



Our future prosperity hinges on our universities By disseminating and generating knowledge, universities are essential to increasing productivity

Québec will soon enter into an unfavourable demographic period. In just a few years, the pool of workers will begin to retract, which will have a direct impact on the growth potential of our economy. Coupled with increasing competition from emerging countries, among other issues, this will propel the labour market to the forefront of our social, political and economic concerns. Without an adequate supply of workers, we will have to focus our efforts on developing top-notch human capital. Our success in improving our productivity will be a deciding factor in preserving our standard of living, social benefits and collective wealth.

Education plays a vital role in developing human capital, and this takes on even greater meaning for universities. Through its *Economic Studies*, the Desjardins Group decided to study the impact of Québec's universities on the economy with the assistance of Professor Fernand Martin from the Economics Department at the Université de Montréal. An original methodology was developed to calculate the dynamic impact of universities on the economy. This dynamic impact stems mainly from the increase in productivity generated by human capital with university training, the development of university-based research initiatives, research at the corporate level that leads to improved production methods, and because universities attract new investment especially in terms of technology. The analysis concluded that the dynamic impact of universities on Québec's GDP reached \$11.9B in 2006. The net static impact of universities based on their operating expenses (net of subsidies), the living expenses paid by foreign students and the expenses of attendees to seminars and conferences organized by the universities were also estimated. The net static impact reached \$670.5M in 2006.

A UNIQUE METHODOLOGY

By now, most people are well aware of the economic impact studies that use the input-output model developed by the Institut de la statistique du Québec (ISQ). For the university network, the economic impact is calculated based on the university's expenses in terms of goods and services and salaries, students' living expenses and the expenses incurred by visitors to attend seminars and conferences organized by universities. This is commonly known as the static impact university activities have on economy, which represents only a small portion of a university's actual impact since its activities are almost fully funded. A university's real contribution lies in the yield on the economic structure achieved by increasing the human capital, training students

and disseminating and creating new knowledge. This is the dynamic impact of a university's most basic activities. Every economic agent has a static economic impact, but the dynamic impact is specific to universities. Universities therefore have a unique role to play, unlike other economic engines, and their role is crucial to our future prosperity.

The approach is relatively simple and is based on the premise that in any economy, there are two production factors: capital and labour. The capital is represented by machinery, equipment and installations while the labour factor is made up solely of the workforce. Both of these production factors join forces to provide goods and services. But there's another element to consider: productivity. If production in an economy

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NOTE TO READERS: The letters k, M and B are used in texts and tables to refer to thousands, millions and billions respectively.

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increases without this increase being explained by variations in production factors, this increase can then be attributed to productivity gains¹.

Economic growth can therefore be attributed not only to increases in the quantity of production factors used, but to increased productivity as well. Variations in productivity usually stem from changes in local variables that are likely the result of how industries are concentrated, ownership rights, infrastructures, market regulations (like labour market regulations), international and inter-regional trade regulations, the quality of the workforce, and a host of other factors. Ultimately, increased productivity is entirely attributable to changes or to improvements in technology², and simply means that we need to do more with less.

Today's companies are turning more and more to what we call invisible assets, in other words, assets that increase the productivity of production factors. These invisible assets are defined as reservoirs of knowledge. While somewhat abstract, the concept of a reservoir of knowledge is, at its source, the combined experience of the workforce. But it's much more than that. To this combined experience or know-how held by employees and executives we have to add the research conducted by companies, universities and research centres, the implementation of new organizational structures, patents, copyrights, etc. This new knowledge is what leads to innovation and increased productivity. However, since these invisible assets depreciate quickly, they have to be renewed on a continual basis—hence the need for ongoing education and R&D.

GROSS STATIC IMPACT

The first part of the impact assessment of Québec's universities focuses on the gross static impact which falls under the general studies conducted by the ISQ. It is calculated based on the university's basic activities (teaching and research) and certain expenses incurred by other economic agents, such as the living expenses paid for by students.

The gross static impact was measured for three categories of expenses. First of all, the operating expenses of Québec's universities were taken into account. These expenses stem from teaching and research activities, including research done in hospitals when this expense was included in the university's budget. Expenses include the salaries paid to professors,

researchers and administrative staff and general operating expenses. The total amount of these expenses was \$3.1B in 2006.

The second category of expenses taken into account to calculate the static economic impacts is the living expenses of students who are investing in their human capital. Students' living expenses, which are similar to household expenses since students generally buy the same products and services as everyday households, were assessed at \$3B for 2006-2007 academic year based on data from the Ministère de l'Éducation, du Loisir et du Sport. Tuition fees paid for by students were not included in the figures since they are included in the university's operating expenses. This second category of expenses will have to be revised and corrected to take into account the fact that some students would have incurred these expenses whether or not they were enrolled at university.

The third category refers to expenses incurred by those who attend symposiums, conferences or seminars organized by universities, hospitals and schools as part of their research activities. These numbers were not systematically accounted for by the universities, but an evaluation was made. The expenses incurred by participants other than university staff members and students to attend symposiums, conferences and other activities organized by the university totalled \$117.6M for the 2006-2007 academic year.

The results of these three categories were applied to the ISQ's input-output model to calculate the direct and indirect gross static effects of Québec's universities. The direct effects measure the value-added to the economy through revenues, salaries and compensation paid to all other production factors, mainly the salaries of university employees and taxes paid. This can also be calculated through the number of jobs generated by the universities themselves.

By purchasing goods and services, universities also spend vast sums of money in other industries, like printing, computer graphics, or travel expenses. The activity generated in these other industries is an indirect effect; representing the value-added created in other industries through the revenues and salaries paid by suppliers to ensure the production of required goods and services. In fact, to calculate the indirect effect of university expenditures, all you need to do is track the supply network of universities, students and visitors to measure the number of jobs and the value-added directly related to teaching and research activities in universities.

The induced effects measure the impact of spending by individuals who are paid salaries either directly or indirectly from the universities or their suppliers. Once re-injected into

¹ Economists call this the total factor productivity (TFP), or multifactor productivity.

² Richard R. NELSON and Paul M. ROMER, "Science, Economic Growth, and Public Policy", *Challenge*, Vol. 39, No. 2, March-April 1996, p. 14.

the economy, these revenues are translated into new value-added or increased production at other economic agents to satisfy consumer spending. The ISQ's input-output model does not take induced effects into account. However, this can be estimated using a table made available by the ISQ to calculate the economic impact of \$100M in consumer spending on the economy. As a result, the household expenses generated by the after-tax salaries spread across the economy by Québec's universities and their suppliers were used, among others, to calculate induced effects.

Presenting only the gross static impacts would be ill-advised since they do not truly reflect the economic reality. Some corrections had to be made to the gross static impact to better reflect the real impact on the economy of university network activities. In so doing, we obtained the net static impact, and the reasoning behind these adjustments is explained in the following section.

NET STATIC IMPACT

The gross static impact described earlier overestimates the real economic impact of universities as economic agents by a fairly wide margin. The reason for this is simple: several expenses that are included in the gross static impact calculation would have been made regardless, whether the universities existed or not. More specifically, we are referring to the living expenses of students who live in Québec. In addition, we must keep in mind that universities are heavily funded, such that only exported educational services and research have any real effect on the economy, with the rest being mere substitutions. Exported educational services are defined as educational services that are provided to students from outside Québec.

Four factors explain the overestimation of the real impact of Québec's universities. With regard to students' living expenses, we must take into account that any expenses made by Québec-based students would have been made through day-to-day living, whether or not the students were enrolled in a university. A correction was therefore made to take into account the living expenses of students from outside Québec only. These expenses directly support Québec's economy since they were incurred by foreigners. The correction made to take into account the living expenses of foreign students only reached \$2.5B. This amount was deducted from the calculation of the gross static impact.

Secondly, when Québec-based students decide to stay in school rather than join the workforce, this actually limits their impact on the economy since students generally spend less than workers do. The expenses they would have incurred correspond to the salary differential they would have earned with a lesser degree, less taxes and any savings. The gross

static impacts were therefore adjusted to take this phenomenon into account. The shortfall is estimated at \$1.2B for 2006 in Québec.

Thirdly, universities are funded by the government. To do so, the government must reduce expenses in other areas or increase the taxes paid by taxpayers. As a result, the money taken from taxpayers' pockets requires that they in turn cut back on spending for goods and services. In the end, any economic activity that is fully funded will have no net effect on the economy. The static economic impact was therefore corrected based on the subsidies granted to universities by the Québec government (\$2.1B), the federal government (\$30.7M), municipalities (\$0.3M) and any other organization (\$1.4M).

Lastly, the decision was made not to include the induced effects since they tend to be uncertain. In fact, the ISQ never calculates the induced effects. However, they were still included in the table that summarizes the static economic impact for information purposes only. Generally speaking, induced effects are rarely included because of their uncertain nature.

Table 1 on page 4 provides a summary of net static impacts for the three categories of expenses discussed here: university operating expenses (net of subsidies), the living expenses of foreign students and foreign attendees to seminars, conferences and symposiums organized by universities in Québec. The net direct and indirect impact on the value-added, excluding induced effects, reached \$670.5M and created 12,327 net jobs within the economy (in person-years). The net salaries generated by these activities in Québec exceeded \$1.1B.

The net static effect of Québec's universities is therefore relatively small given the scope of the university network. This is largely explained by the fact that students elect to study instead of work, and as such, they have less impact on the economy. It is easy to understand that the more universities export teaching services to foreign students and the more research they do for the private sector, the greater their impact will be on the economy. It is plain and simple fact that if Québec's heavily-funded universities provided no trickle-down benefit other than their net static impact, their overall role in Québec's economy would be similar to that of a useful and even necessary infrastructure, but not an economic driver. However, the dynamic effect of Québec's universities has a major impact on the economy by improving the human capital and creating and transmitting knowledge. The figures speak for themselves, as shown in the next section that explains the method used to calculate the dynamic economic impact.

Table 1
Net static economic impact of Québec's universities*

	Gross direct and indirect effects	Corrections to gross impacts	Net static economic impact	Induced effects	Overall effects
In K\$ (except if indicated)					
Labour (person-years)	67,594	55,267	12,327	19,209	31,536
Value-added	4,568,399	3,897,904	670,495	1,262,722	1,933,217
<i>Before-tax salaries and wages</i>	2,952,631	1,816,644	1,135,987	528,414	1,664,401
<i>Net rev. of sole proprietorships</i>	193,268	536,542	-343,274	123,998	-219,276
<i>Other before-tax revenues</i>	1,422,499	1,544,718	-122,219	610,309	488,090
Québec government revenues	496,673	390,302	106,371	199,283	305,654
Federal government revenues	326,504	232,076	94,428	121,886	216,314
Incidental taxation in Québec ¹	385,182	256,154	129,028	76,890	205,918
Incidental taxation in Canada ²	75,987	53,741	22,246	16,774	39,020

* Expenses of \$6.23B for Québec's universities, students' living expenses and expenses incurred by attendees to conferences/seminars for 2006.

¹ Québec Pension Plan (QPP), Fonds des services de santé (FSS), Commission de la santé et de la sécurité du travail (CSST); ² Employment Insurance.

Sources: Institut de la statistique du Québec and Desjardins, Economic Studies

CALCULATING THE DYNAMIC IMPACT

This section discusses the method used to evaluate the dynamic impact of Québec's universities. As mentioned earlier, the true impact of universities on the economy is reflected in the productivity gains and knowledge that universities transmit.

The first step in the methodology consisted in measuring the contribution of productivity to GDP growth. Note that if production increases in an economy and this increase cannot be explained by increased production factors, this additional production would be attributed to increased productivity. In this context, we would use the term total factor productivity (TFP), which takes all production factors into account when assessing productivity. In addition, it is widely assumed that productivity increases stem entirely from new knowledge. However, increases in productivity cannot be solely attributed to universities. It is therefore important to determine each economic agent's share and responsibility in acquiring and appropriating knowledge within the economy.

The knowledge acquired does not originate from Québec only, however. This important fact was taken into account when evaluating the dynamic impact of Québec's universities. The reality is that we also import knowledge from outside Québec. As such, we have to separate the knowledge gathered from outside Québec that contributed to increasing productivity. To identify the contribution made by Québec-based universities to the TFP, we have to limit ourselves to the content contributed by Québec to knowledge production, meaning that any contribution from other provinces or

countries is subtracted from the equation. This allows us to determine Québec's TFP.

The third and final step consists in allocating Québec's TFP to the various invisible assets that produce and disseminate knowledge—individuals who enlist human capital, universities, corporations and governments that carry out research and development. The results of each of these steps were derived through complex mathematical calculations. The objective here isn't to provide readers with detailed information on these calculations; the intention is to provide a better understanding of the methodology applied and a visual representation of the main results. For example, the value of the production generated by the total increase in TFP in Québec was assessed at \$39.6B for 2006. This figure will be used as a basis for assessing the dynamic impact without specifying the overall calculations used to reach this estimate. Note that this amount corresponds to the increase in production in the economy that is not explained by an increase in production factors. The breakdown of the TFP's contribution to GDP growth in Québec is presented in table 2 on page 5.

Knowledge that was not produced in Québec, but that is part of the invisible assets available to all Québécois stems from imports of goods and services that have technological content, licences and royalties bought from and paid to foreigners, as well as research services provided by foreigners. The value imports of technological goods and services were estimated using statistics on international imports for like products published by the ISQ, retaining only

Table 2
Breakdown of TFP's contribution to GDP growth in Québec

In \$M

Value of TFP's contribution to GDP growth in 2006		39,595
Less:		
Value of international technology imports	3,041	
Value of inter-provincial technology imports	972	
Payments for foreign licences and royalties	280	
Payments for foreign R&D services	1,726	6,019
Value of Québec-based knowledge (Québec's TFP)		33,576
Less:		
Québec universities' contribution to improving human capital	5,004	
Students' contribution to improving human capital	9,245	14,249
Residual to be allocated to productivity improvements in other production factors		19,327
Portion attributable to Québec's universities	6,869	
Portion attributable to other knowledge producers (corporations, governments, etc.)	12,458	

Source: Desjardins, Economic Studies

the statistics that were based on the technology index provided by the rankings set by the Organisation for Economic Co-operation and Development (OECD). This same technological content was taken into account for inter-provincial imports. Overall, Québec imported technological content estimated at \$4B in 2006.

To this technological content we must add royalty and licence payments made by Québec to international agents. Since these numbers are not accounted for throughout the province, estimates were made using information on Canadian payments. As such, Québec would have made payments for royalties and licences and purchased R&D services for foreigners to the tune of approximately \$2B in 2006. As a result, the value of knowledge produced in and appropriated by Québec reached \$33.6B, i.e. the difference between the overall increase in TFP in 2006 (\$39.6B) and the value of knowledge imports from the rest of Canada or abroad (\$6B).

Generally speaking, two types of organizations in Québec take ownership of technology: universities that retransmit technology to students by training human capital, which in turn produces new knowledge, and corporations that use technology to produce new knowledge. The capacity of universities to improve human capital usually translates into the wage differential of university graduates. This can be measured by calculating the difference between what graduates earn vs. what they would earn if they did not have a university education. For example, for an undergraduate degree, the wage differential vs. someone who does not have a degree reached \$21,991 according to Statistics Canada. For

a graduate degree, add another \$16,196 per year. Given the number of graduates produced by Québec in 2006, the productivity increase attributable to universities was \$16.8B for that same year. A few adjustments had to be made however to take into account that a portion of this productivity was imported.

Research universities routinely recruit professors and researchers who received at least some or all of their training abroad. The same applies to landed immigrants or to visitors who bring to Québec the educations they received in their home countries. With these adjustments, the increase in human capital due to Québec's universities totalled \$14.3B instead of \$16.8B calculated previously. Lastly, since the education of human capital is the result of a joint effort between students and universities and that universities, in terms of overall resources used, contributed only 35.12% of total education costs, the increase in human capital attributable to Québec's universities was \$5.0B (or 35.12% of \$14.3B).

Of the \$33.6B that represents the value of knowledge produced in Québec, \$14.3B was allocated to creating human capital based on Québec-based knowledge. The remaining \$19.3B could be allocated to producing knowledge and distributing it to universities and other knowledge producers. This distribution could be done based on a fairly simple rule: the materiality of the university's R&D expenditures. For Québec's universities, the ratio is 35.54%; in other words, the contribution made by Québec's universities to producing knowledge made right here in Québec is \$6.9B.

A MAJOR DYNAMIC IMPACT

That fact that Québec's universities are heavily funded prevents us from measuring their real economic role in the economy using the net static impact. Based on this approach, the net static impact of Québec's universities was only \$670M in 2006. However, they played a large role due to their dynamic impact—returns on the economy—through improvements to human capital or by creating and disseminating knowledge. Using an original and proven methodology that has been applied by other university researchers, we were able to evaluate the dynamic impact of universities on the economy. This approach allowed us to evaluate the specific impact of universities on the economy.

The overall dynamic economic impact on the economy of Québec's universities was assessed at \$11.9B for 2006. This impact can be broken down into a \$5B contribution to the training of human capital, and a \$6.9B contribution to increasing the productivity of other production factors in Québec by creating and disseminating knowledge. In a similar study carried out for the Association of Universities and Colleges of Canada, the dynamic impact of Canada's universities was estimated at approximately \$56.6B, representing about 3.91% of Canada's GDP for that same year compared with 4.18% in Québec. The economic impact of universities is stronger in Québec than it is elsewhere in Canada.

Québec's universities contribute a great deal to Québec's economy, and they merit special attention. For the past several years now, universities have been dealing with chronic underfunding, which has had major repercussions on recruiting and retaining professors. In addition, our university infrastructures are crumbling and this is having a serious impact on our ability to innovate, especially now that emerging countries like China and India are investing in education and research on an ongoing basis. In view of this reality and the dynamic economic impact of Québec's university network, we must continue to invest heavily in our universities if we want Québec to continue to prosper. Québec's future prosperity will be even more dependent on innovations that are the end result of new knowledge. We must invest in our universities to increase our collective wealth and ensure that we sustain and further develop our standard of living going forward.

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