Industry Canada
Research Publications Program

# R&D PROPENSITY AND PRODUCTIVITY PERFORMANCE OF FOREIGN-CONTROLLED FIRMS IN CANADA

*Working Paper Number 33*
*March 2001*

***Industry Canada Research Publications Program***

The Industry Canada Research Publications Program provides a forum for the analysis of key micro-economic challenges in the Canadian economy and contributes to an informed public debate on these issues. Under the direction of the Micro-Economic Policy Analysis Branch, the Program's research paper series features peer-reviewed analytical working papers or policy-related discussion papers written by specialists on micro-economic issues of broad importance.

Industry Canada
Research Publications Program

# R&D PROPENSITY AND PRODUCTIVITY PERFORMANCE OF FOREIGN-CONTROLLED FIRMS IN CANADA

*By Jianmin Tang and Someshwar Rao*
*Industry Canada*

*Working Paper Number 33*
*March 2001*

Aussi disponible en français

***Canadian Cataloguing in Publication Data***

Rao, P. Someshwar (Ponugoti Someshwar), 1947-

R&D propensity and productivity performance of foreign-controlled firms in Canada

(Working paper; number 33)
Text in English and French on inverted pages.
Title on added t.p.: Propension à la R-D et productivité dans les entreprises sous contrôle étranger au Canada.
Includes bibliographical references.
ISBN 0-662-65578-8
Cat. No. C21-24/33-2001

1. Research, Industrial – Canada.
2. Industrial productivity – Canada.
3. Business enterprises, Foreign – Technological innovations – Canada.
I. Tang, Jianmin, 1962- .
II. Canada. Industry Canada.
III. Title: Propension à la R-D et productivité dans les entreprises sous contrôle étranger au Canada.
IV. Series: Working paper (Canada. Industry Canada); no. 33.

HC79.R47R36 2001 338.4'567'0971 C2001-980090-8E

Published in March 2001

---

The list of titles available in the Research Publications Program and details on how to obtain copies can be found at the end of this document. Abstracts of research volumes and the full text papers published in Industry Canada's various series and of our quarterly newsletter, *MICRO*, are available on *STRATEGIS*, the Department's online business information site, at http://strategis.gc.ca.

Comments should be addressed to:

Someshwar Rao
Director
Strategic Investment Analysis
Micro-Economic Policy Analysis
Industry Canada
5th Floor, West Tower
235 Queen Street
Ottawa, Ontario
K1A 0H5

Tel.: (613) 941-8187
Fax: (613) 991-1261
E-mail: rao.someshwar@ic.gc.ca

*ACKNOWLEDGEMENTS*

We wish to thank Jeffrey Bernstein and Don McFetridge for helpful comments and suggestions. All opinions expressed in this paper are entirely our own and should in no way be attributed to Industry Canada. Please send comments to Jianmin Tang by email at tang.jianmin@ic.gc.ca.

## TABLE OF CONTENTS

## ABSTRACT

Using firm-level data, this paper examines the R&D propensity of Canadian-controlled and foreign-controlled firms in Canada. The empirical results suggest that foreign-controlled firms in Canada, after accounting for other factors, spend significantly less on R&D than Canadian-controlled firms. But, foreign-controlled firms increased their R&D propensity at the same pace as Canadian-controlled firms during the 1985–94 period. In the two groups of firms, R&D propensity is higher in high-technology and export-oriented firms, and lower in large and medium-size firms. In addition, the paper shows that foreign-controlled firms are actively adopting advanced technology (including other intangible assets) from their parents. This may explain why foreign-controlled firms are more productive than Canadian-controlled firms.

# 1. INTRODUCTION

Foreign direct investment plays a significant role in the Canadian economy, especially in the manufacturing sector. Today, foreign-controlled firms generate more than half of revenues in the Canadian manufacturing sector and about one third of revenues in the Canadian economy (Table 1). More importantly, foreign-controlled firms create more than one third of well-paid jobs in the Canadian manufacturing sector.[1] Besides output and employment, foreign-controlled firms also represent a significant share of total R&D spending in Canada. In 1997, they accounted for about 42 percent of total R&D spending in the Canadian manufacturing sector (Table 2). In textiles, chemicals, petroleum refining, and transportation equipment industries, their share of total R&D spending is more than two thirds.

But, the total R&D propensity — defined as the ratio of R&D spending to sales — of foreign-controlled firms in the Canadian manufacturing sector is significantly lower than that of their Canadian-controlled counterparts.[2] For instance, in 1994, the R&D propensity of foreign-controlled firms was 0.77, compared to 1.19 for Canadian-controlled firms (Table 3). Because of this seemingly significant gap in manufacturing R&D propensity, foreign-controlled firms are generally blamed for Canada's innovation problems and, ultimately, productivity problems. In addition, the lower R&D propensity of foreign-controlled firms is perceived as a potential loss to the Canadian economy in terms of creating well-paid jobs and local spillover effects of R&D.[3]

However, many factors could contribute to the observed gap in manufacturing R&D propensity between the two groups of firms. These include differences in firm size, industry composition and export orientation.[4] These variables and their relationship to R&D spending will be discussed in this paper.

**Table 1**
**Share of Foreign-controlled Firms in Total Operating Revenue in Canada**

| Industry | 1988 | 1994 | 1996 |
|---|---|---|---|
| Food, beverage and tobacco | 38.6 | 44.1 | n.a. |
| Wood and paper | 21.2 | 27.2 | 28.9 |
| Chemicals and textiles | 57.2 | 62.3 | 64.4 |
| Metallic minerals and metal products | 25.8 | 31.2 | 29.4 |
| Rubber and plastics | 51.4 | 55.5 | n.a. |
| Machinery | 35.2 | 39.9 | 37.0 |
| Electrical and electronic products | 53.8 | 56.0 | 56.4 |
| Transportation equipment | 49.8 | 58.1 | 57.8 |
| Instruments | 65.2 | 64.3 | n.a. |
| **Total manufacturing** | 45.8 | 51.2 | 50.9 |
| Communications services | 11.6 | 14.8 | 16.5 |
| Financial services | 26.2 | 27.5 | 27.0 |
| **All industries** | 27.3 | 31.0 | 31.1 |

Source: Statistics Canada

**Table 2**
**Share of Foreign-controlled Firms in R&D Expenditures in Canada**

| Industry | 1985 | 1988 | 1994 | 1997 |
|---|---|---|---|---|
| Food, beverage and tobacco | 53.1 | 49.8 | 55.5 | 51.2 |
| Textiles | 80.6 | 85.5 | 83.4 | 80.7 |
| Wood and furniture | 8.3 | 1.8 | 1.5 | 1.6 |
| Paper and printing | 7.2 | 5.9 | 3.4 | 1.5 |
| Pharmaceutical and medicine | 67.3 | 65.4 | 84.9 | 81.9 |
| Other chemical products | 56.7 | 65.7 | 73.7 | 74.1 |
| Petroleum refining | 55.2 | 87.9 | 80.2 | 67.9 |
| Rubber and plastics | 58.9 | 26.0 | 24.6 | 29.9 |
| Stone, clay and glass | 76.8 | 76.3 | 38.0 | 37.3 |
| Primary metal | 2.3 | 1.8 | 1.2 | 1.2 |
| Fabricated metal | 42.1 | 38.5 | 17.9 | 12.8 |
| Machinery except electrical | 20.5 | 21.3 | 20.6 | 17.5 |
| Electrical and electronic equip. | 39.1 | 35.4 | 26.4 | 28.5 |
| Motor vehicles | 63.7 | 68.3 | 85.9 | 72.4 |
| Other trans. equip. | 58.2 | 68.5 | 54.3 | 63.4 |
| Scientific and professional equipment | 56.5 | 31.5 | 20.7 | 16.1 |
| Other manufacturing | 13.8 | 7.1 | 16.9 | 38.0 |
| **Total manufacturing** | 43.8 | 44.1 | 40.4 | 42.1 |
| Communications services | 7.5 | 12.4 | 6.3 | 11.0 |
| Computer and related services | 1.6 | 8.0 | 17.1 | 23.9 |
| Engineering and scientific services | 7.5 | 18.8 | 18.5 | 9.5 |
| **All industries** | 34.3 | 35.3 | 31.1 | 32.6 |

Source: Statistics Canada

**Table 3**
**R&D Propensity in Manufacturing**
**(R&D Expenditures as a Percentage of Sales)**

| Year | Canadian-controlled | Foreign-controlled | Total |
|---|---|---|---|
| 1988 | 0.87 | 0.82 | 0.85 |
| 1989 | 0.85 | 0.83 | 0.84 |
| 1990 | 0.95 | 0.89 | 0.92 |
| 1991 | 1.07 | 0.92 | 0.99 |
| 1992 | 1.15 | 0.88 | 1.02 |
| 1993 | 1.27 | 0.82 | 1.04 |
| 1994 | 1.19 | 0.77 | 0.97 |

Source: Statistics Canada

The main objective of the paper is to examine the R&D performance of foreign-controlled and Canadian-controlled firms in the Canadian manufacturing sector, using firm-level data for the 1985–94 period. We focus on the manufacturing sector because it has the highest share of foreign ownership. Our research hopes to shed some light on the following four related questions:

- What are the key determinants of R&D propensity?
- Does the nationality of ownership of multinational firms matter for R&D spending in Canada after controlling for other relevant factors?
- Have foreign multinationals in Canada increased their R&D propensity over time?
- Why are foreign-controlled firms more productive than Canadian-controlled firms?

Our empirical results suggest that foreign-controlled firms, after accounting for other factors, spend significantly less on R&D than Canadian-controlled firms. But, in the two groups of firms, R&D propensity increased at the same pace during the 1985–94 period. The R&D propensity is higher in high-technology and export-oriented firms, and lower in large and medium-sized firms in the two groups. We also show that foreign-controlled firms are actively adopting advanced technology (including other intangible assets) from their parents. This may explain why they are more productive than their Canadian-controlled counterparts.

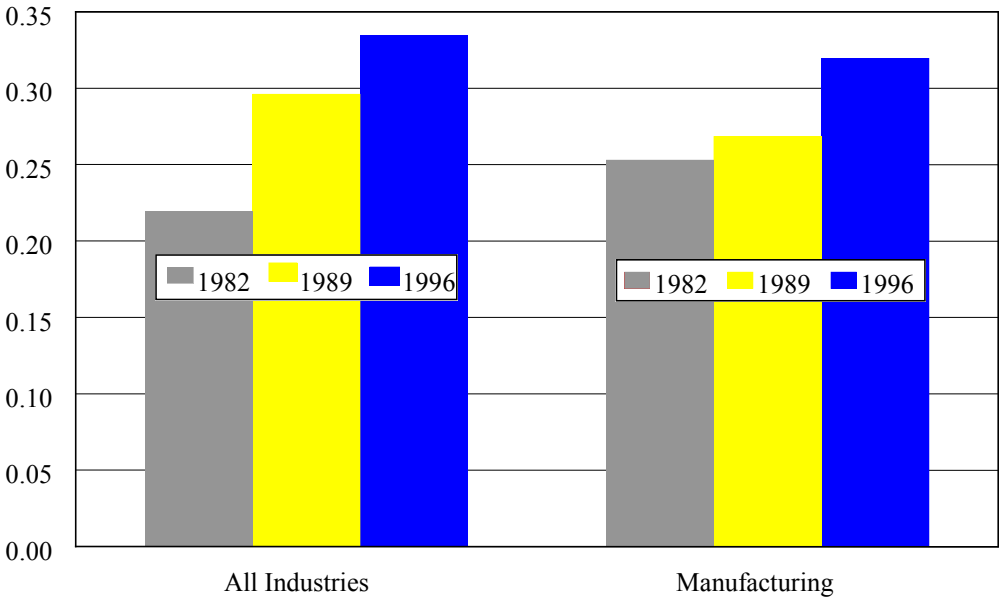
In the next section, we briefly examine the R&D performance of foreign multinationals in host countries. Then, using panel data on firms, we present regression results on the determinants of R&D propensity in foreign-controlled and Canadian-controlled firms in Canada. In section 3, we review the R&D performance of foreign multinationals in the United States over the last 20 years and the R&D record of U.S. multinationals abroad. In section 4, we examine technology adoption and the productivity performance of foreign-controlled firms in Canada. Finally, in section 5, we summarize the main findings of our research and discuss their implications.

## 2. R&D PERFORMANCE OF FOREIGN MULTINATIONALS IN CANADA

It is well known that multinationals do the major part of their R&D at home.[5] The phenomenon is commonly called the headquarter effect of R&D spending of multinationals. For instance, in 1996, the R&D propensity of U.S. non-bank parent firms in the United States was 4.2 percent while the R&D propensity of their affiliates abroad was only 1.4 percent, about one third of the R&D propensity of their parents (Chart 1). In general, the R&D propensity of foreign affiliates is less than the national average in the host country. For instance, the R&D propensity of foreign affiliates in the U.S. manufacturing sector is only about 78 percent of the national average for the U.S. manufacturing sector (Chart 2). Similarly, the R&D propensity of U.S. affiliates in Canada is only about 60 percent of the Canadian national average.

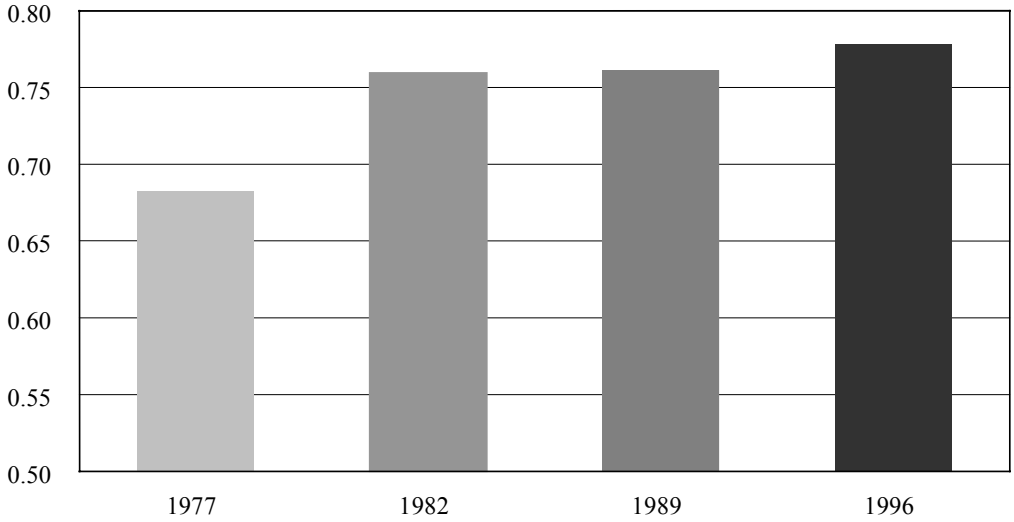
There are many reasons for multinationals to centralize their R&D spending. Multinational enterprises still perform the major part of their R&D at home, because of scale economies in R&D, proximity to the firm's headquarters, and protection of the secrecy of the firm's top technologies at headquarters for strategic reasons (Fors, 1996). In addition, the centralization of R&D has a further advantage: sending intangible research results around the world may be less costly than shipping physical components (Caves, 1996, p. 84).

**Chart 1**
**Ratio of R&D Intensity of Majority-owned Non-bank Affiliates Abroad to the R&D Intensity of their U.S. Non-bank Parents (R&D Intensity of Parent = 1.00)**




Source: Bureau of Economic Analysis, *Surveys of Foreign Direct Investment in the United States*.

**Chart 2**
**Ratio of R&D Intensity of Foreign Affiliates in the U.S. Manufacturing Sector**
**(R&D Intensity of U.S. National Firms = 1.00)**




Sources: OECD ANBERD, OECD STAN, Bureau of Economic Analysis, *Surveys of Foreign Direct Investment in the United States*.

## Firm Panel Data

To examine the impact of the headquarter effect on foreign-controlled firms in Canada, we construct a balanced panel data set on Canadian-controlled and foreign-controlled firms over the 1985–94 period. This panel data set is compiled from a number of sources: Compact-Disclosure/Canada databases, supplemented by data from Micromedia's "Profile Canada", Moody's International, and Statistics Canada's Inter-corporate Ownership. Firms based in Canada with data on R&D expenditures, sales, and ownership have been selected. Our panel data set consists of 58 manufacturing firms with observations for the 1985–94 period. All firms in the sample are performing R&D. Most of the sampled firms are publicly-traded companies listed either on a Canadian stock exchange or on an American stock exchange. Of this number, 28 firms are Canadian-controlled and 30 are foreign-controlled. A firm is labelled as Canadian-controlled if it is ultimately controlled by Canadians; otherwise it is labelled as foreign-controlled.[6]

Table 4 shows that our sample firms represent about 22 percent of total manufacturing sales and about 25 percent of total manufacturing R&D expenditures. The R&D coverage ratio is slightly higher than the sales coverage ratio.

**Table 4**
**Sample Coverage Ratios**
**(Percentage Share of Total Manufacturing)**

| | Sales | | | R&D | | |
|---|---|---|---|---|---|---|
| Year | Canadian-controlled | Foreign-controlled | Total | Canadian-controlled | Foreign-controlled | Total |
| 1988 | 17.2 | 28.1 | 22.2 | 17.6 | 37.0 | 26.2 |
| 1989 | 17.2 | 28.7 | 22.4 | 17.7 | 38.1 | 26.9 |
| 1990 | 16.9 | 26.2 | 21.2 | 18.9 | 34.1 | 25.8 |
| 1991 | 17.7 | 27.8 | 22.6 | 17.1 | 37.8 | 26.4 |
| 1992 | 18.8 | 27.2 | 22.9 | 16.6 | 36.2 | 25.1 |
| 1993 | 17.8 | 26.3 | 22.2 | 14.1 | 28.4 | 19.9 |
| 1994 | 17.8 | 25.2 | 21.6 | 13.7 | 30.4 | 20.5 |

Sources: Authors' sample and Statistics Canada.

## Empirical Analysis

To examine the difference in R&D propensity between Canadian-controlled and foreign-controlled firms in our sample, we first run a simple regression: R&D propensity as a function of the ownership dummy variable and a constant,

$$(1) \qquad r_i = \alpha + \beta D_i + \varepsilon_i$$

where $r_i$ denotes the R&D propensity of firm *i*, defined as the percentage ratio of R&D expenditures to sales; $D_i$ is the ownership dummy variable for firm *i*, taking on a value of 1 if the firm is foreign-controlled and of 0 if it is Canadian-controlled; $\varepsilon_i$ is the error term; finally, $\alpha$ and $\beta$ are the parameters.

The pooled regression results after taking into account heteroskedasticity show that foreign-controlled firms have a significantly lower R&D propensity than Canadian-controlled firms (Column 1 of Table 5).[7] This finding is consistent with the significant gap in manufacturing R&D propensity between the two groups of firms, as shown in Table 3.

However, many other factors could contribute to the observed gap in manufacturing R&D propensity between the two groups of firms. In this paper, we focus on the differences in firm size, industry composition and export orientation.[8] To examine the effect of nationality of ownership on R&D propensity, we need to control for the influence of such factors.

Medium- and large-size R&D performing firms, other things remaining constant, have a lower R&D propensity than small-size R&D performing firms (Holbrook and Squires, 1996).[9] To control for the influence of firm size on R&D propensity, we divide our sample firms into three size groups according to sales: less than $500 million (small firms); between $500 and $1,500 million (mid-size firms); and greater than $1,500 million (large firms).

Export-oriented firms have to spend more on R&D because they need to be highly competitive in terms of price, quality of service and product novelty. As shown by Rao, Legault and Ahmad (1994), outward-oriented firms are doing more R&D than domestically-oriented firms by a significant margin. To disentangle the influence of export orientation, we divide the sample firms into two groups: firms that export and firms that do not export.

**Table 5**
**Determinants of R&D Propensity[a]**

| Variables | (1) Simple Regression | (2) Multiple Regression |
|---|---|---|
| Ownership dummy | –0.0044 | –0.0065 |
| | (–3.8)* | (–4.1)* |
| Ownership x Time | | –0.0002 |
| | | (–0.6) |
| Mid-size dummy | | –0.0025 |
| | | (–1.6)** |
| Large-size dummy | | –0.0042 |
| | | (–3.9)* |
| High-tech dummy | | 0.0146 |
| | | (7.0)* |
| Export dummy | | 0.0057 |
| | | (4.1)* |
| Time | | 0.0003 |
| | | (1.8)** |
| Constant | 0.0160 | 0.0069 |
| | (20.0)* | (4.6)* |
| Number of observations | 580 | 580 |
| R-Square (Buse) | 0.03 | 0.21 |

[a] T-ratios are in parentheses.
* Significant at the 5 percent level.
** Significant at the 10 percent level.

Similarly, firms in high-tech industries tend to spend more on R&D than firms in other industries on average. To capture the influence of industry composition, we divide our sample firms into two groups: high-technology and others. A firm is labelled as high-tech if its major business is in chemicals, petroleum & coal products, electrical & electronic products, or industrial machinery.

Finally, the globalization of the world economy may lead multinationals to decentralize their R&D spending. This may change the pattern of R&D spending of firms. In particular, it may reduce the disparity between foreign-controlled firms and Canadian-controlled firms in R&D propensity. To capture trend changes in R&D spending, a time-trend variable is introduced. The product of the time variable and the ownership dummy variable is used to capture the differences in trend changes in R&D propensity between foreign-controlled and Canadian-controlled firms.

The pooled regression results after taking into account the above factors and heteroskedasticity are reported in column (2) of Table 5.[10] Several interesting findings emerge. First, foreign-controlled firms spend significantly less on R&D than Canadian-controlled firms after controlling for other factors. Second, as expected, the R&D propensity of high tech and export-oriented firms is significantly higher than that of low-tech and non-exporting firms. Third, R&D propensity and firm size are significantly negatively related. Finally, the estimated coefficient of the time-trend variable is positive and significant, indicating that the R&D propensity of both foreign-controlled and Canadian-controlled firms increased during the 1985–94 period.[11] In addition, the pace of expansion is the same for both groups of firms, as indicated by the insignificant coefficient of the product of ownership and time variables. Thus, our analysis does not support the hypothesis of a narrowing R&D propensity gap between Canadian-controlled and foreign-controlled firms.

## 3. GLOBALIZATION OF R&D SPENDING BY MULTINATIONALS

As part of the globalization of the world economy, R&D expenditures of multinationals have been increasing in some host countries. Four factors have been identified as the main drivers of the decentralization of multinationals R&D spending: the increasing share of foreign production, leading to a corresponding increase in R&D spending to adapt advanced technologies in host countries (Ronstadt, 1978; Behrman and Fischer, 1980; and Pearce, 1989); the growing share of knowledge workers in host-country employment (Pearce and Singh, 1992; Fors, 1996); increasing synergies between parents and subsidiaries, a result of advances in transportation and communications technologies; and increased competition in the host country (OECD, 1998).

The globalization of R&D is increasing, but the scale and significance of this phenomenon is not universal across countries. Some host countries are benefiting more than others from this trend. The United States, as a host country, is clearly a beneficiary of R&D globalization (Florida, 1997; Hounshell, 1996; Serapio and Dalton, 1999). Indeed, the R&D propensity of foreign affiliates in the United States increased relative to the national average in the U.S. manufacturing sector (Chart 2). At the same time, U.S. multinationals are increasing their R&D spending overseas. As shown in Chart 1, the R&D propensity of majority-owned non-bank foreign affiliates of U.S. parent firms has increased over time relative to their parents in all industries and in the manufacturing sector. For instance, in 1982, the R&D propensity of U.S. foreign affiliates in all industries was less than 22 percent that of their parents, but this number had increased to 33 percent in 1996.

Is Canada benefiting from the globalization of R&D? The answer seems to be negative. As shown in Table 3, the R&D propensity of foreign-controlled firms fell behind that of Canadian-controlled firms. Consequently, the gap in R&D propensity increased significantly during the 1988–94 period. A close examination of the data reveals that 86 percent of the widening gap was due to an increase in the R&D propensity of Canadian-controlled firms, while the remaining 14 percent was due to a decline in the R&D propensity of foreign-controlled firms. Although foreign-controlled firms increased their share of R&D expenditures in motor vehicles, chemicals, and high-tech services industries, their share of R&D in most of resource-based industries decreased dramatically (see Table 2). The decline in their share of R&D in wood and furniture; paper and printing; rubber and plastics; stone, clay and glass; and metals was more than 50 percent from 1985 to 1997.

This result is consistent with the findings from the panel data. As shown in the previous section, after controlling for other factors, both foreign-controlled and Canadian-controlled firms increased their R&D propensity in Canada during the 1985–94 period, but there is no evidence that foreign-controlled firms in Canada were doing more R&D per unit of sales over time than their Canadian-controlled counterparts.[12]

## 4. R&D SPENDING, TECHNOLOGY TRANSFER AND PRODUCTIVITY

In this section, we relate R&D spending of foreign-controlled firms to their productivity performance. As shown in the previous section, foreign-controlled firms do less R&D per unit of sales than Canadian-controlled firms. The question is, does this affect their relative productivity performance? The answer is No. On the contrary, previous studies have consistently shown that foreign-controlled firms outperform Canadian-controlled firms in productivity.[13]

Globerman, Ries and Vertinsky (1994) compared the economic performance of Canadian-controlled and foreign-controlled establishments, using Statistics Canada's Census of Manufacturing, Mines and Logging for 1986. They showed that foreign affiliates have significantly higher value-added per worker than Canadian-controlled firms.[14] Corvari and Wisner (1993) came to the same conclusion, using industry-level data. More recently, Baldwin and Dhaliwal (1998) examined labour productivity differences between domestic and foreign-controlled firms in the Canadian manufacturing sector, using the micro-economic establishments data from the Canadian Census of Manufacturers for the period 1973–93. Their analysis also showed that Canadian-controlled manufacturing firms lagged behind their foreign-controlled counterparts in labour productivity growth among different size and growth groups. In terms of total factor productivity, Rao and Tang (2000), using firm-level data, showed that foreign-controlled firms are, on average, about 15 percent more productive than Canadian-controlled firms, even after taking into account the influence of many factors such as industrial structure, unionization, export orientation, firm size and firm age.

Why do foreign-controlled firms outperform Canadian-controlled firms in productivity despite the fact they do less R&D per unit of output than their Canadian-controlled counterparts? The answer to this question lies in the rationale for the existence of multinationals. According to the transaction cost theory, the rationale for the existence of multinationals is the international utilization of technology (including other intangible assets) to avoid the market failures associated with such assets (Fors, 1996). While it is costly, technology transfer via intra-firm trade is less costly than arm's length market alternatives (Teece, 1977).[15] In addition, advances in transportation and communications technologies have increased the ability to control and coordinate operations in different countries. It has become more efficient for multinationals to exploit their firm-specific knowledge in different countries.

The comparative advantage of multinationals resides in state-of-the-art technologies, often developed in their home country. Multinationals then exploit these firm-specific technologies in many countries to maximise the returns on their investment in those technologies. The international operations lead to technology transfer into the host countries. Fors (1996) and Behrman and Fischer (1980) provided two observations for this argument, based on evidence from company data. First, most R&D is undertaken in multinationals' home operations even though the share of overseas R&D is increasing. Second, R&D performed in the home country is more basic, generally applicable and long-term in character, compared with R&D in foreign affiliates, which is mainly oriented toward adapting technologies created at home to local conditions and regulations.

The Canadian experience strongly supports the hypothesis of a technology transfer from parents to their foreign subsidiaries in host countries. The evidence stems from international transactions linked to technology transfers (Table 6).[16] Technology transfers here cover a variety of income flows for the use of intellectual property rights, including patents, industrial designs, trademarks, franchises, copyrights and related rights. We first observe that the receipts from technology transfers of Canadian-controlled firms were much larger than the corresponding payments, indicating that Canadian-controlled firms are net exporters of technology.

**Table 6**
**International Transactions Linked to Technology Transfers* of Canadian Firms by Ownership and Affiliation, 1997**
**($CDN million)**

| | | Technology Transfers | |
|---|---|---|---|
| | | **Receipts** | **Payments** |
| Foreign-controlled firms | Affiliates | 245 | 2,441 |
| | Other firms | 88 | 205 |
| Canadian-controlled firms | Affiliates | 291 | 77 |
| | Other firms | 279 | 214 |

* This notion covers a variety of flows for the use of intellectual property rights, including patents, industrial designs, trademarks, franchises, copyrights and related rights (the sale of the rights themselves is excluded).
Source: Statistics Canada

This is in a sharp contrast to foreign-controlled firms in Canada. Payments associated with technology transfers by foreign-controlled firms are much larger than the corresponding receipts. The evidence clearly indicates that foreign-controlled firms are massive net importers of technology. Most of their technology is imported from affiliated firms; more than 92 percent of the payments made by foreign-controlled firms go to affiliated companies.

How much technology is transferred from parent firms? In Table 7, we have listed technology transfers of U.S. affiliates in Canada in 1994. In this case, we were able to further decompose affiliated firms into parent companies and other affiliated firms. Table 7 shows that about 78 percent of technology transfers to U.S. foreign affiliates in Canada come from their U.S. parents.

**Table 7**
**Receipts and Payments of Technology Transfers* of U.S. Affiliates in Canada, 1994**
**($US million)**

| | | Technology Transfers | |
|---|---|---|---|
| | | **Receipts** | **Payments** |
| Related firms | U.S. Parents | 23 | 1,123 |
| | Other affiliated firms | 33 | 125 |
| Other firms | | 42 | 200 |

* This notion covers a variety of flows for the use or sale of intangible property or rights, such as patents, industrial processes, trademarks, copyrights, franchises, designs, expertise, formulas, techniques, manufacturing rights, and other intangible assets or proprietary rights.
Source: U.S. Bureau of Economic Analysis

The trade patterns in technology transfers clearly indicate that foreign affiliates in Canada receive massive amounts of technology transfers from their parents. Thus, although foreign affiliates tend to do less R&D in Canada, technology transfers from their parent firms maintain their technological capability and competitiveness.[17] This conclusion is consistent with the observation that foreign-controlled firms tend to spend relatively less on basic research than their Canadian counterparts, reflecting their access to technologies developed by their parent firms (Holbrook and Squires, 1996). It is also in line with the finding that foreign direct investment is associated with lower costs and higher productivity in Canada

over the period 1973–92 (Gera, Gu and Lee, 1999). In addition, it is strongly supported by international evidence from many studies identifying a link between foreign direct investment and efficiency improvements in the host country. For instance, Barrell and Pain (1997) demonstrated that FDI raised technical progress in West Germany and in the United Kingdom. Thus, all the evidence suggests that technology transfers are the key explanation behind the superior productivity performance of foreign-controlled firms in Canada.

## 5. CONCLUSIONS

The main objective of this paper was to analyse the R&D performance of foreign-controlled firms in Canada. Our empirical results from panel data show that even after accounting for other factors, the R&D propensity of foreign-controlled firms is significantly lower than that of Canadian-controlled firms. In both groups, the R&D propensity is higher in high-tech and export-oriented firms, and lower in large and mid-size firms. Although the R&D propensity of the two groups of firms has increased at the same pace during the 1985–94 period, there is no evidence that Canada is benefiting from the globalization of R&D.

Despite the fact that foreign-controlled firms spend less on R&D, they are, on average, more productive than Canadian-controlled firms because of their superior technological and managerial capabilities, imported from their parents. An important implication of this result is that R&D as an indicator of innovation is biased against foreign-controlled firms, which suggests that the innovative performance of foreign-controlled firms should not be judged by their R&D propensity. Instead, it should be judged on the basis of a broad set of performance indicators such as output and productivity growth, export orientation and technology adoption.

## NOTES

1 In 1997, on average, foreign-controlled manufacturing firms paid their employees 25 percent more than Canadian-controlled firms.

2 We use R&D propensity instead of R&D intensity. Jeffrey Bernstein pointed out that although the term R&D intensity is often used, especially by the OECD, it is in fact incorrect. Intensity usually refers to either an input-output ratio or the ratio of two inputs.

3 There are intra-industry, inter-industry and cross-border R&D investment spillovers. In general, the social rates of return to R&D investments greatly exceed their private rates of return (Griliches, 1979; Bernstein, 1988).

4 Some people may argue that foreign-controlled firms have a lower R&D propensity than Canadian-controlled firms because they are more productive — they generate more sales than Canadian-controlled firms per unit of input. However, the question is why foreign-controlled firms are more productive than Canadian-controlled firms. The issue is discussed in section 4.

5 As shown by Behrman and Fischer (1980) and Fors (1996), home-country R&D is more basic and long-term while R&D undertaken in foreign affiliates is mainly oriented toward adapting technologies created at home to local conditions and regulations.

6 A firm is ultimately foreign-controlled if a majority of its voting rights is held by foreign citizens or by one or more Canadian companies that are themselves foreign-controlled. Ownership here is measured in discrete terms as Canadian-controlled or foreign-controlled. We are constrained by the data to measure this variable in a more continuous fashion.

7 Similar results are obtained with ordinary least-square estimation.

8 There are many other factors, such as cash flows, government grants, and R&D tax credits, affecting R&D activities in Canadian-controlled and foreign-controlled firms. In terms of government grants, Howe and McFetridge (1976) showed that an incentive grant has on average more effect on increasing total own-funds R&D expenditures in Canadian-controlled firms than in foreign-controlled firms.

9 Note here that all firms are performing R&D. In general, large firms are more likely to perform R&D than small firms (Cohen and Klepper, 1996; Baldwin, 1997).

10 Autocorrelation is not considered here because it is inconsistent with the objective of the study. One of the main objectives of our study is to examine whether ownership matters in R&D spending. Autocorrelation in the specification will essentially eliminate any fixed effect of individual firms on R&D. Thus, with autocorrelation, we are unable to measure the difference in R&D spending between foreign-controlled firms and Canadian-controlled firms. Indeed, the model with autocorrelation does not converge at all for the same reason.

11 The positive coefficient of the time trend could be capturing the influence of the growing importance of innovation for competitiveness and profitability, and the positive influence of government incentives in encouraging R&D spending in Canada.

12 Anderson and Gault (1999) showed that the percentage of foreign sources of funding for Canadian R&D performers has been increasing during the period 1987–95. However, this increase largely reflects the relative increase of foreign firms in Canada, and does not indicate a trend towards increased internationalization of R&D.

13 Using U.S. establishments data, Doms and Jensen (1998) also found that foreign-controlled firms were more productive than domestically-controlled firms in the United States.

14 Note, however, that the difference vanished once factors such as size and capital propensity were controlled.

15 Behrman and Wallender (1976) suggest five general mechanisms of technology transfer from parents to foreign affiliates: (i) documentation in the form of manuals produced for specific purposes or through regular reporting from parent companies, (ii) instruction programs, (iii) visits and exchanges of technical personnel, (iv) development and transfer of specialised equipment for use in affiliates, and (v) continuous oral and written communications.

16 There is strong evidence showing that part of knowledge transfers to affiliates are also "embodied" in intermediate-good deliveries from parent companies (Coe and Helpman, 1995; Scherer, 1982; and Fors, 1996).

17 This is true for a country as a whole, as the OECD (1998) shows that some countries where the R&D propensity is low spend far more on patent and licence imports than they do on their own research.

## BIBLIOGRAPHY


Anderson, Frances and Fred Gault. "Developing Indicators of the Internationalization of R&D: The Case of Canada," *Research Evaluation,* 8, 1 (1999): 15–22.

Baldwin, John R. "The Importance of Research and Development for Innovation in Small and Large Canadian Manufacturing Firms," Working Paper, Statistics Canada, 1997.

Baldwin, John and Naginder Dhaliwal. "Labour Productivity Differences Between Domestic and Foreign-Controlled Firms in the Canadian Manufacturing Sector," manuscript, Statistics Canada and Agriculture and Agri-Food Canada, 1998.

Barrell, Ray and Nigel Pain. "Foreign Direct Investment, Technological Change, and Economic Growth within Europe," *Economic Journal,* 107 (1997): 1770–86.

Behrman, J.N. and W.A. Fischer. *Overseas R&D Activities of Transnational Companies*. Cambridge: Oelgeschlager, Gunn & Hain Publishers, 1980.

Behrman, J.N. and H. Wallender. *Transfers of Manufacturing Technology Within Multinational Enterprises*. Cambridge: Ballinger Publishing Co., 1976.

Bernstein, Jeffrey I. "Costs of Production, Intra- and Interindustry R&D Spillovers: Canadian Evidence," *Canadian Journal of Economics,* XXI (1988): 325–47.

Caves, Richard E. *Multinational Enterprise and Economic Analysis*, Second Edition, Cambridge University Press, 1996.

Coe, D. and E. Helpman. "International R&D Spillovers," *European Economic Review*, 39 (1995): 859–87.

Cohen, W.M. and S. Klepper. "A Reprise of Size and R&D," *Economic Journal*, 106 (1996): 925–52.

Corvari, Ronald and Robert Wisner. "Foreign Multinationals and Canada's International Competitiveness," Working Paper No. 16, Investment Canada, 1993.

Doms, M.E. and J.B. Jensen. "Comparing Wages, Skills, and Productivity between Domestically and Foreign-Owned Manufacturing Establishments in the United States," in *Geography and Ownership as Bases for Economic Accounting*. Edited by Robert E. Baldwin, Robert E. Lipsey and J. David Richardson, Chicago: University of Chicago Press, 1998.

Florida, Richard. "The Globalization of R&D: Results of a Survey of Foreign-Affiliated R&D Laboratories in the USA," *Research Policy*, 26 (1997): 85–103.

Fors, Gunnar. "R&D and Technology Transfer by Multinational Enterprises," A dissertation for the Doctor's Degree in Philosophy, Stockholm School of Economics, 1996.

Gera, Surendra, Wulong Gu and Frank Lee. "Foreign Direct Investment and Productivity Growth: The Canadian Host-Country Experience," Working Paper No. 30, Industry Canada, 1999.

Globerman, Steven, John C. Ries, and Ilan Vertinsky. "The Economic Performance of Foreign Affiliates in Canada," *Canadian Journal of Economics*, 27 (1994): 141–56.

Griliches, Z. "Issues in Assessing the Contribution of Research and Development to Productivity Growth," *Bell Journal of Economics*, 10 (1979): 92–116.

Holbrook, J.A.D. and R.J. Squires. "Canadian R&D: Firm-Level Analysis of Determinants of Canadian Industrial R&D Performance," *Science and Public Policy*, 23, 6 (1996): 369–74.

Hounshell, D.A. "Pondering the Globalization of R&D: Some New Questions for Business Historians," *Business and Economic History*, 25 (1996): 131–43.

Howe, J.D. and D.G. McFetridge. "The Determinants of R&D Expenditures," *Canadian Journal of Economics*, 9 (1976): 57–71.

OECD. *Internationalisation of Industrial R&D: Patterns and Trends*, Paris, 1998.

Pearce, R.D. *The Internationalization of R&D by Multinational Enterprises*. London: McMillan, 1989.

Pearce, R.D. and S. Singh. *Globalizing Research and Development*. London: McMillan, 1992.

Rao, S., M. Legault and A. Ahmad. "Canadian-Based Multinationals: An Analysis of Activities and Performance," Working Paper No. 2, Industry Canada, 1994.

Rao, S. and J. Tang. "Are Canadian-controlled Manufacturing Firms less Productive than their Foreign-Controlled Counterparts?" Working Paper No. 31, Industry Canada, 2000.

Ronstadt, R.C. "International R&D: The Establishment and Evolution of Research and Development Abroad by Seven U.S. Multinationals," *Journal of International Business Studies*, (1978): 7–24.

Scherer, F.M. "Inter Industry Technology Flows and Productivity Growth," *Review of Economics and Statistics*, 64 (1982): 627–34.

Serapio Jr., Manuel G. and Donald H. Dalton. "Globalization of Industrial R&D: An Examination of Foreign Direct Investments in R&D in the United States," *Research Policy*, 28 (1999): 303–16.

Teece, D.J. "Technology Transfer by Multinational Firms: The Resource Cost of Transferring Technological Know-How," *Economic Journal*, 87 (1977): 242–61.

# INDUSTRY CANADA RESEARCH PUBLICATIONS

## *INDUSTRY CANADA WORKING PAPER SERIES*

No. 1 **Economic Integration in North America: Trends in Foreign Direct Investment and the Top 1,000 Firms**, Micro-Economic Policy Analysis staff including John Knubley, Marc Legault, and P. Someshwar Rao, Industry Canada, 1994.

No. 2 **Canadian-Based Multinationals: An Analysis of Activities and Performance,** Micro-Economic Policy Analysis staff including P. Someshwar Rao, Marc Legault, and Ashfaq Ahmad, Industry Canada, 1994.

No. 3 **International R&D Spillovers Between Industries in Canada and the United States**, Jeffrey I. Bernstein, Carleton University and National Bureau of Economic Research, under contract with Industry Canada, 1994.

No. 4 **The Economic Impact of Mergers and Acquisitions on Corporations**, Gilles Mcdougall, Micro-Economic Policy Analysis, Industry Canada, 1995.

No. 5 **Steppin' Out: An Analysis of Recent Graduates Into the Labour Market**, Ross Finnie, School of Public Administration, Carleton University, and Statistics Canada, under contract with Industry Canada, 1995.

No. 6 **Measuring the Compliance Cost of Tax Expenditures: The Case of Research and Development Incentives**, Sally Gunz and Alan Macnaughton, University of Waterloo, and Karen Wensley, Ernst & Young, Toronto, under contract with Industry Canada, 1996.

No. 7 **Governance Structure, Corporate Decision-Making and Firm Performance in North America**, P. Someshwar Rao and Clifton R. Lee-Sing, Micro-Economic Policy Analysis, Industry Canada, 1996.

No. 8 **Foreign Direct Investment and APEC Economic Integration**, Ashfaq Ahmad, P. Someshwar Rao, and Colleen Barnes, Micro-Economic Policy Analysis, Industry Canada, 1996.

No. 9 **World Mandate Strategies for Canadian Subsidiaries**, Julian Birkinshaw, Institute of International Business, Stockholm School of Economics, under contract with Industry Canada, 1996.

No. 10 **R&D Productivity Growth in Canadian Communications Equipment and Manufacturing**, Jeffrey I. Bernstein, Carleton University and National Bureau of Economic Research, under contract with Industry Canada, 1996.

No. 11 **Long-Run Perspective on Canadian Regional Convergence**, Serge Coulombe, Department of Economics, University of Ottawa, and Frank C. Lee, Industry Canada, 1996.

No. 12 **Implications of Technology and Imports on Employment and Wages in Canada**, Frank C. Lee, Micro-Economic Policy Analysis, Industry Canada, 1996.

No. 13 **The Development of Strategic Alliances in Canadian Industries: A Micro Analysis,** Sunder Magun, Applied International Economics, under contract with Industry Canada, 1996.

No. 14 **Employment Performance in the Knowledge-Based Economy**, Surendra Gera, Industry Canada, and Philippe Massé, Human Resources Development Canada, 1996.

No. 15 **The Knowledge-Based Economy: Shifts in Industrial Output**, Surendra Gera, Industry Canada, and Kurt Mang, Department of Finance, 1997.

No. 16 **Business Strategies of SMEs and Large Firms in Canada**, Gilles Mcdougall and David Swimmer, Micro-Economic Policy Analysis, Industry Canada, 1997.

No. 17 **Impact of China's Trade and Foreign Investment Reforms on the World Economy**, Winnie Lam, Micro-Economic Policy Analysis, Industry Canada, 1997.

No. 18 **Regional Disparities in Canada: Characterization, Trends and Lessons for Economic Policy**, Serge Coulombe, Department of Economics, University of Ottawa, under contract with Industry Canada, 1997.

No. 19 **Inter-Industry and U.S. R&D Spillovers, Canadian Industrial Production and Productivity Growth**, Jeffrey I. Bernstein, Carleton University and National Bureau of Economic Research, under contract with Industry Canada, 1998.

No. 20 **Information Technology and Labour Productivity Growth: An Empirical Analysis for Canada and the United States**, Surendra Gera, Wulong Gu, and Frank C. Lee, Micro-Economic Policy Analysis, Industry Canada, 1998.

No. 21 **Capital-Embodied Technical Change and the Productivity Growth Slowdown in Canada**, Surendra Gera, Wulong Gu, and Frank C. Lee, Micro-Economic Policy Analysis, Industry Canada, 1998.

No. 23 **Restructuring in Canadian Industries: A Micro Analysis**, Sunder Magun, Applied International Economics, under contract with Industry Canada, 1998.

No. 24 **Canadian Government Policies Toward Inward Foreign Direct Investment**, Steven Globerman, Simon Fraser University and Western Washington University, and Daniel Shapiro, Simon Fraser University, under contract with Industry Canada, 1998.

No. 25 **A Structuralist Assessment of Technology Policies – Taking Schumpeter Seriously on Policy,** Richard G. Lipsey and Kenneth Carlaw, Simon Fraser University, with a contribution by Davit D. Akman, research associate, under contract with Industry Canada, 1998.

No. 26 **Intrafirm Trade of Canadian-Based Foreign Transnational Companies,** Richard A. Cameron, Micro-Economic Policy Analysis, Industry Canada, 1998.

No. 27 **Recent Jumps in Patenting Activities: Comparative Innovative Performance of Major Industrial Countries, Patterns and Explanations**, Mohammed Rafiquzzaman and Lori Whewell, Micro-Economic Policy Analysis, Industry Canada, 1998.

No. 28 **Technology and the Demand for Skills: An Industry-Level Analysis**, Surendra Gera and Wulong Gu, Industry Canada, and Zhengxi Lin, Statistics Canada, 1999.

No. 29 **The Productivity Gap Between Canadian and U.S. Firms**, Frank C. Lee and Jianmin Tang, Micro-Economic Policy Analysis, Industry Canada, 1999.

No. 30 **Foreign Direct Investment and Productivity Growth: The Canadian Host-Country Experience**, Surendra Gera, Wulong Gu and Frank C. Lee, Micro-Economic Policy Analysis, Industry Canada, 1999.

No. 31 **Are Canadian-Controlled Manufacturing Firms Less Productive than their Foreign-Controlled Counterparts?** Someshwar Rao and Jianmin Tang, Micro-Economic Policy Analysis, Industry Canada, 2000.

No. 32 **The Canada-U.S. Productivity Growth Paradox**, Serge Coulombe, Department of Economics, University of Ottawa, under contract with Industry Canada, 2000.

No. 33 **R&D Propensity and Productivity Performance of Foreign-Controlled Firms in Canada**, Jianmin Tang and Someshwar Rao, Micro-Economic Policy Analysis, Industry Canada, 2001.

### *INDUSTRY CANADA DISCUSSION PAPER SERIES*

No. 1 **Multinationals as Agents of Change: Setting a New Canadian Policy on Foreign Direct Investment**, Lorraine Eden, Carleton University, under contract with Industry Canada, 1994.

No. 2 **Technological Change and International Economic Institutions**, Sylvia Ostry, Centre for International Studies, University of Toronto, under contract with Industry Canada, 1995.

No. 3 **Canadian Corporate Governance: Policy Options**, Ronald. J. Daniels, Faculty of Law, University of Toronto, and Randall Morck, Faculty of Business, University of Alberta, under contract with Industry Canada, 1996.

No. 4 **Foreign Direct Investment and Market Framework Policies: Reducing Frictions in APEC Policies on Competition and Intellectual Property**, Ronald Hirshhorn, under contract with Industry Canada, 1996.

No. 5 **Industry Canada's Foreign Investment Research: Messages and Policy Implications**, Ronald Hirshhorn, under contract with Industry Canada, 1997.

No. 6 **International Market Contestability and the New Issues at the World Trade Organization,** Edward M. Graham, Institute for International Economics, Washington (D.C.), under contract with Industry Canada, 1998.

No. 7 **Implications of Foreign Ownership Restrictions for the Canadian Economy – A Sectoral Analysis,** Steven Globerman, Western Washington University, under contract with Industry Canada, 1999.

No. 8 **Determinants of Canadian Productivity Growth: Issues and Prospects**, Richard G. Harris, Simon Fraser University and Canadian Institute for Advanced Research, under contract with Industry Canada, 1999.

No. 9 **Is Canada Missing the "Technology Boat"? Evidence from Patent Data**, Manuel Trajtenberg, Tel Aviv University, National Bureau of Economic Research and Canadian Institute for Advanced Research, under contract with Industry Canada, 2000.

No. 10 **North American Economic Integration: Issues and Research Agenda**, Richard G. Harris, Simon Fraser University, under contract with Industry Canada, 2001.

### *INDUSTRY CANADA OCCASIONAL PAPER SERIES*

No. 1 **Formal and Informal Investment Barriers in the G-7 Countries: The Country Chapters**, Micro-Economic Policy Analysis staff including Ashfaq Ahmad, Colleen Barnes, John Knubley, Rosemary D. MacDonald, and Christopher Wilkie, Industry Canada, 1994.

**Formal and Informal Investment Barriers in the G-7 Countries: Summary and Conclusions**, Micro-Economic Policy Analysis staff including Ashfaq Ahmad, Colleen Barnes, and John Knubley, Industry Canada, 1994.

No. 2 **Business Development Initiatives of Multinational Subsidiaries in Canada**, Julian Birkinshaw, University of Western Ontario, under contract with Industry Canada, 1995.

No. 3 **The Role of R&D Consortia in Technology Development**, Vinod Kumar, Research Centre for Technology Management, Carleton University, and Sunder Magun, Centre for Trade Policy and Law, University of Ottawa and Carleton University, under contract with Industry Canada, 1995.

No. 4 **Gender Tracking in University Programs**, Sid Gilbert, University of Guelph, and Alan Pomfret, King's College, University of Western Ontario, under contract with Industry Canada, 1995.

No. 5 **Competitiveness: Concepts and Measures**, Donald G. McFetridge, Department of Economics, Carleton University, under contract with Industry Canada, 1995.

No. 6 **Institutional Aspects of R&D Tax Incentives: The SR&ED Tax Credit**, G. Bruce Doern, School of Public Administration, Carleton University, under contract with Industry Canada, 1995.

No. 7 **Competition Policy as a Dimension of Economic Policy: A Comparative Perspective**, Robert D. Anderson and S. Dev Khosla, Economics and International Affairs Branch, Bureau of Competition Policy, Industry Canada, 1995.

No. 8 **Mechanisms and Practices for the Assessment of the Social and Cultural Implications of Science and Technology**, Liora Salter, Osgoode Hall Law School, University of Toronto, under contract with Industry Canada, 1995.

No. 9 **Science and Technology: Perspectives for Public Policy**, Donald G. McFetridge, Department of Economics, Carleton University, under contract with Industry Canada, 1995.

No. 10 **Endogenous Innovation and Growth: Implications for Canada**, Pierre Fortin, Université du Québec à Montréal and Canadian Institute for Advanced Research, and Elhanan Helpman, Tel Aviv University and Canadian Institute for Advanced Research, under contract with Industry Canada, 1995.

No. 11 **The University-Industry Relationship in Science and Technology**, Jérôme Doutriaux, University of Ottawa, and Margaret Barker, Meg Barker Consulting, under contract with Industry Canada, 1995.

No. 12 **Technology and the Economy: A Review of Some Critical Relationships**, Michael Gibbons, University of Sussex, under contract with Industry Canada, 1995.

No. 13 **Management Skills Development in Canada**, Keith Newton, Micro-Economic Policy Analysis, Industry Canada, 1995.

No. 14 **The Human Factor in Firm's Performance: Management Strategies for Productivity and Competitiveness in the Knowledge-Based Economy**, Keith Newton, Micro-Economic Policy Analysis, Industry Canada, 1996.

No. 15 **Payroll Taxation and Employment: A Literature Survey**, Joni Baran, Micro-Economic Policy Analysis, Industry Canada, 1996.

No. 16 **Sustainable Development: Concepts, Measures, Market and Policy Failures at the Open Economy, Industry and Firm Levels**, Philippe Crabbé, Institute for Research on the Environment and Economy, University of Ottawa, under contract with Industry Canada, 1997.

No. 17 **Measuring Sustainable Development: A Review of Current Practice,** Peter Hardi and Stephan Barg, with Tony Hodge and Laszlo Pinter, International Institute for Sustainable Development, under contract with Industry Canada, 1997.

No. 18 **Reducing Regulatory Barriers to Trade: Lessons for Canada from the European Experience**, Ramesh Chaitoo and Michael Hart, Centre for Trade Policy and Law, Carleton University, under contract with Industry Canada, 1997.

No. 19 **Analysis of International Trade Dispute Settlement Mechanisms and Implications for Canada's Agreement on Internal Trade**, E. Wayne Clendenning and Robert J. Clendenning, E. Wayne Clendenning & Associates Inc., under contract with Industry Canada, 1997.

No. 20 **Aboriginal Businesses: Characteristics and Strategies for Growth**, David Caldwell and Pamela Hunt, Management Consulting Centre, under contract with Aboriginal Business Canada, Industry Canada, 1998.

No. 21 **University Research and the Commercialization of Intellectual Property in Canada,** Wulong Gu and Lori Whewell, Micro-Economic Policy Analysis, Industry Canada, 1999.

No. 22 **A Regional Perspective on the Canada-U.S. Standard of Living Comparison,** Raynald Létourneau and Martine Lajoie, Micro-Economic Policy Analysis, Industry Canada, 2000.

No. 23 **Linkages Between Technological Change and Productivity Growth**, Steven Globerman, Western Washington University, under contract with Industry Canada, 2000.

No. 24 **Investment and Productivity Growth – A Survey From the Neoclassical and New Growth Perspectives**, Kevin J. Stiroh, Federal Reserve Bank of New York, under contract with Industry Canada, 2000.

No. 25 **The Economic Determinants of Innovation,** Randall Morck, University of Alberta, and Bernard Yeung, New York University, under contract with Industry Canada, 2000.

No. 26 **SMEs, Exports and Job Creation: A Firm-Level Analysis**, Élisabeth Lefebvre and Louis A. Lefebvre, CIRANO and École Polytechnique de Montréal, under contract with Industry Canada, 2000.

### *CANADA IN THE 21ST CENTURY SERIES*

No. 1 **Global Trends: 1980-2015 and Beyond**, J. Bradford DeLong, University of California, Berkeley, under contract with Industry Canada, 1998.

No. 2 **Broad Liberalization Based on Fundamentals: A Framework for Canadian Commercial Policy**, Randy Wigle, Wilfrid Laurier University, under contract with Industry Canada, 1998.

No. 3 **North American Economic Integration: 25 Years Backward and Forward**, Gary C. Hufbauer and Jeffrey J. Schott, Institute for International Economics, Washington (D.C.), under contract with Industry Canada, 1998.

No. 4 **Demographic Trends in Canada, 1996-2006: Implications for the Public and Private Sectors**, David K. Foot, Richard A. Loreto, and Thomas W. McCormack, Madison Avenue Demographics Group, under contract with Industry Canada, 1998.

No. 5 **Capital Investment Challenges in Canada**, Ronald P.M. Giammarino, University of British Columbia, under contract with Industry Canada, 1998.

No. 6 **Looking to the 21st Century – Infrastructure Investments for Economic Growth and for the Welfare and Well-Being of Canadians**, Christian DeBresson, Université du Québec à Montréal, and Stéphanie Barker, Université de Montréal, under contract with Industry Canada, 1998.

No. 7 **The Implications of Technological Change for Human Resource Policy**, Julian R. Betts, University of California, San Diego, under contract with Industry Canada, 1998.

No. 8 **Economics and the Environment: The Recent Canadian Experience and Prospects for the Future**, Brian R. Copeland, University of British Columbia, under contract with Industry Canada, 1998.

No. 9 **Individual Responses to Changes in the Canadian Labour Market**, Paul Beaudry and David A. Green, University of British Columbia, under contract with Industry Canada, 1998.

No. 10 **The Corporate Response – Innovation in the Information Age**, Randall Morck, University of Alberta, and Bernard Yeung, University of Michigan, under contract with Industry Canada, 1998.

No. 11 **Institutions and Growth: Framework Policy as a Tool of Competitive Advantage for Canada**, Ronald J. Daniels, University of Toronto, under contract with Industry Canada, 1998.

### *PERSPECTIVES ON NORTH AMERICAN FREE TRADE SERIES*

No. 1 **Can Small-Country Manufacturing Survive Trade Liberalization? Evidence from the Canada-U.S. Free Trade Agreement**, Keith Head and John Ries, University of British Columbia, under contract with Industry Canada, 1999.

No. 2 **Modelling Links Between Canadian Trade and Foreign Direct Investment,** Walid Hejazi and A. Edward Safarian, University of Toronto, under contract with Industry Canada, 1999.

No. 3 **Trade Liberalisation and the Migration of Skilled Workers,** Steven Globerman, Western Washington University and Simon Fraser University, under contract with Industry Canada, 1999.

No. 4 **The Changing Industry and Skill Mix of Canada's International Trade**, Peter Dungan and Steve Murphy, Institute for Policy Analysis, University of Toronto, under contract with Industry Canada, 1999.

No. 5 **Effects of the Canada-United States Free Trade Agreement on Interprovincial Trade**, John F. Helliwell, University of British Columbia, Frank C. Lee, Industry Canada, and Hans Messinger, Statistics Canada, 1999.

No. 6 **The Long and Short of the Canada-U.S. Free Trade Agreement,** Daniel Trefler, University of Toronto, under contract with Industry Canada, 1999.

### *MONOGRAPH*

**Industry-Level Productivity and International Competitiveness Between Canada and the United States**, edited by Dale W. Jorgenson, Harvard University, and Frank C. Lee, Industry Canada, 2001.

### *RESEARCH VOLUME SERIES*

No. 1 **Foreign Investment, Technology and Economic Growth**, Donald G. McFetridge ed., University of Calgary Press, 1991.

No. 2 **Corporate Globalization Through Mergers and Acquisitions**, L. Waverman ed., University of Calgary Press, 1991.

No. 3 **Multinationals in North America**, Lorraine Eden ed., University of Calgary Press, 1994.

No. 4 **Canadian-Based Multinationals**, Steven Globerman ed., University of Calgary Press, 1994.

No. 5 **Corporate Decision-Making in Canada**, Ronald J. Daniels and Randall Morck eds., University of Calgary Press, 1995.

No. 6 **Implications of Knowledge-Based Growth for Micro-Economic Policies,** Peter Howitt ed., University of Calgary Press, 1996.

No. 7 **The Asia Pacific Region in the Global Economy: A Canadian Perspective,** Richard G. Harris ed., University of Calgary Press, 1996.

No. 8 **Financing Growth in Canada**, Paul J.N. Halpern ed., University of Calgary Press, 1997.

No. 9 **Competition Policy and Intellectual Property Rights in the Knowledge-Based Economy**, Robert D. Anderson and Nancy T. Gallini eds., University of Calgary Press, 1998.

***JOINT PUBLICATIONS***

**Capital Budgeting in the Public Sector**, in collaboration with the John Deutsch Institute, Jack Mintz and Ross S. Preston eds., 1994.

**Infrastructure and Competitiveness**, in collaboration with the John Deutsch Institute, Jack Mintz and Ross S. Preston eds., 1994.

**Getting the Green Light: Environmental Regulation and Investment in Canada**, in collaboration with the C.D. Howe Institute, Jamie Benidickson, G. Bruce Doern, and Nancy Olewiler, 1994.

To obtain copies of documents published under Industry Canada's Research Publications Program, please contact:

Publications Officer
Micro-Economic Policy Analysis
Industry Canada
5th Floor, West Tower
235 Queen Street
Ottawa, Ontario, K1A 0H5

Tel.: (613) 952-5704
Fax: (613) 991-1261
E-mail: mepa.apme@ic.gc.ca