Economic Impact of Flow-Through Shares in Biotechnology Industry

September 14, 2010

PricewaterhouseCoopers

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Economic impact results estimated in this report are based on the methodology employed and data input assumptions. The flow-through share program was introduced in the mining and petroleum industries and it is assumed that experience in these industries proxies for what may occur in the biotechnology sector. Economic impacts estimated in this study are solely related to the employment and spending impacts associated with increased R&D spending. Spin-offs, productivity benefits and other economic and social benefits associated with increased R&D spending are not quantitatively addressed. For the purposes of this analysis, we further assume a fully operational flow-through share program.

Table of Contents

Executive Summary

Background

The biotechnology (biotech) sector, as one of Canada's leading knowledge-based sectors, has the potential to be an important driver of the Canadian economy. A key challenge now facing the biotech industry is the need to commercialize the research currently flowing from the industry.

Research on the federal government's flow-through shares program in the mining and petroleum sectors has shown it to be an effective means of providing needed risk capital to junior mining and petroleum companies. BIOTECanada recommends the extension of the applicability of flow-through shares to Canada's biotech sector.

Objective of Study

The objective of this study is to provide, where possible, quantitative estimates of the incremental R&D and the resultant incremental economic and fiscal impacts, expected to flow from the extension of the applicability of flow-through shares to Canada's biotech sector.

In terms of the economic and financial modeling and quantification, this study estimates the economic and fiscal impacts from the incremental "operational" expenditures on R&D resulting from the application of flow-through shares to Canada's biotech industry. This is a major, but certainly not exclusive, source of economic benefits from the program. To be specific, this study estimates at a high level the direct, indirect and induced economic impacts of the increase in expenditures on R&D due to the extension of the flow-through share program to the biotech sector.

Results

The following table shows the gross output, value added (GDP), wages and salaries, employment and government tax revenue (income taxes and direct and indirect taxes on production and consumption) associated with a 69.5% increase in junior biotech R&D expenditures. This value was taken from the experience of the mining and petroleum industries and it is assumed that these industries represent good proxies for the biotech sector resulting from similarities in their risk profiles.

	Direct	Indirect	Induced	Total Impact
Gross Output, (Millions)	$411.4	$366.9	$189.0	$967.3
Value Added (GDP), (Millions)	$246.1	$158.4	$153.6	$558.0
Wages and Salaries, (Millions)	$201.8	$69.1	$65.8	$336.8
Employment , (Full-Tme Equivalent)	4,420	1,442	2,082	7,945
Government Taxes, (Millions)	$44.9	$13.1	$22.8	$80.8

1 Introduction

The biotechnology (biotech) sector, as one of Canada's leading knowledge-based sectors, has the potential to be an important driver of the Canadian economy. A key challenge now facing the biotech industry is the need to commercialize the research now flowing from the industry. Commercialization requires capital, specifically risk capital, which is currently, and is expected to continue to be, inadequate.

Research on the federal government's flow-through shares program in the mining and petroleum sectors has shown it to be an effective means of providing needed risk capital to junior mining and petroleum companies. BIOTECanada recommends the extension of the applicability of flow-through shares to Canada's biotech sector. In this context, the objective of this study is to provide, where possible, quantitative estimates of the incremental R&D and the resultant incremental economic and fiscal impacts, expected to flow from the extension of the applicability of flow-through shares to Canada's biotech sector.

1.1 Background

It is well recognized that Canada's future competitiveness must depend upon leadership in knowledge-based industries. Knowledge-based industries provide Canadians with the best opportunity to profit from our relatively high level of education and to earn a higher level of income in a sustainable, environmentally friendly economy. The aging of the population will bring rapidly increasing demands for drugs, diagnostic equipment and therapies. Biotech companies also provide products to help protect our environment and enhance our food supply. Other developed countries continue to competitively position their biotech sectors through regulatory, tax, intellectual property, education and other policies. If Canada wants to be a leader in this potentially robust and critical area of the international economy, Canada should have a policy environment focused on maximizing the commercial returns on its bio-based economy.

The bio-based economy accounts for over 6% of Canada's GDP.[1] Many of Canada's biotech companies are emerging companies, with fewer than 100 full-time employees, and many currently have no products for sale. They are located all across Canada, but mostly in Ontario and Quebec with relatively large sectors in British Columbia and Alberta.[2] Most of Canada's biotech companies are in the health, medical and pharmaceutical area, but many are developing agriculture, food and chemical products. These junior biotech companies require a significant amount of time and capital to reach profitability.

The inability to raise funds to finance the costs of commercializing research is seen as the major challenge for biotech companies, which is one reason why the level of investment in biotech companies has fallen in recent years. To provide the risk capital required for Canada's biotech sector, most industry stakeholders are looking to government to create incentives for risk capital and to create more favourable tax incentives. To achieve sustainable capital formation for the industry, expansion of the federal government's flow-through shares program to the biotech sector appears to be an attractive approach from an economic growth as well as fiscal perspective.

Flow-through shares allow investors to purchase company shares whereby they would receive both an equity share in the company and the right to income tax deductions associated with new qualifying expenditures. This benefit to investors reduces the risk associated with share purchase thereby providing companies with a less costly means of raising equity-based financing for those qualifying expenditures.

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[1] Pelliam, William and Taylor, Wayne, Measuring the Biobased economy: A Canadian perspective, Industrial Biotechnology, Winter 2008, Volume 4, Number 4.

[2] Statistics Canada, Lonmo, Charlene and McNiven, Chuck, Selected Results of Biotechnology Use and Development Survey, Science, Innovation and Electronic Information Division, 2005, Catalogue no. 88F0006XIE — No. 006.

Currently, flow-through shares support exploration and development in the petroleum and mining industries. They were officially put in place in the 1954 taxation year in response to the 1947 introduction of full income tax deductibility for qualifying expenditures on exploration and development. Flow-through shares have been used to generate equity-based financing primarily by junior mining companies which are unable to utilize income tax deductions for exploration and development and who have limited access to traditional sources of capital.

Evaluations undertaken on the ability of flow-through shares to support junior mining and petroleum companies have found that the issuing of flow-through shares has resulted in incremental increases in spending on mining and development over and above the government expenditure required. In addition, flow-through shares have been found to be "generally relevant, effective and cost-efficient in meeting the federal government's policy objectives of encouraging exploration in Canada, stimulating equity-based investments in mining and petroleum companies, and assisting junior exploration companies".[3]

In the same way that flow-through shares were successful in encouraging exploration and development in the mining and petroleum sectors, expanding flow-through shares to the biotech sector is seen to be an effective means to encourage spending in areas which are deemed qualifying expenditures, which in this case are expenditures on scientific research and experimental development.

Economic Benefits

Expanding flow-through shares to the biotech sector would result in a number of economic benefits. The most significant are outlined below.

(1) ***More research and development (R&D) would be undertaken than would otherwise be undertaken.*** As demonstrated in the mining and petroleum industries, the extension of the flow-through shares program to the biotech sector is expected to result in an incremental increase in R&D activity in the sector.

(2) ***R&D spending, such as spending on products and services, would give rise to an increase in the demand for those products in other industries, resulting in benefits over and above direct spending on R&D.*** Extension of the flow-through shares program to biotech is expected to result in incremental research and in incremental commercialization of that research. Economic benefits expected to result from incremental R&D and the commercialization of that R&D, results from the new products created out of that R&D.

(3) ***Positive externalities which result from successful R&D, where the private sector is unable to fully capture the full benefit of the success, would translate into positive benefits for the public over and above the government spending required.*** One potential benefit of these new products may be the improved health of Canadians. While which or how many R&D initiatives will lead to successful new products is almost impossible to estimate, history has shown a generally positive relationship between increased research input and increased output of successful new patents and inventions. Successful new products directly generate their own stream of new jobs, wealth and incomes within their companies. Furthermore, these new drugs, vaccines, medical tools, environmentally friendly products and/or enhancements to crops work to, for example, improve the health of Canadians.

(4) ***Financial returns on investments to investors investing in flow-through shares.*** Some economic benefits can also be expected to arise directly from the investors who buy the flow-through shares. By definition, these investors expect to make a greater return from their purchase of these flow-through shares relative to other similar investments that do not benefit from flow-through share

[3] Finance Canada, Flow-Through Shares: An Evaluation Report, October 1994.

tax advantages. The sale of the flow-through shares depends upon this expectation and the hope that early results will re-enforce this expected return. Fundamentally, the extension of the flow-through shares program is putting a new attractive investment into the marketplace. Increased returns to investors provide them with incremental income, which sets off a stream of direct and indirect economic impacts as these investors spend their incremental income.

Economic Costs

While the expansion of flow-through shares to the biotech sector would result in economic benefits, it would also result in some government costs and potential negative impacts on other areas of the economy. These are outlined below.

(1) ***Administrative costs to government.*** Any government program or intervention which requires administration by the government will have an administrative cost associated with it. The magnitude of this cost will depend on the amount of government oversight required and the familiarity of the government with administering the program in the past. Since the flow-through share program has been administered by the government in the past in both the mining and petroleum sectors this will confer some administrative efficiencies if the flow-through share program is applied to the biotech sector.

(2) ***Tax expenditures associated with allowing tax losses to be claimed earlier than they otherwise would be claimed without the availability of flow-through shares, and in the case of an unsuccessful company, allowing for the claiming of tax losses where this claim would have otherwise not been made.*** This is the main government cost as it would be a direct decrease in the amount of taxes collected, due to the increase in the number of losses being claimed. There would also be a loss of potential returns on capital in the short run, due to the time value of money loss of tax claims being made before they would otherwise have been made.

(3) ***There are finite resources available in the economy and therefore allocating government funds to support the biotech sector would result in an opportunity cost of what is deemed the next most productive and beneficial activity.*** There are three fundamental alternative uses of the funds used for the flow-through share program; namely, the government could simply reduce income tax rates; the funds could be used for an alternative focussed tax cut (for example, a focussed investment tax credit or a specific reduction in the corporate income tax.); or, the government could incur the fiscal cost at issue by enhancing some social program (for example, increase EI benefits).

(4) ***Other industries, specifically petroleum and mining industries, may realize a reduction in the uptake of flow-through shares issued as investors may reallocate some of their investment in flow-through share from the mining and petroleum sectors to the biotech sector.*** This cost is based on the premise that there is some substitutability or competition between the existing and the new flow-through shares in the eyes of investors.

For the purposes of this study, we have not attempted to estimate the economic costs of expanding the flow-through share program to the biotech sector.

1.2 Objective of Study

Recognizing the importance to the Canadian economy of a strong and competitive biotech sector and specifically the challenge of making risk capital more readily available, the objective of this study is to quantitatively estimate, where possible, the economic and fiscal impacts of extending the flow-through shares program to the biotech sector.

In the context of the list of benefits and costs listed above, in terms of the economic and financial modeling and quantification, this study estimates the economic and fiscal impacts from the incremental "operational" expenditures on R&D (one aspect of benefit 1). This would be a major, but certainly not exclusive, source of economic benefits from the program. This source is the most certain, easiest to

understand and easiest to estimate. To be specific, we will measure the direct economic impacts of the increase in expenditures on R&D. These expenditures, analytically, will be treated similarly to increased expenditures on other forms of investment. These R&D expenditures are allocated primarily to increased wages, but also to increased expenditure on equipment and building construction.

The second benefit that this study will estimate is the indirect economic benefits associated with the incremental "operational" expenditures on R&D (benefit 2 above). These indirect benefits take the form of increased economic growth, measured as real GDP, incremental job creation, incremental productivity which would result in incremental wages per job. An example of an indirect economic impact would be the new jobs and incremental income generated within the equipment supply companies serving the expansion of the biotech sector. This study also estimates the incremental revenue which would result to federal and provincial governments from this incremental economic activity.

Our methodology for modeling and quantifying the incremental R&D and the resultant incremental economic and fiscal impacts expected to flow from the extension of the applicability of flow-through shares to Canada's biotech sector, is summarized in the following section.

1.3 Limitations

PwC has relied upon the completeness, accuracy and fair presentation of all the information, data, advice, opinions or representations obtained from various sources which we did not audit or otherwise verify. These sources (collectively, the "Information"), include:

- Data provided by BIOTECanada
- Statistics Canada;
- Academic literature,
- Other various public sources.

The findings in the Report are conditional upon such completeness, accuracy and fair presentation of the Information. PwC has not verified independently the completeness, accuracy and fair presentation of the Information. We are providing no opinion, attestation or other form of assurance with respect to our work and we did not verify or audit any information provided to us.

Economic impact results estimated in this report are based on the methodology employed and data input assumptions. The flow-through share program was introduced in the mining and petroleum industries and it is assumed that experience in these industries proxies for what may occur in the biotech sector. Economic impacts estimated in this study are solely related to the employment and GDP impacts associated with increased R&D spending. Spin-offs, productivity benefits and other economic and social benefits associated with increased R&D spending are not quantitatively addressed. For the purposes of this analysis, we further assume a fully operational flow-through share program.

PwC reserves the right at its discretion to withdraw or make revisions to the Report should PwC be made aware of facts existing at the date of the Report that were not known to PwC when it prepared the Report. The findings are as of the date hereof and PwC is under no obligation to advise any person of any change or matter brought to its attention after such date, which would affect the findings and PwC reserves the right to change or withdraw the Report.

2 Methodology

Flow-through shares issued to raise capital in the mining and petroleum sectors and the SR&ED tax credit are the most comparable government programs to offering flow-through shares in the biotech sector for qualifying research and development expenditure. As such, the literature review has focused on assessments of evaluations of these two government programs in order to gauge their incremental impact on R&D spending.

This section briefly reviews the literature on the SR&ED tax credit and flow-through shares in the petroleum and mining sectors and summarizes these two comparable government tax incentive programs. It then benchmarks empirical work which has estimated the incremental increase in spending on R&D (direct benefits) associated with these types of government incentives. Finally, this section describes the approach taken to estimate the direct and indirect economic impacts which will be observed in the biotech sector as well as other sectors of the economy.

2.1 Empirical Benchmarks of Incremental Impacts

The ***Federal Scientific Research and Experimental Development Tax Credit (SR&ED)*** allows for a federal tax credit of 20% to 35% on a broad range of eligible expenses. Industries primarily utilizing SR&ED are information technology (35% of claims), manufacturing and processing (25% of claims) and materials (12% of claims). Of the corporations claiming SR&ED in 1992, 94% were Canadian owned. There is also empirical evidence that SR&ED tax incentives played a role in the decision making process of firms, meaning that a higher level of R&D spending takes place than would otherwise occurred without the SR&ED tax incentive.[4]

Various studies have estimated the incremental increase in R&D spending due to the SR&ED tax credit being in place, as a multiplier of government expenditures, through interviews, surveys and econometric analysis, and demand and economic impact models. Two studies have estimated an incremental government multiplier which can be used to contrast this study's estimate with the past studies on the economic impact of a similar tax credit. The first, estimated jointly by Finance Canada and CRA (1997), stated that a $1 tax incentive would generate $1.38 in R&D spending. The second estimate, by Klassen, Pitman and Reed (2004), estimated a $1 tax incentive would result in $1.30 of R&D spending.

The ***Flow-Through Share Program***, in the mining and petroleum sectors, allows investors to purchase company shares whereby they would have received both an equity share in the company and the right to income tax deductions associated with new expenditures on exploration and development. Overall, flow-through shares provide companies with a less costly means of raising equity-based financing for exploration and development. Companies primarily using flow-through shares were found to be mining companies (accounted for 75% of flow-through shares between 1987 and 1991) where the trend was that the bulk of the renunciations were made by a disproportionately small number of issuing companies. The number of investor claimants were spread across all income ranges however, 38% and 47% of claim value came from investors with over $250K of income in 1989 and 1990 respectively.[5]

There are two types of incrementality associated with flow-through shares:

(1) Scope incrementality arises when shares result in new or larger projects taking place than would otherwise occur. This results in either the entire project being incremental or the addition which was made due to flow-through share capital raised.

[4] Finance Canada, The Federal System of Income Tax Incentives for Scientific Research and Experimental Development: Evaluation Report, December 1997.

[5] Finance Canada, Flow-Through Shares: An Evaluation Report, October 1994.

(2) Time incrementality would be associated with projects that are undertaken earlier than had previously been planned, where the incremental impact in this case is equal to the time value of money.

Various studies have estimated the incremental government spending multiplier associated with flow-through shares in the mining and petroleum sector both in terms of scope and time incrementally. The Department of Finance's 1994 evaluation of flow-through shares estimated that $1 of federal tax expenditures resulted in, on average, exploration and development expenditures of $2.6 in the case of the mining industry and $1.8 in the case of petroleum industry.[6] These multipliers are comparable to those estimated for the SR&ED tax incentive program.

In addition to estimating incremental government spending multipliers, estimating incremental spending by companies if flow-through shares are issued in the biotech sector is essential to estimating the increase in qualifying R&D expenditure. Past evaluations of flow-through shares have estimated incremental company spending associated with flow-through shares which can be used to estimate an incremental industry spending multiplier, i.e. a multiplier that would enable one to estimate the new level of R&D spending under the flow- through share program given the current level of R&D spending in the absence of the flow-through share program. In other words, this approach seeks to estimate new spending as a function of baseline spending not associated with flow-through shares.

The most cited work reviewed was that by Peat Marwick, Stevenson & Kellogg (1993) which estimated that 49% and 30% of all mining and petroleum industry spending was incremental during the 1987 and 1991 period. Using these estimates one can estimate an industry spending multiplier of 1.96 and 1.43 respectively.[7]

2.2 Data Inputs and Methodology

This section describes the three key data inputs to the economic impact model. These are: baseline biotech qualifying R&D expenditures; the percent of baseline biotech expenditures attributable to junior biotech companies and the percent increase in junior biotech qualifying R&D expenditures due to flow-through shares (industry spending multiplier).

(1) Baseline biotech qualifying R&D expenditures is an important data input to the economic impact model as it establishes total spending associated with biotech R&D. In order to estimate this baseline, Statistics Canada's Industrial Research and Development Intentions (2009) estimated total amount of R&D expenditure of $16.146 billion is used.[8] Statistics Canada also established that the biotech sector accounted for approximately 11% of total R&D expenditure in 2005 which is used as a second input.[9] Multiplying total estimated R&D expenditure by the share of R&D expenditure taking place in the biotech sector, it is estimated that $1.8 billion of R&D expenditure takes place in the biotech sector. This is a slight increase to Statistics Canada's 2005 estimate of $1.7 billion.[10]

(2) The percent of baseline biotech expenditure attributable to junior biotech companies is estimated using comparable data from Statistics Canada's *Selected Results of the Biotechnology Use and Development Survey* (2005). In this report, Statistics Canada breaks down biotech companies into three groups: large companies with more than 150 employees, medium companies with between

[6] The highest marginal investor tax rate was used to estimate the value of the investor tax credit. This assumption will tend to overstate estimated federal tax expenditures.

[7] Dividing 100% by the percent of spending that is not incremental yields the company spending multiplier. For example, 100% divided by 51% (non incremental spending in the mining industry) yields the cited 1.96 company spending multiplier.

[8] Statistics Canada, Industrial Research and Development: Intentions 2009, Business Special Surveys and Technology Statistics Division, 2010, Catalogue no. 88-202-X.

[9] Science Statistics, November 2007, Statistics Canada, Catalogue No.88-0001-X, vol.31, no.6, Table 1-1, p.9

[10] Statistics Canada, Lonmo, Charlene and McNiven, Chuck, Selected Results of Biotechnology Use and Development Survey, Science, Innovation and Electronic Information Division, 2005, Catalogue no. 88F0006XIE — No. 006.

50 and 150 employees and small companies with less than 50 employees. They find that approximately one third of R&D expenditure is spent by small firms. Hence, if the definition of a small firm was used a proxy for a junior biotech company, 33.3% of biotech R&D spending would be associated with junior biotech companies.

(3) ***The percent increase in junior biotech qualifying R&D expenditures due to the flow-through shares (industry spending multiplier)*** will be taken from Peat Marwick, Stevenson & Kellogg (1993) as it estimated the percentage of R&D spending in the mining and petroleum sectors which was incremental to the flow-through share program. Specifically, and as discussed in Section 3.1, this incremental industry spending multiplier ranged from 1.96 in the mining industry to 1.43 in the petroleum sector. If we assume the biotech industry will act similarly to the mining and petroleum sectors, this represents between a 43% to 96% increase in biotech R&D among junior biotech companies. The median between these two estimates, which is used as a base case in the economic impact model is 69.5%.

These three data inputs will be used to estimate incremental junior biotech qualifying R&D expenditures under a new flow-through share regime in the biotech sector. Sensitivity analysis will look at the uncertainty around the three data inputs above by leveraging the both extremes of the ranges provided by Peat Marwick, Stevenson & Kellogg (1993), i.e. 43% increase and a 96% increase in incremental biotech R&D.

The other main data inputs for the methodology come from Statistics Canada's Input-Output multiplier tables. The Statistics Canada Input-Output W-aggregation table set is used as the source of output, employment, GDP, wages and salaries and government tax revenue multipliers. It is assumed that all incremental spending associated with the flow-through share program in the biotech sector will take place in the Other Professional, Scientific and Technical Services. It is believed that this sector best represents the eligible expenditures in the biotech sector and hence can act as a proxy.

3 Economic Impact Results

3.1 Introduction

Economic impacts resulting from the extension of the flow-through share program in this section are based on the input-output methodology employed, data input assumptions and are subject to the limitations outlined above. Direct, indirect and induced economic impacts flow from increased R&D spending that the flow-through share program facilitates. R&D spending in the biotech sector is primarily comprised of employment wages and salaries, expenditures on capital equipment and other supplies. This initial increase in spending is multiplied throughout the economy as employees hired spend their wages and salaries and as business supplying junior biotech companies purchase goods and services from other industries to satisfy this increased demand.

While R&D spending produces many qualitative benefits for an economy, the measurement of economic impacts is generally viewed as being restricted to quantitative, well-established measures of economic activity. The most commonly used of these measures are gross output, value added (or gross domestic product (GDP)), government tax revenues and employment:

- **Gross Output** – the total gross value of all business revenue. This is the broadest measure of economic activity and indicates the total sales and transactions triggered by operations.
- **Value Added (GDP)** – the "value added" to the economy or the unduplicated total value of goods and services. Includes only final goods to avoid double counting of products sold during an accounting period.
- **Wages and Salaries** – the total value of wages and salaries associated with employment impacts.
- **Employment** – the number of jobs created. It is expressed as the number of equivalent full-time jobs indicated in person years.
- **Government Tax Revenue** – the total amount of tax revenues generated. In this study only federal and provincial personal income taxes and indirect taxes on production and consumption are estimated.

Moreover, it is convention to report the above economic impacts at the direct, indirect and induced levels. These are defined below:

- **Direct impacts** are changes that occur in "front-end" businesses that would initially receive expenditures and operating revenue as a direct consequence of the operations and activities of the University (e.g. the purchase of equipment for R&D purposes from supplying firm by a junior biotech company).
- **Indirect impacts** arise from changes in activity by suppliers of the "front-end" businesses (e.g. purchase of goods and services from business supplying equipment to a junior biotech firm).
- **Induced impacts** arise from shifts in spending on goods and services as a consequence of changes to the wages and salaries of the directly and indirectly affected businesses (e.g. an increase in demand stimulated by junior biotech spending prompts R&D equipment suppliers to hire new workers who then spend their wages on consumer goods).

The total impact of any given initial expenditure – in this case R&D expenditures – is calculated as the sum of direct, indirect and induced impacts.

3.2 Economic Impacts of Increased R&D Spending due to Extension of Flow-Through Share Program to Biotech Sector

This section of the study provides economic impact estimates associated with increased R&D spending in the biotech sector due to the extension of the flow-through share program to the biotech sector. It is envisioned that junior biotech companies would predominately leverage this program. As such, economic impact estimates flow from the increased R&D spending undertaken by these companies. A key input into the model is the assumption regarding the percent increase in junior biotech R&D expenditures. Peat Marwick, Stevenson & Kellogg (1993) estimated that mining and petroleum industries witnessed a 43% to 96% increase in qualifying expenditures. To account for this uncertainty, economic impact estimates for this study are estimated using the following scenarios:

- **Median** – 69.5% increase in incremental R&D expenditures
- **High** – 96% increase in incremental R&D expenditures
- **Low** – 43% increase in incremental R&D expenditures

Expenditures

The table below shows the direct, indirect, induced and total gross output impact associated with increased biotech R&D expenditures due to the extension of the flow-through share program to the biotech sector under the three scenarios outlined above.

Table 1 – Gross Output Economic Impacts of Increased Junior Biotech R&D Expenditures (Millions)

	Direct	Indirect	Induced	Total Impact
Median	$411.4	$366.9	$189.0	$967.3
High	$568.3	$506.8	$261.0	$1,336.1
Low	$254.5	$227.0	$116.9	$598.5

Based on Statistics Canada reports and data, the biotech sector accounts for approximately 11% of total private sector R&D or nearly $1.8 billion and junior biotech companies are estimated to account for a third of this spending ($592 million). At the median (i.e. 69.5% increase in R&D expenditures), the extension of the flow-through share program is estimated to result in increased R&D expenditures of approximately $411 million. This spending produces multiplier effects throughout the economy. Indirect and induced economic impacts associated with these initial expenditures are estimated to result in gross output impacts of $367 million and $189 million respectively for a total gross output impact of $967 million.

Results of the sensitivity analysis indicate significant variation around this estimate. A 96% (High) and 43% (Low) increase in junior biotech R&D expenditures results in a total gross output impact of $1.3 billion and $599 million respectively.

Value Added (GDP)

Table 2 shows the value added or GDP impact associated with increased junior biotech R&D expenditures associated with the extension of the flow-through share program to the biotechnology sector.

Table 2 – Value Added (GDP) Economic Impacts of Increased Junior Biotech Expenditures (Millions)

	Direct	Indirect	Induced	Total Impact
Median	$246.1	$158.4	$153.6	$558.0
High	$339.9	$218.8	$212.1	$770.8
Low	$152.2	$98.0	$95.0	$345.3

At the median, increased junior biotech R&D expenditures of $411 million are estimated to directly contribute about $246 million to Canadian GDP. Taking into consideration indirect and induced impacts, the total GDP impact associated with the extension of the flow-through share program is nearly $558 million. A 96% increase in junior biotech R&D expenditures results in a total GDP impact of $771 million. If the biotech sector follows the experience in the petroleum sector after the introduction of the flow-through shares (i.e. a 43% increased in qualifying expenditures) then this results in a total GDP impact of $345 million.

Wages and Salaries

Table 3 shows wages and salaries generated by increased junior biotech R&D expenditures at the direct, indirect and induced levels.

Table 3 – Wages and Salaries Economic Impacts of Increased Junior Biotech R&D Expenditures (Millions)

	Direct	Indirect	Induced	Total Impact
Median	$201.8	$69.1	$65.8	$336.8
High	$278.8	$95.5	$90.9	$465.2
Low	$124.9	$42.8	$40.7	$208.4

A 69.5% increase in junior biotech R&D expenditures due to the extension of flow-through shares is estimated to result in a direct GDP impact of approximately $246 million. Of this, wages and salaries are estimated to account for $202 million. Taking into consideration indirect and induced economic impacts, total wages and salaries generated by increased junior biotech R&D expenditures are estimated to result in a total impact of $337 million with a range of $208 million to $465 million.

Employment

The Input-Output tables also allow the estimation of employment impacts in terms of full-time equivalent jobs – Table 4 shows these impacts that result from increased junior biotech R&D expenditures due to the extension of the flow-through share program.

Table 4 – Employment Economic Impacts of Increased Junior Biotech R&D Expenditures

	Direct	Indirect	Induced	Total Impact
Median	4,420	1,442	2,082	7,945
High	6,106	1,993	2,876	10,975
Low	2,735	892	1,288	4,916

At the median, 4,420 full-time equivalent jobs are estimated to be created as a result of increased junior biotech R&D expenditures. Taking into consideration indirect and induced economic impacts, the flow-through share program is estimated to result in a total economic impact of 7,945 jobs. Under the high scenario, the extension of the flow-through shares to the biotech sector is estimated to result in a total economic impact of 10,975 full-time equivalent jobs.

Government Taxes

Lastly, the government revenue impacts of extending the flow-through share program to the biotech sector are shown in Table 5. Tax impacts are estimated based on increased federal and provincial personal income taxes and direct and indirect taxes on consumption and production that result from increased junior biotech R&D expenditures. Corporate taxes are not modeled given that junior biotech companies have little to no revenue and have accumulated significant tax losses to date. In addition, government outlays associated with the flow-through share program are not taken into consideration.

Table 5 – Government Taxes Economic Impacts of Increased Junior Biotech R&D Expenditures (Millions)

	Direct	Indirect	Induced	Total Impact
Median	$44.9	$13.1	$22.8	$80.8
High	$62.0	$18.1	$31.5	$111.6
Low	$27.8	$8.1	$14.1	$50.0

Increased junior biotech R&D expenditures due to the flow-through share program are estimated to result in increased income taxes and direct and indirect taxes on production and consumption of approximately $81 million. Of this, $45 million is expected to be directly related to initial biotech R&D expenditures of $411 million. Under the low and high scenarios, approximately $50 million and $112 million of government taxes are estimated to be generated through the extension of the flow-through share program to the biotech sector.

Key Highlights

Economic impacts of the extension of the flow-through share program to the biotech sector estimated above are focused on estimating the gross output, value added (GDP), wages and salaries, employment and government tax revenue impacts associated with increased R&D spending. Increased R&D expenditures are comprised of wages/salaries, purchase of equipment/supplies and capital expenditures. This spending leads to spending in other industries as businesses work to satisfy the increased demand in the biotech sector and employees hired spend their wages on consumer goods.

In summary, the extension of the flow-through shares program to the biotech sector is estimated to result in increased R&D expenditures of $411 million (69.5% increase in baseline junior biotech expenditures). These incremental R&D expenditures result in the following total economic impacts (direct, indirect and induced):

- **Gross Output** - $967 million
- **Value Added (GDP)** - $558 million
- **Wages and Salaries** - $337 million
- **Employment** - 7,945 full-time equivalent jobs
- **Government Revenues** - $81 million (personal income taxes and direct and indirect taxes on consumption and production).

R&D spending, however, produces many other benefits that were not estimated in this report. For instance, spin-offs, productivity benefits, the economic impacts associated with successful commercialization of R&D and other externalities flowing to the public were not quantitatively addressed above. Accounting for these benefits would likely increase the economic impacts measured in this study.

In terms of costs, extension of the flow-through share program would require an initial outlay by the government to investors purchasing flow-through shares. If companies succeed, the government can recoup part or more of its initial investment as investors sell their shares and realize capital gains. In addition, as demonstrated above, the government can also earn substantial revenues from taxes associated with increased R&D expenditures by junior biotech companies.

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