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Innovation and Bioproduct Development

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The Issue

The creation of industrial products from biomass has opened a new field of opportunity for agriculture. Although ethanol dominates the policy agenda, the bioproduct opportunity is much broader. As the industry expands, the ability to develop bioproducts will be a key competitive priority. This analysis examines the relationship between firm characteristics and strategies and innovation, as measured by the total number of products under development and on the market. As financing is often a challenge for firms involved in new technologies, this brief also examines the factors that influence the degree to which firms achieve financing targets.

Key Findings

An analysis of the determinants of product innovation and financing success generates several insights into bioproduct development in Canada.

Intellectual property is a determining factor in both innovation and financing
Licensing in intellectual property (IP) had a significant positive impact on total product numbers in the general population of bioproduct firms. However, firms looking for financing achieved greater success if they owned intellectual property. These results parallel findings in other industries, where IP has been shown to be a significant factor in both innovation and securing funding. One surprising finding, however, was the negative impact of owning policy on total product count for all bioproduct firms. This might be related to the fact that firms with IP tend to focus on developing their own technologies rather than search for external IP.

Scientific research and experimental development tax credit
The use of SR&ED tax credits was a significant positive factor in the total number of products for both bioproduct firms and those using agricultural biomass. However, it had no impact on financing.

The impact of collaborations varies
Collaborations were important for increasing total product numbers in both agricultural biomass firms and the general population. However, collaborations had a negative impact on finance.

Experience matters—but in different ways
The number of years in the biochemical industry positively affected product numbers for both agricultural and bioproduct firms, but negatively affected financing success. The latter result may be somewhat related to size. Large companies tended to have more experience, but smaller firms, unexpectedly, were more likely to achieve a higher percentage of their financing goal.

Industry and region matter—sometimes
In product development, involvement in the biochemical industry was a significant positive factor in both agricultural and bioproduct firms. Involvement in biofuels positively affected product innovation in the general population of bioproduct firms. Likewise, developing biopesticides improved

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financing possibilities.
The only significant regional factor was in the total number of products from firms using agricultural biomass. In such cases, being located in Quebec had a significant positive impact.

In 2003, Quebec was definitely at the forefront of bioproduct development in Canada. The province had more start-ups, its firms had a high level of financing success across the entire range of financing options, and Quebec-based companies were at or near the front on a number of dimensions of bioproduct innovation (Sparling, Cranfield, Henson, and Laughland, 2006). Quebec firms tended to adopt IP management as one of their key strategies, a strategy not ranked highly in other parts of the country.

Firm focus
Firms that undertook all activities, from development to marketing, were more successful in product innovation than those that focused exclusively on product development or production and marketing. For Canadian bioproduct firms, having direct sales to consumers also positively affected product numbers but negatively affected financing success.

Implications of the key results for policy
These findings point to several ways in which public policy can support innovation in the Canadian bioproducts industry. Innovation is positively affected by the sharing of knowledge among public and private sector organizations. Policies that encourage R&D, developing IP, and helping organizations share IP will benefit the industry as a whole. The value of promoting knowledge networks is reinforced by findings that suggest that collaborations also positively affect product innovation.

The SR&ED program in particular is a significant factor in promoting bioproduct innovation. However, participation in the program was less than fifty percent. Expanding both the program and firm participation should benefit the industry and the country. For individual regions, particularly Ontario, an examination of why uptake in government programs of all kinds was low would assist in developing programs better suited to their constituents.

Because firms were generally more successful when they operated along the entire commercialization continuum, policies that support firms in developing and commercializing their technologies would assist product innovation. These policies could include programs to promote investments in R&D, assistance with financing, and development of production capabilities.

Several anomalies, however, challenge the authors. Collaborations, experience, and direct sales to customers all positively affected product numbers but negatively affected financing success. This might be related to the fact that financing success examines only a subset of the population, or it might be that the requirements for success in financing are completely different than those for product innovation. These matters will be examined in more detail using data from the 2006 survey.

Background

According to estimates from a Statistics Canada survey of bioproduct use and development, the Canadian bioproduct industry consists of an estimated 232 bioproduct firms. Forty percent used agricultural biomass as their primary input, one-third used forestry biomass, and food processing biomass was far behind at fifteen percent. For most firms, bioproducts was a secondary activity in terms of revenue, employees, and R&D (Table 1).

Table 1. Key statistics for Canadian bioproduct firms, 2003.

Firm Size	Total Revenue	Percentage from bioproducts	Total Employees	Percentage from bioproducts	Total R&D	Percentage in bioproducts
Small	$6,026	45%	14	79%	$444	72%
Medium	$43,429	63%	98	70%	$1,517	34%
Large	$244,654	18%	476	19%	$2,906	21%

Source: Statistics Canada Bioproduct Development Survey, 2003.

Bioproducts encompass a range of product categories, and the number of products under development or on the market varies by product category, region, and firm size.[1] Several studies have used the total number of products under development and on the market as a measure of innovation (van Moorsel, Cranfield, and Sparling, 2006).

New technologies are built on knowledge and intellectual property. Although sixty-five percent of firms entered the bioproduct industry as a result of internal R&D efforts, they accessed outside knowledge through contract collaborations and licenses. The proportion of firms that owned intellectual property (IP) varied by product type and province (Sparling et al, 2006).

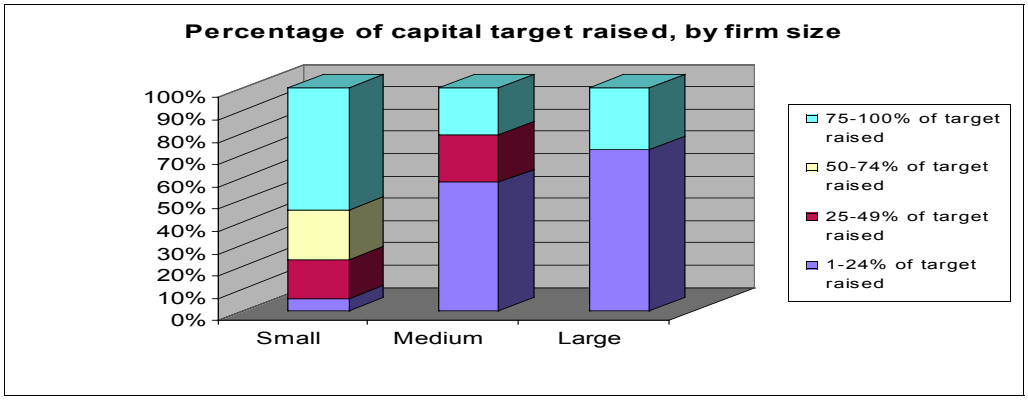
Access to financing is a constant challenge for new technologies, and bioproducts are no exception. Firms across Canada identified this as a major obstacle to growth. Although only seventy-five percent of small firms were successful in raising money, those that did raised an average of just under $2.5 million. Small firms had greater success in relation to their goals than large companies, and raised more on average than large firms (Figure 1). However, the opposite was true with the SR&ED program (Sparling et al, 2006).

Economic Model

Regression analysis was employed to identify factors driving product innovation and financing success. Empirical models were estimated in SPSS using ordinary least squares and assuming a linear relationship. Dependent variables were: 1) the total product count for all bioproduct firms; 2) the total product count for bioproduct firms using agricultural biomass as their primary input; and 3) the percentage of total target capital raised. Total product count represents the total number of products in development or on the market for each firm, as estimated in 2003. The analysis for financing success included only those firms that attempted to secure funding. The percentage of total target capital measures the success of firms in raising capital relative to their goals.

The tables below summarize the significant, non-zero determinants for the three regression models.

Figure 1. Financing success by Canadian bioproduct firms seeking funding, 2003.



Source: Statistics Canada Bioproduct Development Survey 2003.

Regression 1. Total product count for all bioproduct firms.

Determinant	St. Beta	Effect
Sold directly to consumers/distributors	.118	+
Years in bioproducts	.289	+
In-licensed IP	.195	+
# of Collaborations	.142	+
Biofuels/Bioenergy	.117	+
Biochemicals	.263	+
SR&ED	.192	+
Owned IP	-.126	-
Early Focus	-.327	-
Late Focus	-.373	-

Regression 2. Total product count for bioproduct firms using agricultural biomass.

Determinant	St. Beta	Effect
Years in bioproducts	.349	+
In-licensed IP	.200	+
Quebec	.255	+
Biochemicals	.292	+
SR&ED	.293	+
Early Focus	-.272	-
Late Focus	-.384	-

Regression 3. Financing success, percentage of funding target achieved.

Determinant	St. Beta	Effect
Owned IP	**.253**	+
Biopesticides	**.223**	+
Sold directly to consumers	**-.341**	-
Years in bioproducts	**-.343**	-
Total collaborations	**-.283**	-

Source for data used in all three regressions: Statistics Canada Bioproduct Development Survey, 2003.

References

Sparling, D., Cranfield, J., Henson, S., and Laughland, P. (2006). The Canadian bioproducts development survey 2003: Analysis of summary results. Retrieved [date] from the World Wide Web: http://www.agr.gc.ca/pol/index_e.php?s1=pub&s2=bioprod

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