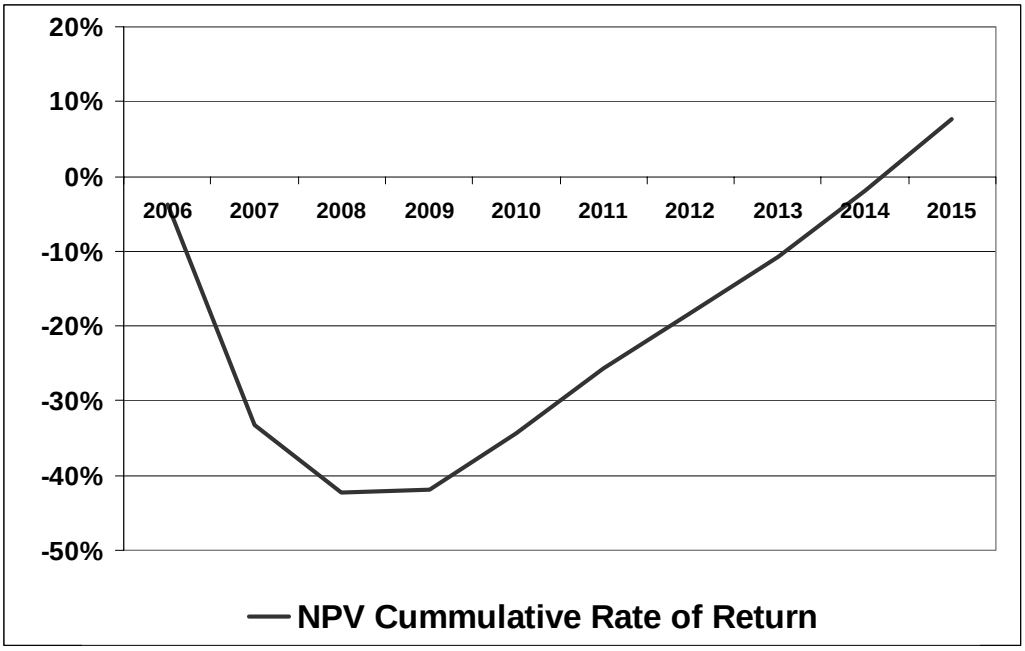
This chart shows the total employment trend resulting from the scenario. The employment results are robust.

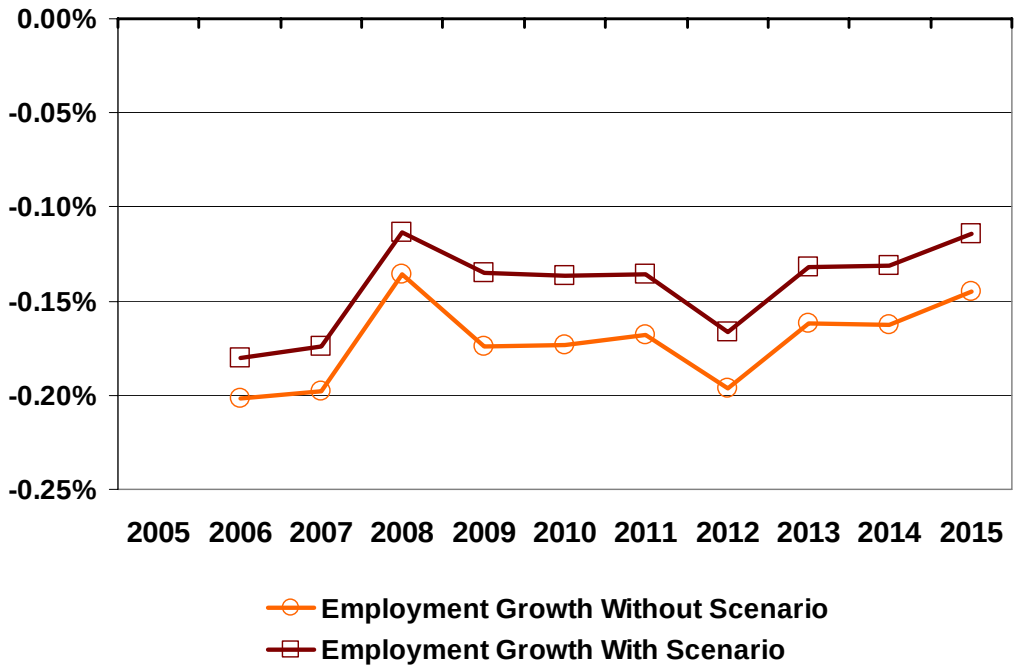


The scenario consolidates its gains by 2010 from which the scenario begins to build value recovery from capital invested in previous years.

This chart shows the change in real GDP for Northern Ontario each year, and does not include a compounding for pervious years. That is a change in a particular year is in addition to the changes in previous years.

The scenario consolidates its gains by 2010 from which the scenario begins to build value recovery from capital invested in previous years. Note that this scenario has a deep and prolonged risk period that caps at 2009.


20%
10%
0%
-10%
-20%
-30%
-40%
-50%
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
NPV Cummulative Rate of Return


0.00%
-0.05%
-0.10%
-0.15%
-0.20%
-0.25%
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Employment Growth Without Scenario
Employment Growth With Scenario

This scenario assumes the implementation of the medical school scenario and the results show the incremental results (in addition to) over and above the medical school results.

Leveraging Current Assets

This scenario assumes the implementation of the medical school scenario and the results show the incremental results (in addition to) over and above the medical school results.

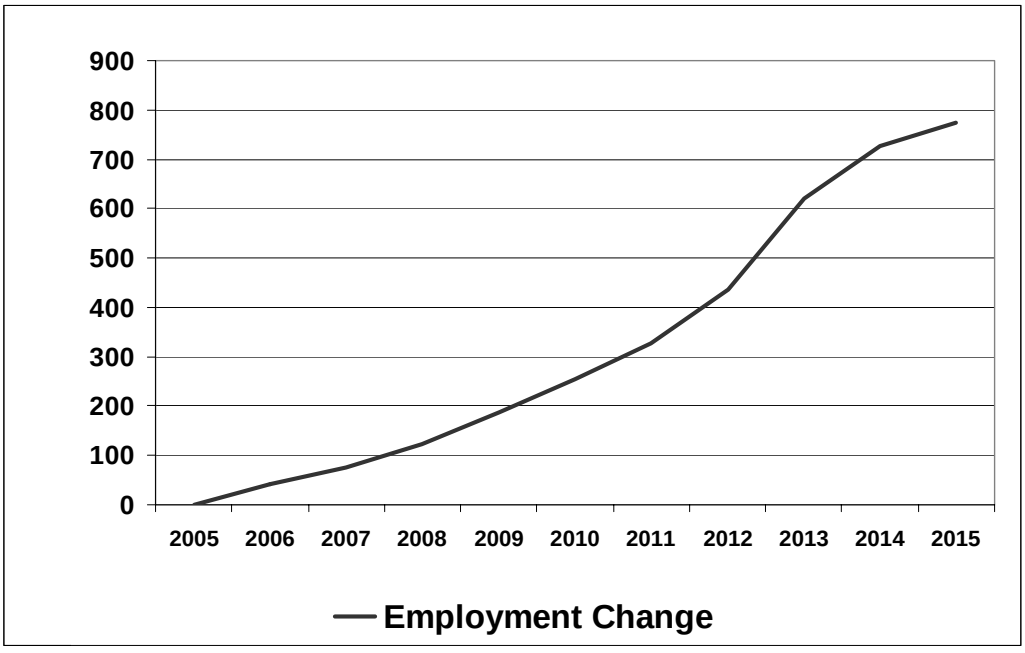
The capital assumptions, wage expenditure assumptions, gauge expected employment results, real economic growth gauge expected results and net present value from investment for the Northern Ontario economy are tabulated below:

Results of Economic Analysis **Northern Ontario**
Scenario: Leveraging Current Assets

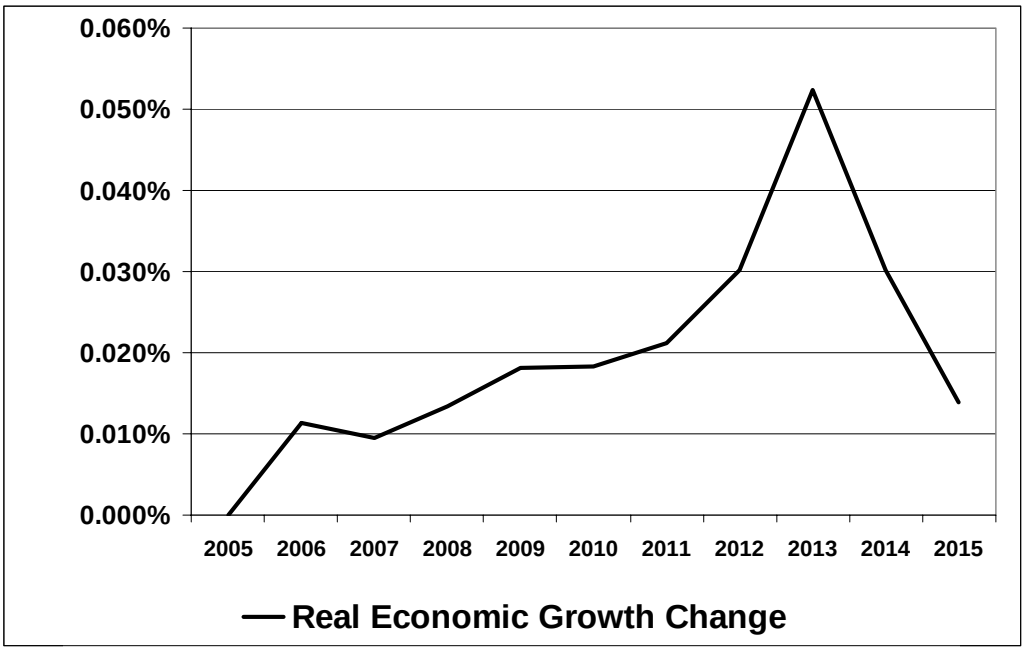
	Total Capital Investment	Percentage Feeding Through to Direct Wages	Northern Ontario Total Employment	Northern Ontario Real Economic Growth	Northern Ontario Economic NPV After Investment	Northern Ontario Cummulative Rate of Economic Return
2005	$0	0%	0	0.000%	$0	
2006	$3,714,452	48%	41	0.011%	-$133,005	-4%
2007	$5,420,681	31%	75	0.009%	-$2,389,388	-28%
2008	$10,559,448	16%	123	0.013%	-$7,800,125	-45%
2009	$4,976,254	41%	188	0.018%	-$6,624,105	-32%
2010	$3,123,328	62%	253	0.018%	-$3,989,158	-18%
2011	$2,118,838	62%	328	0.021%	-$121,850	-1%
2012	$1,773,217	62%	435	0.030%	$5,805,060	26%
2013	$1,383,935	62%	621	0.052%	$16,352,647	73%
2014	$778,035	62%	727	0.030%	$21,637,322	100%
2015	$503,445	62%	775	0.014%	$23,252,243	112%

Total Net Present Value	**$23,252,243**
PV Economic Costs	**-$20,785,436**
PV Economic Gains	**$44,037,679**

This scenario shows a strong ability to generate long term returns for less capital investment. This flip side is the risk associated with the scenario as it takes a significant amount of time for the scenario to pay back in net present value terms.

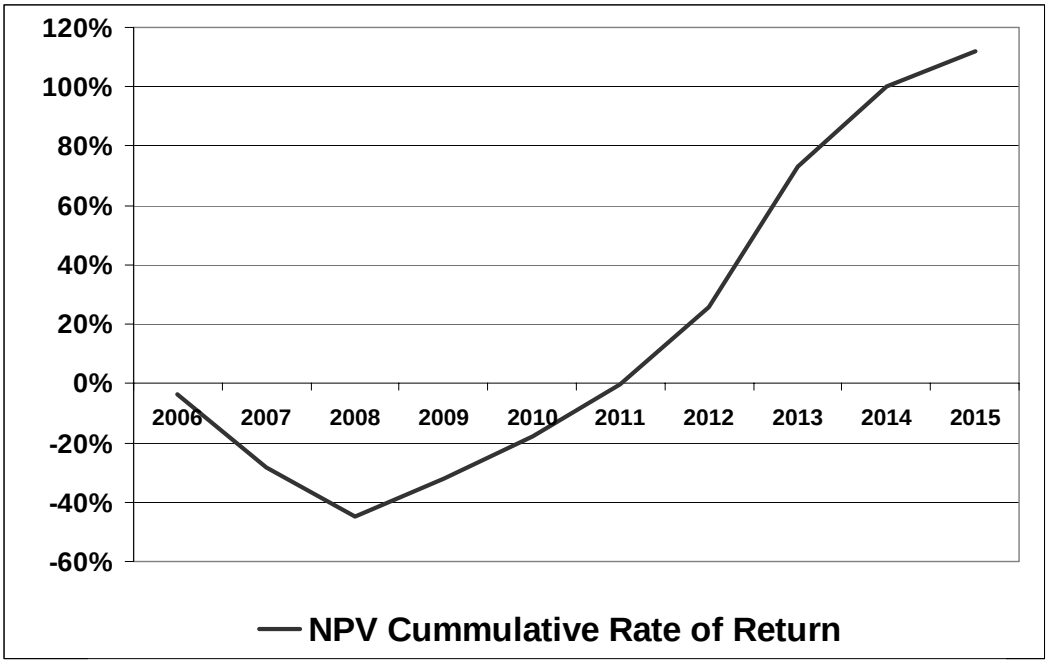


This chart shows the total employment trend resulting from the scenario. The scenario consolidates its gains by 2010 from which the scenario begins to build value recovery from capital invested in previous years.



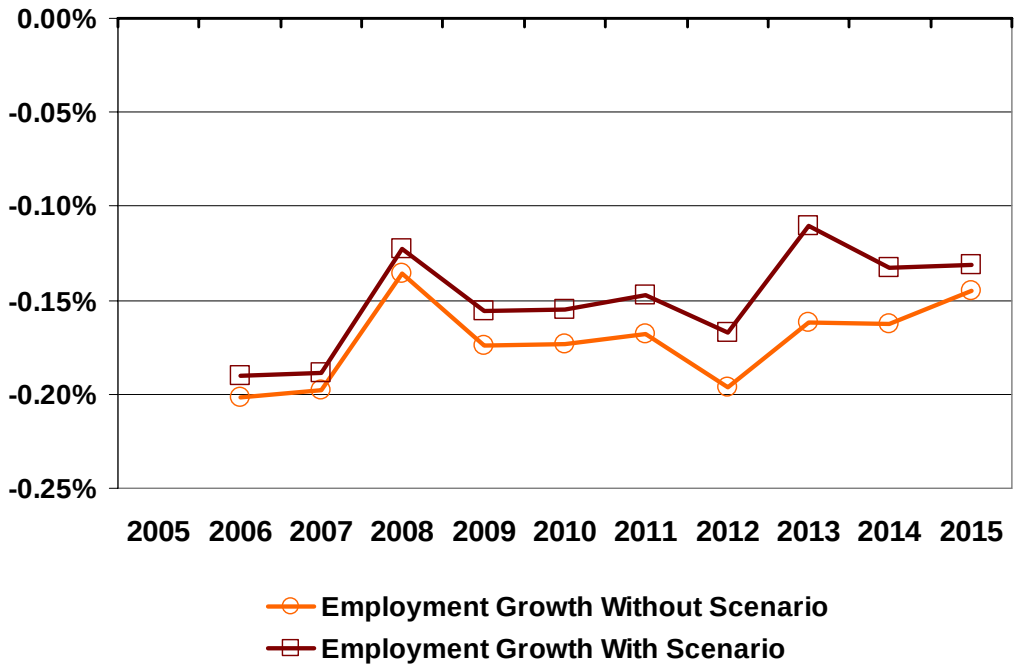
The employment results are slow moving with an employment reversal occurring by 2013.

This chart shows the change in real GDP for Northern Ontario each year, and does not include a compounding for pervious years. That is a change in a particular year is in addition to the changes in previous years. The employment results are slow moving with an employment reversal occurring by 2013. This indicates that the scenario will have to be refreshed by this time.



The scenario shows a relatively deep risk profile in 2008 which indicates that the capital investment for this scenario will have to be well placed and managed.

This chart shows the net rate of return for the Northern Ontario economy adjusted for time value for each year taking into account all previous years. The scenario shows a relatively deep risk profile in 2008 which indicates that the capital investment for this scenario will have to be well placed and managed.



Niche Strategy

This scenario assumes the implementation of the medical school scenario and the results show the incremental results (in addition to) over and above the medical school results.

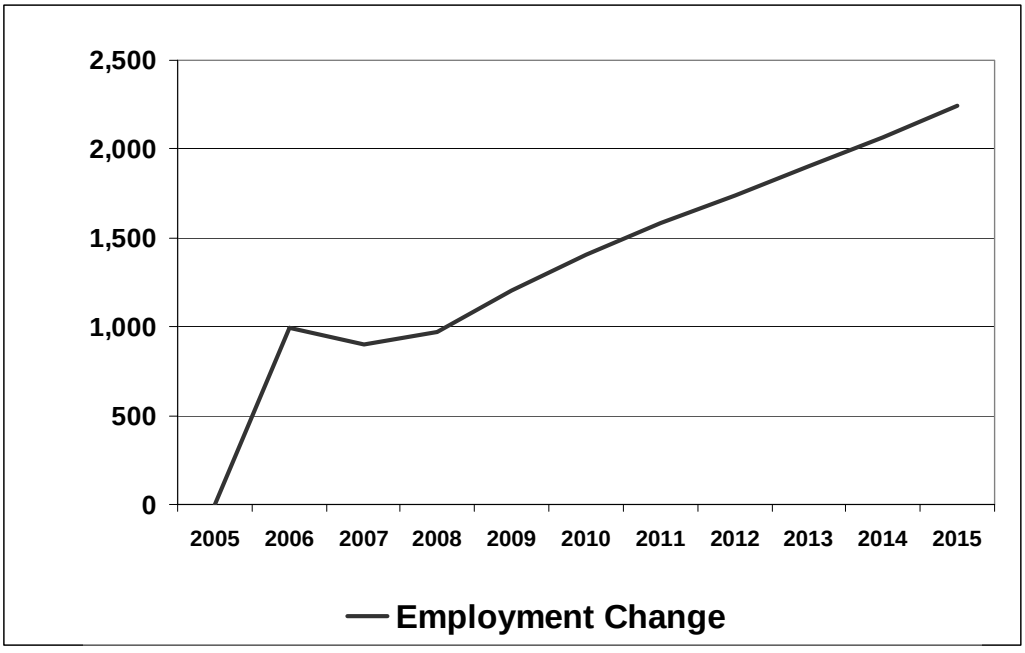
The capital assumptions, wage expenditure assumptions, gauge expected employment results, real economic growth gauge expected results and net present value from investment for the Northern Ontario economy are tabulated below:

Results of Economic Analysis **Northern Ontario**
Scenario: Niche Strategy

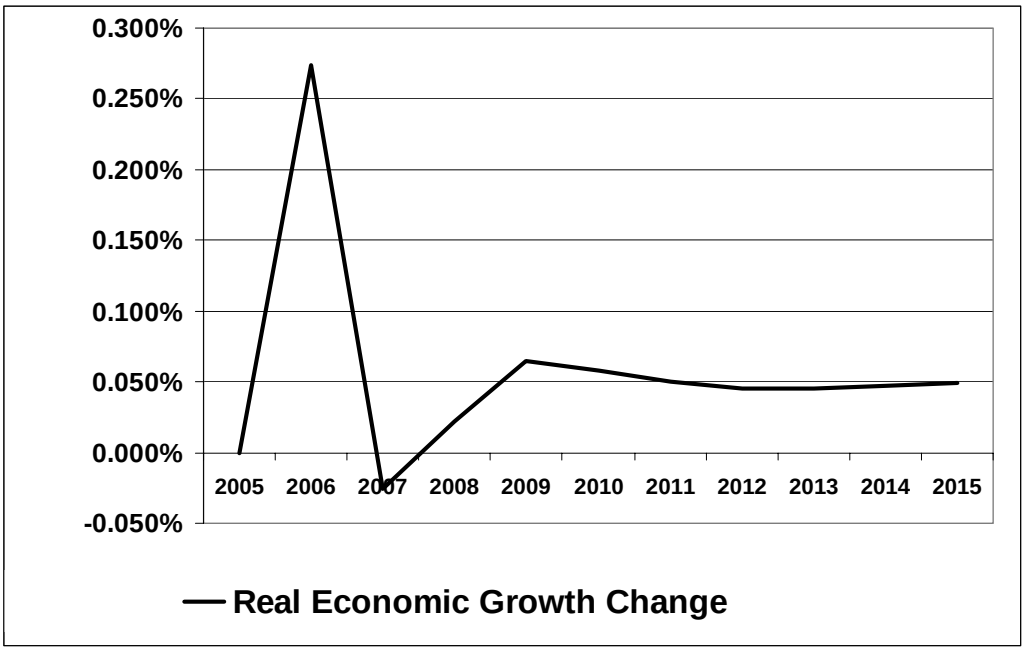
	Total Capital Investment	Percentage Feeding Through to Direct Wages	Northern Ontario Total Employment	Northern Ontario Real Economic Growth	Northern Ontario Economic NPV After Investment	Northern Ontario Cummulative Rate of Economic Return
2005	$0	0%	0	0.000%	$0	
2006	$69,433,549	80%	995	0.274%	$16,047,724	24%
2007	$6,374,534	80%	899	-0.026%	$2,381,971	3%
2008	$11,954,092	60%	973	0.022%	-$1,735,025	-2%
2009	$9,238,615	50%	1,204	0.065%	$8,617,430	11%
2010	$13,129,913	40%	1,409	0.058%	$13,129,908	15%
2011	$8,047,203	40%	1,585	0.050%	$19,233,321	22%
2012	$3,412,528	40%	1,743	0.045%	$27,045,194	31%
2013	$2,886,279	40%	1,900	0.045%	$34,364,947	41%
2014	$2,137,270	40%	2,067	0.048%	$42,087,162	52%
2015	$1,595,796	40%	2,240	0.049%	$49,692,006	64%
				Total Net Present Value	**$49,692,006**	
				PV Economic Costs	**-$77,576,987**	
				PV Economic Gains	**$127,268,994**	

This scenario shows the highest ability to generate long term returns for less capital investment, but it also has the highest risk associated with it as it will either succeed of fail quickly as indicated by the volatility of economic returns in the initial phases of the project.

This scenario shows the highest ability to generate long term returns for less capital investment. This flip side is that this scenario has the highest risk associated with it as it will either succeed of fail quickly as indicated by the volatility of economic returns in the initial phases of the project.

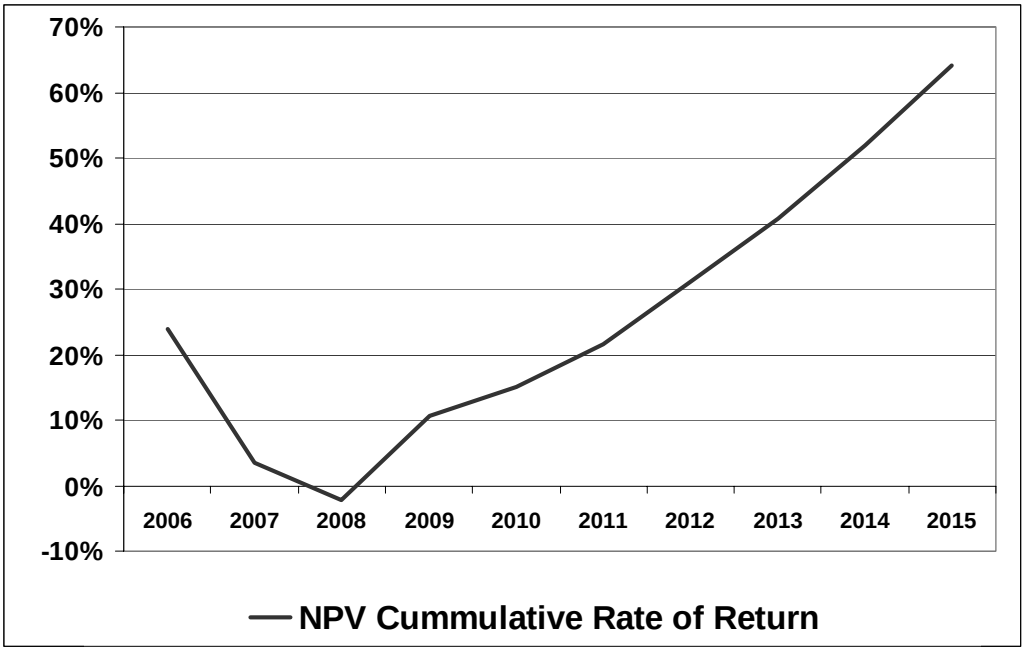


This chart shows the total employment trend resulting from the scenario. The strong increase in employment is reflective of the reward for risk exhibited by this scenario.



The net present value result of this scenario is expected at $49.7 million for the Northern Ontario economy as a whole, and is highly dependent upon how the project performs over the 2006 to 2011 period.

This chart shows the change in real GDP for Northern Ontario each year, and does not include a compounding for pervious years. That is a change in a particular year is in addition to the changes in previous years. This chart shows how the scenario generates strong real GDP growth initially with consolidation from 2009 onwards. The net present value result of this scenario is expected at $49.7 million for the Northern Ontario economy as a whole, and is highly dependent upon how the project performs over the 2006 to 2011 period. This reflects the risk associated with this scenario which, if managed appropriately is expected to result in commensurate rewards. This is a “succeed or fail quickly” scenario.



This chart shows the net rate of return for the Northern Ontario economy adjusted for time value for each year taking into account all previous years. With the large reward potential from a relatively lower investment base, there is risk.