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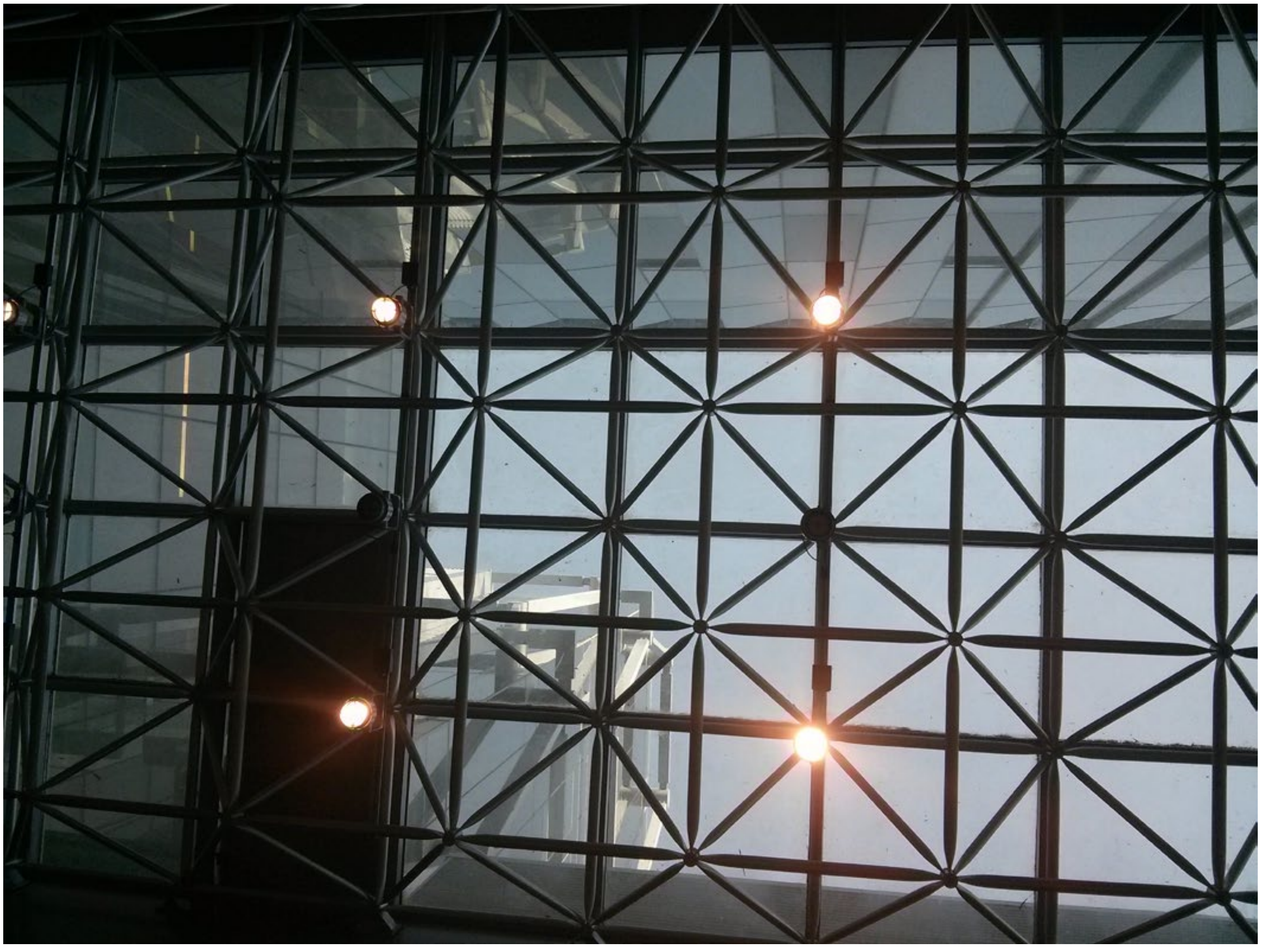

RESEARCH ARTICLE

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Cogent Economics & Finance (2014), 2: 920269

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Received: 21 October 2013
Accepted: 21 April 2014
Published: 26 June 2014

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Reviewing Editor:
Steve Cook, Swansea University

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Abstract: Few studies have examined the relationship between inter-industry, inter-corporate ownership (ICO) patterns and inter-industry resource exchange patterns. Using data from Statistics Canada, this paper reveals a positive association between the degree of ICO linkages and the degree of input–output dependence among Canadian industry groups. This provides empirical support for the primary assertion of resource dependence theory: that corporations employ ICO linkages to manage their input–output dependence resulting from recurrent resource exchanges. This research differs from extant tests of resource dependence in that it uses data for the population of firms (over a size threshold) in Canada and includes all forms of interdependence between enterprises. The findings suggest scenarios in which corporations can adopt ICO linkages to manage resource dependence and reduce transaction costs.

Keywords: D57—input–output analysis, L1—market structure, firm strategy, and market performance, P23—factor and product markets|industry studies|population

1. Introduction

Despite the influence of resource dependence theory on management theory, few studies explicitly examine the relationship between inter-corporate ownership (ICO) patterns and inter-industry resource exchange patterns. The key empirical evidence for attempts to domesticate markets for key resources is implied from observed patterns of mergers and acquisition, joint ventures, interlocking directorates and the like (e.g. Finkelstein, 1997; Pfeffer, 1972b). This research examines how Canadian corporations in aggregate employ ICO linkages to manage their input–output dependence. The Canadian national account of input–output tables and the ICO Database serve as the data sets for an examination of the association between ICO linkages and input–output dependence. The findings provide strong evidence for a positive association between the degree of ICO linkages and the degree of input–output dependence among Canadian industry groups, thus supporting arguments developed from resource dependence theory.

Resource dependence theory is an external control organization theory that argues that organizations employ various inter-organizational linkages to manage and control their resource dependence on other actors in the environment (Jones, 2001; Pfeffer, 1982; Pfeffer & Salancik, 1978). The resource dependence literature (see Glasberg & Schwartz, 1983, pp. 331–314, or Pfeffer, 1982, Chap. 5 for a review) characterizes the industrial structure of an economy as a dense network of interdependent companies, each vying for positional advantage relative to their environment and each other (Glasberg & Schwartz, 1983). Firms relate to each other in complex ways, beyond market transactions, in an attempt to gain co-operation and full or partial control over resources. This includes mergers that internalize resources, and diversification and conglomerate strategies to reduce dependence on a particular set of resources (Pfeffer & Salancik, 1978). Resource dependence theory does not hypothesize a stable hierarchy of dominance within an industrial system, so a market for corporate control is created as firms adapt to the ever-changing network and attempt to reduce their dependencies.

The resource dependence literature helps scholars and managers to understand the role and implications of ICO linkages in managing input–output dependencies. Our research is an extension of Pfeffer et al.'s tests of resource dependence theory. Extant empirical work focuses on particular forms of market domestication e.g. mergers and acquisitions or interlocking directorates, and are based on samples. The research reported in this paper uses a unique data-set that includes Greenfield investments, control gained through acquisition or merger, joint ventures, minority controlling interests and the like. The data are also a population of ownership linkages for the Canadian economy (subject to certain size thresholds and deletion of non-profit and government sectors). Our research addresses the following question: *Is there an association between patterns of* input–*output dependence and inter-industry ownership links?*

2. Resource Dependence

Resource dependence theory asserts that the goal of an organization is to minimize its dependence on other organizations for the supply of scarce resources in its environment and to find ways of influencing other organizations to make resources available (Jones, 2001). The rationale of the theory is as follows. Organizations are open systems whose survival and development are constrained by external influences (Boyd, 1990; Buvik & Gronhaug, 2000; Pfeffer & Salancik, 1978). Some resources are scarce and controlled by other organizations in the environment (Pfeffer, 1982). To survive and grow, organizations have to use various strategies to secure their inputs from suppliers and outputs to buyers (Sheppard, 1995).

Selznick's (1949) study of the Tennessee Valley Authority is the first focusing on the organizational environment (Mizruchi & Galaskiewicz, 1993). Selznick noticed that an organization facing strong opposition could partially neutralize the opposition by bringing representatives of hostile groups into the organization's governing boards. The Tennessee Valley Authority's approach to dealing with its problem illustrates the management of the organizational environment to fulfil organizational goals.

Other significant developments in the resource view include Levine and White's (1961) focus on exchange as a conceptual framework for the study of inter-organizational relationships. They argued that under the condition of resource scarcity, organizations must implement inter-organizational exchanges to attain their goals. In addition, Katz and Kahn's (1966) characterization of an open-systems approach for studying organizations enhanced the theoretical foundation of resource dependence theory by regarding organizations as an element of the environment. Starbuck's (1965) study of organizational growth suggests that organizations attempt to manage their environment to make it more favourable, and Thompson (1967) proposed that organizations seek to manage their dependence on the environment.

Pfeffer and Salancik's (1978) book is a forceful exposition of resource dependence theory and is often cited as the most important reference of resource dependence theory. In the book, Pfeffer and Salancik discuss relationships between organizations and their environment and introduce various organizational strategies to manage the environment. The focus of the book is organizational strategies to manage organizational environment. The organization and social context were defined in the book followed by discussion of social control of organizations and enacted organizational environment. The strategies range from adaptation to avoidance, altering interdependence, inter-organizational action, law and social sanction, and executive succession.

Empirical studies of resource dependence theory typically focus on testing propositions developed from the perspective that organizations employ various strategies to control critical resources for organizational survival and development. Researchers usually choose organizational responses to manage and control their resource dependence as dependent variables. Organizations can reduce their resource dependence on other actors in the environment by employing appropriate mechanisms in corporate governance and establishing inter-organizational linkages. The size and composition of boards of directors, inter-industry merger patterns, and inter-organizational linkages are organizational responses commonly used in studies of resource dependence. The characteristics of the environment faced by organizations normally serve as independent variables in empirical tests of the theory. Most extant studies find evidence that organizations do respond to resource dependence by employing appropriate strategies to reduce the dependence. Table 1 summarizes some of the better-known empirical tests of resource dependence theory.

A particularly prominent test of the theory is Pfeffer's (1972a) study of the size and composition of corporate boards of directors. Instead of viewing the board as a managing body, Pfeffer argued that board composition depends on the needs to deal differentially with various important organizations in the environment. The thesis is that organizations use their boards of directors as vehicles to deal with important organizations with whom they are interdependent. A random sample of eighty corporations was drawn from the Dun and Bradstreet directory for 1969, and correlations where calculated number of directors, size of the firm, debt-equity ratio, and measures of the regulatory environment. A multiple regression analysis was performed for two dimensions of size and board composition. The results indicated that board size and composition were systematically related to the organization's needs to deal with important external sectors, financial and legal forces, to gain

Table 1. Summary of Empirical Studies of Resource Dependence Theory

Empirical study	Research context	Data sample	Research methods	Key findings
Pfeffer (1972a)	Size and composition of the corporate boards of directors as a response to resource dependence	A random sample of eighty corporations drawn from the Dun and Bradstreet *Reference Book of Corporate Management, 1969*	Spearman correlation analysis and multiple linear regression	Board size and composition systematically relate to the organization's needs to deal with important external sectors, financial and legal forces, to gain an adequate supply of resources for the future
Pfeffer (1972b)	Mergers are responses to organizational resource dependence	A sample of 854 mergers between manufacturing companies in US from 1948 to 1969	Correlation analysis	Mergers positively correlate to the exchange relationships between merger parties organizations employ mergers as a strategy to control their resource dependence
Sheppard (1995)	Organizational success and failure	A sample of failed firms and non-failed firms in US in 1977, 1980, and 1982	Logit analysis	Possession of critical resources is an important determinant for organizational success
Finkelstein (1997)	Relationship between inter-industry mergers and inter-industry resources exchanges	A sample 17850 inter-industry mergers among 51 manufacturing industries in US from 1947 to 1992	Multiple linear regression	Mergers are organizational response to their resource dependence on their input–output transaction partners
Buvik and Gronhaug (2000)	Vertical coordination as a response to resource dependence	A sample of 157 industrial purchasing relationships in US manufacturing industries	Multiple linear regression	Vertical coordination positively correlated to the inter-industry transactions
Hillman, Cannella, and Paetzold (2000)	The change of board composition responding to the deregulation of US air travel industry	A sample of 202 directors of the boards in 14 airlines from 1968 to 1988	Loglinear	The composition of boards changed to reflect the shift in resource need facing the firm when changes in organizational environment occur

an adequate supply of resources for the future. Similarly, Pfeffer (1972b) studied the relationship between M&A activity and external variables, reaching a similar conclusion.

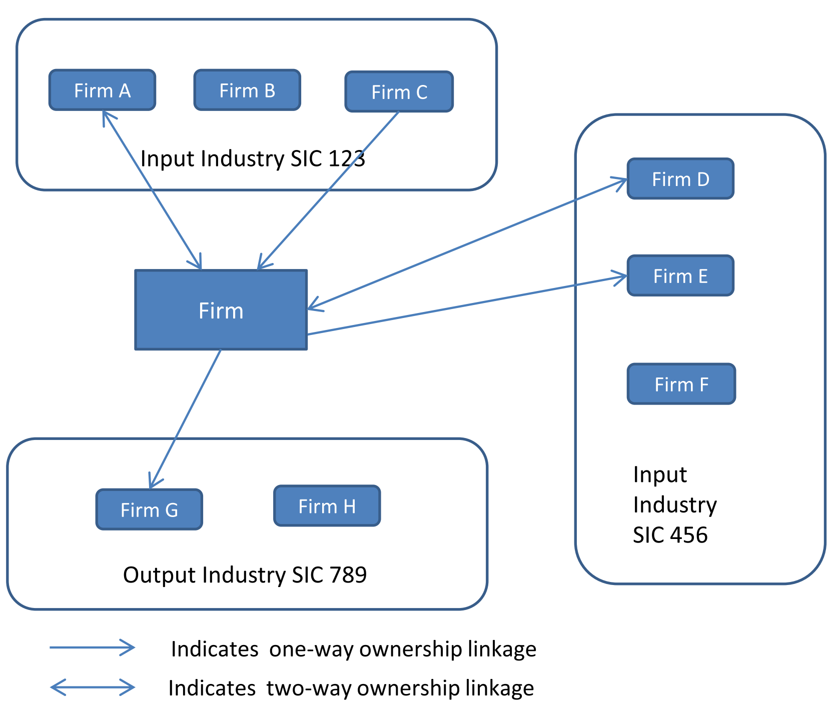
Finkelstein (1997) replicated and extended Pfeffer's (1972b) study on inter-industry merger patterns and resource dependence. Finkelstein argues that relatively little attention is paid to the influence of the industrial environment on merger behaviour. In his study inter-industry merger patterns were measured as the proportion of an industry's total mergers conducted with each other industry. Inter-industry input–output tables containing data on the value of goods an industry transacts with every other industry quantify the transaction pattern among industries. Finkelstein replicated the results from Pfeffer's (1972b), but refinements to the model suggest that the resource dependence explanation for inter-industry mergers may not be as robust as previously thought. Organizations can develop many other means such as joint ventures, long-term contracts, alliances, or board-level linkages to secure the vital resources.

In another recent study, Buvik and Gronhaug (2000) explored the effects of inter-firm dependence and environmental uncertainty on vertical co-ordination in industrial purchasing relationships. Analysis of data from a survey of 157 industrial buyers shows supporting evidence for a positive relationship between environmental uncertainty and vertical co-ordination, as resource dependence theory predicts. Other recent studies have applied resource dependence theory to the case of alliance formation and networks among organizations (e.g. Grandori & Soda, 1995; Gulati, 1998; Oliver & Ebers, 1998). These studies also provide evidence that supports the notion of a relationship between the organizational environment and degrees of inter-organizational linkage.

3. Propositions

Inter-industry input–output transaction patterns can serve as indicators of the degree of resource dependence or frequency of recurrent transactions among sectors in an economy (Burt, 1988; Buvik & Gronhaug, 2000; Grandori & Soda, 1995; Levine & White, 1961; Provan, 1993). Furthermore, inter-industry corporate ownership patterns are a suitable proxy for the degree of inter-organizational linkages to manage resource interdependence (e.g. Boyd, 1990; Gulati, 1998; McNaughton & Green, 2006). Our research tests the degree of association between these two variables. The unit of analysis is aggregate exchanges at the inter-industry level and frequency of ICO between industries. Figure 1

Figure 1. Resource dependence theory.



is a pictorial example of what is meant by ownership linkages between a given firm and its input and output industries. While the extant literature tests relatively small samples at the level of individual enterprises, we test the aggregate relationships that result at the industry level when many enterprises try to condition their environment by reducing their input–output dependence. Oliver and Ebers (1998) noted the lack of industry-level studies of the mechanisms used to manage resource dependence.

From a resource dependence perspective, organizations adopt different inter-organizational linkages, including corporate ownership mechanisms, to manage external constraints. As the number of transactions increase between trading parties, interdependence also increases. Thus, more ownership linkages may be employed. When the actions of individual firms are aggregated to the industry level, our proposition is that:

> *Proposition* 1: There is a positive association between the degree of inter-industry corporate ownership linkages and the degree of inter-industry input–output transactions.

The relationship between the degree of inter-industry corporate ownership linkages and the degree of inter-industry input–output transactions varies from industry to industry (Finkelstein, 1997; McNaughton & Green, 2006). Raw-material industries such as the mining industry and agricultural industry have less dependence on other industries from their input side since most of their inputs are from natural sources. Some service industries are also less dependent on other industries in the economy because some of their outputs go directly to final consumers instead of other industries. Manufacturing industries have closer relationships with other sectors in an input–output transactions sense because they fall between raw material and services industries (Burt, 1988). Thus:

> *Proposition* 2: The positive association between the degree of inter-industry corporate ownership linkages and the degree of inter-industry input–output transactions is stronger for manufacturing sectors than for other sectors of the economy.

A directional difference exists between the perceptions of buyers and sellers with regard to the degree of resource dependence (Buvik & Gronhaug, 2000). Industries that have more transactions with other industries on the output side tend to exert more ownership linkages on the downstream side of the value chain. On the other hand, industries having more transactions with other industries on the input side prefer to pursue more ownership linkages upstream in the value chain. Industries with balanced input–output transactions likely have balanced ownership linkages with other industries. Our expectation is:

> *Proposition* 3: Compared to other industries in the Canadian economy, manufacturing industries have a weaker association between the differential degree of two-way directional corporate ownership linkages (owner-type and owned-type linkages) and the degree of inter-industry input–output transactions.

Proposition 1, a direct argument developed from resource dependence theory, suggests there is a positive relationship between the degree of ICO linkages and the degree of input–output dependence in Canadian industries. To consider the differences originating from the structural positions of industries in the input–output network, Proposition 2 suggests that industry-level differences in the relationship between ICO and input–output dependence should be tested. Finally, Proposition 3 suggests a further refinement by examining the directional difference in ICO linkages.

4. Methods

A linear regression model tests the association between the degree of ICO linkages and the degree of inter-industry input–output transaction patterns. The goal of the statistical analysis is to test the propositions described in the previous section about the determinants of inter-industry corporate ownership linkages. The dependent variable in the regression model is the degree of inter-industry ICO linkages. These linkages are organizational responses to the environment and need for inputs and access to markets. The degree of inter-industry input–output transaction patterns serves as the independent variable and measures the degree of resource dependence. Support for use of this measure is found in Burt (1988), Provan (1993), and Buvik and Gronhaug (2000).

The moderator in the study is industry classification. Inter-industry input–output transaction patterns differ because industries have different structural positions in the economy (Burt, 1988). Manufacturing industries are central in the input–output structure of the economy since manufacturing industries pursue more recurrent transactions to acquire intermediate products from other industries as inputs, and to sell output to other industries. In contrast, raw-material industries get input mostly from natural sources that are not controlled by other industries. Service industries partly target household consumers as a destination for their output. This difference in the structural position of industries leads to the use of industry classification as the moderator.

The linear regression equations are:

$$\mathrm{RLINK}_{ij} = a + b \times \mathrm{INPUT}_{ij} + c \times \mathrm{OUTPUT}_{ij} + \varepsilon \quad (1)$$

$$\mathrm{DLINK}_{ij} = a + b \times \mathrm{INPUT}_{ij} + c \times \mathrm{OUTPUT}_{ij} + \varepsilon \quad (2)$$

$$\mathrm{LINK}_{ij} = a + b \times \mathrm{INPUT}_{ij} + c \times \mathrm{OUTPUT}_{ij} + \varepsilon \quad (3)$$

$$\mathrm{ABSLINK}_{ij} = a + b \times \mathrm{INPUT}_{ij} + c \times \mathrm{OUTPUT}_{ij} + \varepsilon \quad (4)$$

Two parties are involved in each ICO linkage. Hence, two linkage types exist in the analysis, an R-type linkage and a D-type linkage. In an R-type linkage for one industry, one corporation from the industry controls as an “owner” one corporation from another industry group. A D-type linkage is a linkage of a corporation in one industry group “owned” by a corporation from another industry group. RLINK_{ij} is the percentage of R-type linkages that industry *i* made with industry *j*. DLINK_{ij} is the percentage of D-type linkages that industry *i* received from industry *j*. LINK_{ij} is the average value of RLINK_{ij} and DLINK_{ij} and $\mathrm{ABSLINK}_{ij}$ is the absolute value of the difference between RLINK_{ij} and DLINK_{ij}. INPUT_{ij} is the percentage of industry *i*’s input that comes from industry *j* out of industry *i*’s total output. OUTPUT_{ij} indicates the percentage of industry *i*’s output that goes to industry *j* out of industry *i*’s total output. ε is the random error in the equation. The first three regression equations are used to test Propositions 1 and 2, and Equation 4 tests Proposition 3. Finkelstein (1997) employed similar multiple regression models in his study of the relationship between inter-industry merger patterns and inter-industry input–output transaction patterns, and both Buvik and Gronhaug (2000) and Frank and Henderson (1992) adopted this methods to examine vertical integration and its determinants.

5. Data

Two data sets were used to extract data for statistical analysis and the procedures of data preparation. The Canadian national account of input–output tables produced by System of National Account Branch at Statistics Canada identifies the patterns of Canadian inter-industry input–output transactions. The ICO database produced by the Industrial Organization and Finance Division of Statistics Canada measures the degree of inter-industry corporate ownership linkages.

5.1. Dependent Variable

The ICO database (from the Industrial Organization and Finance Division of Statistics Canada) reports which corporation owns and/or controls which enterprises in Canada. The primary source for the ICO database are annual reports filed under the Corporations and Labour Unions Returns ACT

(CALURA). Under CALURA, corporations that carry out business in Canada, or that are incorporated under a law of Canada or a province, are required to file an ownership information report if they: (1) have gross revenue for the reporting period exceeded $15 million, (2) have assets exceeding $10 million, or (3) have foreign ownership exceeding a book value of $200,000 (Statistics Canada, 1997). The ICO database for the final quarter of 1997 was used to keep the year of data consistent with that of the latest available Canadian input–output tables using the same Standard Industrial Classification (SIC) as the ICO database.

A complete data-set containing all effective ownership linkages between "owner" corporation and "owned" enterprise was extracted from the ICO database. An effective ownership linkage is defined as a corporation owning over 33% of the voting equity of another corporation, and this holding is greater than the combined percentage of the next two largest holdings (Statistics Canada, 1997). Each record of the ICO database has five data entities: the CALURA Corporate Identifier (CCID) of the "owner" corporation in an effective ownership linkage; the 1980 Canadian SIC of the "owner" corporation; the CCID of the "owned" enterprise in the same effective ownership linkage; the 1980 Canadian SIC of the "owned" enterprise; and finally the percentage of voting rights of the linkage.

Before calculation of the degree of inter-industry corporation ownership linkages, we narrowed the scope of the ICO database. Those effective corporate ownership linkages having foreign control in either end of the linkages were screened out since the context of the research is purely Canadian. The ICO database also contains some holding companies and investment companies that generate corporate ownership linkages for tax and other reasons (McNaughton & Green, 2006). Thus, all the linkages with SIC of holding (7215) and investment (7214) industries in either party were eliminated from the data. In addition, we screened out corporate ownership linkages involving government service industries because there are no equivalent industries in the Canadian national input–output tables.

For the purpose of aggregating corporate ownership linkages into industry groups, the SIC codes of the "owner" and the "owned" entities in each corporate ownership linkage were changed to two-digit industry group codes that are the first two digits of the original SIC codes. Seventy-five industry groups were represented in the ICO database, while there are 45 industry groups in the modified input–output tables. The SIC codes of both parties of corporate ownership linkages were converted to be consistent with the industry group codes adopted by the input–output tables. Industry group 10 (tobacco products industry) was eliminated from further analysis because there were no ICO linkages between that industry group and other industries.

The dependent variable is the degree of inter-industry corporate ownership linkages. The calculation of inter-industry corporate ownership linkages discriminates the linkages that one industry group made from the linkages that the same industry received. The percentage of linkages that industry A made with industry B out of all linkages that industry A initiated measures the degree of inter-industry corporate ownership linkages that industry A made with industry B. Following the same logic, the degree of inter-industry linkages that A received from industry B is calculated as the ratio of linkages that industry A received from industry B over all linkages that industry A received from all industries. The average value of the above two ratios, taking into account both directional linkages, serves as the dependent variable to document the degree of inter-industry corporate ownership linkages.

5.2. Independent Variables

The Canadian input–output tables produced by Statistics Canada serve to measure the degree of inter-industry input–output transactions. The inter-industry input–output transaction patterns are derived from the 1997 version of the terminated input–output tables, which use the SIC 1980 classification. The ICO data are classified by SIC 1980 industry codes. There are two levels of aggregation for terminated input–output tables. The M-level tables contain input and output information of 110 commodities among 59 industries, and the S-level tables show the information of 58 commodities among 26 industries. The M-level tables serve as the source for input–output patterns because the S-level tables are inadequate for analysis of inter-industry interaction since the 21 industries in the M-level manufacturing sector are aggregated into a single industry (Gilchrist & St Louis, 1999).

Statistics Canada uses the United Nations System of National Accounts (SNA) procedures for constructing input–output tables. In the SNA system, transaction tables are separated into two tables: the "use" table, which employs the use of commodities by industries (commodity by industry) and the final demand for commodities, and the "make" table, which shows which commodities are produced by which industries (industry by commodity) (Jansen & Raa, 1990; Lee, 1991; Raa, 1994). To focus on business sectors of the Canadian economy and to be consistent with the industrial classification of the ICO database, the revised use and make tables eliminate 13 industries including government sectors and non-business industries. Thirty-one commodities are eliminated in the revised use and make tables in the analysis because those commodities appear in only one of the original use and make tables published by Statistics Canada.

The inter-industry input–output transaction patterns are developed from the revised use and make tables (46 rows by 79 columns) to document the inter-industry dependence on both the input side and output side. Two new tables have an industry-by-industry dimension: the INPUT table shows how much one industry depends on another industry on the input side and the OUTPUT table contains information about how much of one industry's output goes to another industry.

5.3. Moderator—Industry Classification
Differences in the structural position of industry groups in the input—output network support the selection of industrial classification as the moderator. The ICO database, INPUT table, and OUTPUT table for 1997 adopt the 1980 Canada Standard Industrial Classification—Establishments (SIC—E) as the industrial classification system. The 1980 SIC—E classifies corporations according to the establishments' primary activities. There are 45 industry groups to be divided into manufacturing and non-manufacturing groups according to the characteristics of the major industries in the industry group. The moderators are also classified in a slightly more refined manner for further analysis: raw material, manufacturing, or services.

6. Results

6.1. Inter-industry Input–output Dependence
The input–output tables are derived from the use and make tables that contain dollar values of commodities flowing among industry groups. The elements in input–output tables show the degree of an industry group's dependence on other groups on its input and output dimensions as a standardized value ranging from zero to one. To check the patterns of degree of inter-industry dependence, the elements in the input–output tables are categorized into industry groups. The means of input dependence (INPUT) and output dependence (OUTPUT) are the same because of the standardization procedure in table development. Thus, interest falls to the standard deviations of input–output dependence for industry groups. Figures 2 and 3 show the patterns of standard deviations for both input and output dependence in 46 industry groups. The comparison of the standard deviations does not show any particular pattern.

The Pearson correlation coefficient between the two variables, INPUT and OUTPUT, is positive but not large, and is statistically significant (coefficient = .341, $p = .000$ and $N = 2070$).

6.2. Inter-industry Corporate Ownership Linkages
Statistics Canada's ICO database contains two linkage types: R-type linkages and D-type linkages. In an R-type linkage for industry group A, one corporation from industry A controls as an "owner" one corporation from another industry group. In a D-type linkage, a corporation in one industry group is

Figure 2. Standard deviation of degrees of inter-industry input dependence.

Source: CANSIM II's 1997 Canadian input–output tables.
*For industry group names please see Table 2.

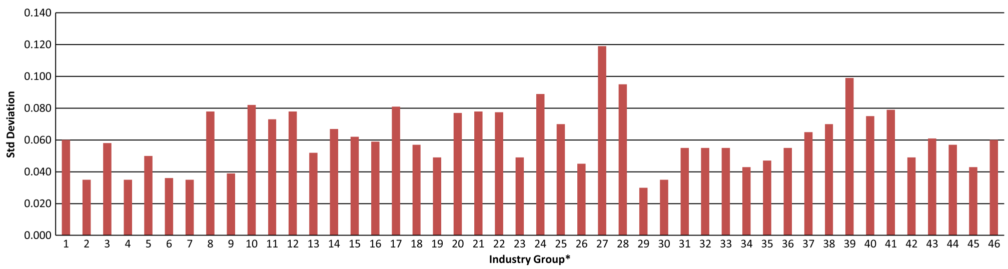
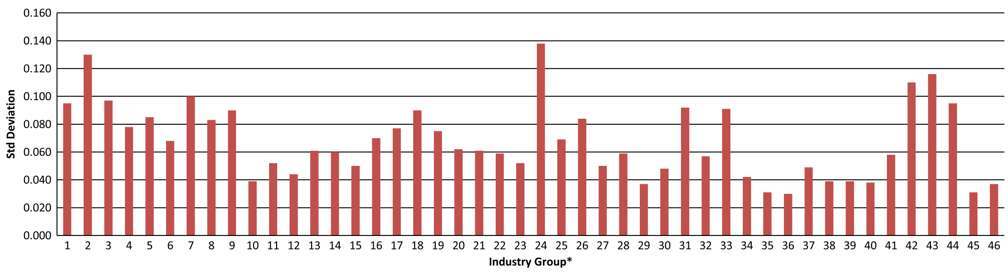


Figure 3. Standard deviation of degrees of inter-industry output dependence.

Source: CANSIM II's 1997 Canadian input–output tables.
*For industry group names please see Table 2.



"owned" by a corporation from another industry group. The descriptive statistics of R-type linkages and D-type linkages by industry groups appear in Table 2. There is a strong positive correlation between two types of linkages among industry groups (.820), which is statistically significant ($p = .000$ and $N = 2070$).

6.3. Testing the Propositions

Proposition 1 postulates a positive association between the degree of inter-industry corporate ownership linkages and the degree of inter-industry input–output dependence. Three indicators show the degree of ICO linkages: RLINK, DLINK, and LINK. RLINK is a standardized value ranging from zero to one showing the ratio of R-type linkages one industry group made with another industry group out of all R-type linkages the focal industry group initiated. DLINK similarly describes the ratio of D-type linkages. LINK for industry groups has the average value of RLINK and DLINK and takes ownership linkages from both directions into account. The degrees of inter-industry input–output dependence are expressed by variables INPUT and OUTPUT.

Three multiple regressions with different dependent variables (RLINK, DLINK, and LINK) are examined to test Proposition 1. Table 3 shows the parameter estimates of the regressions on two data sets. The first data-set includes all the ICO linkages and input–output dependence amongst all industry groups. The second data-set eliminates all intra-industry ICO linkages and input–output transactions. The results from all six regressions strongly support Proposition 1. The positive coefficients of INPUT and OUTPUT (INPUT coefficients ranging from .30 to .45 and OUTPUT coefficients ranging from .12 to .28 with all p values .000) in all equations confirm a positive association between the degree of inter-industry corporate ownership and the degree of inter-industry input–output dependence. In all regressions, the dependent variables have a stronger positive association with input dependence than with output dependence. The regressions on the data-set excluding intra-industry transactions show a weaker association between dependent variables and independent variables than those on the full data-set.

Proposition 2 is tested to explore the difference between raw material, manufacturing, and service industry groups in terms of the association between degree of inter-industry corporate ownership

Table 2. Descriptive Statistics of Inter-industry R-type and D-type Ownership Linkages

Ind	Industry group	Number of industry groups occurring R-type linkages	Mean of R-type linkages	Std. dev. of R-type linkages	Number of industry groups occurring D-type linkages	Mean of D-type linkages	Std. dev. of D-type linkages
1	Agricultural and related services industries	13	7.7692	11.0992	17	8.0000	13.0096
2	Fishing and trapping industries	5	2.0000	1.2247	6	3.3333	3.1411
3	Logging and forestry industries	9	4.1111	3.7565	17	3.5294	3.9705
4	Mining industries	16	10.0625	16.9173	11	5.5455	11.3081
5	Crude petroleum and natural gas industries	24	11.7500	22.8687	12	14.8333	28.4408
6	Quarry and sand pit industries	9	2.5556	2.6034	10	3.6000	3.9497
7	Service industries incidental to mineral extraction	21	6.9048	10.1681	16	13.1250	18.9063
8	Food industries	21	14.5238	22.6442	15	12.6000	21.3903
9	Beverage industries	9	5.8889	6.8089	8	3.8750	5.4625
10	Tobacco products industry	0	.0000	.0000	0	.0000	.0000
11	Rubber products industries	4	1.7500	1.5000	6	1.8333	1.3292
12	Plastic products industries	11	2.5455	2.9108	18	3.6667	4.5633
13	Leather and allied products industries	5	2.8000	2.0494	6	3.1667	2.4014
14	Primary textile industries	5	1.6000	1.3416	4	1.2500	.5000
15	Textile products industries	8	1.5000	.7559	10	1.8000	1.2293
16	Clothing industries	9	4.3333	6.3443	7	9.5714	10.5808
17	Wood industries	16	7.6250	11.2242	16	9.1250	12.2086
18	Furniture and fixture industries	10	3.6000	3.6878	13	3.6154	4.4635
19	Paper and allied products industries	23	6.5217	9.8805	12	5.5000	11.9886
20	Printing, publishing and allied industries	13	10.6923	20.1923	16	8.4375	18.5651
21	Primary metal industries	16	4.0000	4.5314	10	4.7000	5.5588
22	Fabricated metal products industries	18	8.1667	10.9987	19	8.8421	13.3303
23	Machinery industries (except electrical machinery)	13	3.5385	4.4463	17	4.0588	5.1414
24	Transportation equipment industries	13	4.3846	4.7878	14	3.3571	4.0876

(Continued)

Table 2. (*Continued*)

Ind	Industry group	Number of industry groups occurring R-type linkages	Mean of R-type linkages	Std. dev. of R-type linkages	Number of industry groups occurring D-type linkages	Mean of D-type linkages	Std. dev. of D-type linkages
25	Electrical and electronic products industries	15	3.9333	4.4315	12	4.0000	4.8617
26	Non-metallic mineral products industries	14	3.0714	3.0500	12	4.0000	4.0452
27	Refined petroleum and coal products industries	9	2.7778	2.4889	9	1.6667	1.1180
28	Chemical and chemical products industries	16	5.0625	6.4443	17	4.1765	5.7035
29	Other manufacturing industries	15	2.6000	2.3543	18	3.8889	5.9694
30	Construction industries	33	29.4242	84.5392	32	38.7813	113.4272
31	Transportation industries	25	11.7200	34.7965	28	15.2500	34.6609
32	Pipeline transport industries	10	5.4000	5.8916	7	5.2857	5.6484
33	Storage and warehousing industries	8	3.2500	1.7525	13	2.7692	2.6506
34	Communication industries	15	11.0667	23.1809	14	10.7857	23.5476
35	Other utility industries	12	6.8333	9.7592	15	5.6667	8.4825
36	Wholesale trade industries	40	24.1000	68.4445	40	31.0000	78.1199
37	Retail trade industries	29	16.9655	44.3207	34	22.4706	60.1771
38	Finance and real estate industries	44	79.0227	229.8727	44	62.5909	218.8235
39	Insurance industries	12	9.6667	15.5525	8	6.8750	9.0307
40	Business service industries	44	26.4773	58.5346	38	22.6842	58.1959
41	Educational service industries	6	1.3333	.5164	4	4.2500	5.2520
42	Health and social services industries	13	5.3077	8.9199	13	7.4615	10.1375
43	Accommodation and food services industries	21	12.8571	30.3929	22	14.0455	30.8645
44	Amusement and recreational services industries	14	18.5714	50.6112	20	14.5500	42.3301
45	Personal and household service industries	9	14.1111	35.2578	8	19.8750	37.4602
46	Other service industries	23	7.5217	10.2597	30	11.2333	20.4647

Source: Statistics Canada's (1997) final quarter ICO database.

Table 3. Parameter Estimates of Regression Models in Testing Proposition 1

Test on the data-set including all inter-corporate ownership linkages and input–output dependence						Test on the data-set excluding intra-industry inter-corporate ownership linkages and input–output dependence					
Variable	DF	Parameter estimate	Standard error	*t* Value	Pr>|*t*|	Variable	DF	Parameter estimate	Standard error	*t* Value	Pr>|*t*|
Dependent variable: RLINK						Dependent variable: RLINK					
Intercept	1	.00746	.00139	5.39	.000	Intercept	1	.00664	.001	7.37	.000
INPUT	1	.39512	.02222	17.78	.000	INPUT	1	.30471	.01602	19.02	.000
OUTPUT	1	.26156	.01906	13.73	.000	OUTPUT	1	.11854	.01366	8.68	.000
Dependent variable: DLINK						Dependent variable: DLINK					
Intercept	1	.00584	.00139	4.20	.000	Intercept	1	.00492	.001	4.96	.000
INPUT	1	.45036	.02228	20.22	.000	INPUT	1	.36806	.01764	20.86	.000
OUTPUT	1	.28103	.01910	14.71	.000	OUTPUT	1	.16740	.01504	11.13	.000
Dependent variable: LINK						Dependent variable: LINK					
Intercept	1	.00665	.00130	5.13	.000	Intercept	1	.00578	.0008	6.86	.000
INPUT	1	.42274	.02080	20.32	.000	INPUT	1	.33638	.01499	22.44	.000
OUTPUT	1	.27129	.01784	15.21	.000	OUTPUT	1	.14297	.01279	11.18	.000

http://dx.doi.org/10.1080/23322039.2014.920269

linkages and the degree of inter-industry input–output dependence. The proposition is tested in a two-industry group scenario that categorizes industries into manufacturing and non-manufacturing industry groups and a three-industry group scenario that further refine non-manufacturing industry group into raw material and services industry groups. The data-set includes 7 raw material industries (industry groups 1–7), 21 manufacturing industries (industry groups 8, 9, 11–29), and 17 services industries (industry groups 30–46).

Regression results for the two-industry group scenario appear in Table 4. A stronger association exists between the degree of inter-industry ownership linkages and the degree of inter-industry output dependence in the manufacturing industry group than in the non-manufacturing industry group. However, the association between ICO linkages and inter-industry input dependence is stronger in the non-manufacturing group than in the manufacturing group. Proposition 2 is supported only on the output dependence side and is rejected on the input side.

Table 5 summarizes the regression results for a three-industry group scenario. The results show the same pattern as for the two-industry group scenario. Manufacturing industries have a stronger association between ownership linkages and output dependence than service industries and raw material industries. However, service industries have a stronger association between ownership linkages and input dependence followed by raw material industries and manufacturing industries. Again, Proposition 2 is supported only on the output dependence side.

Proposition 3 concerns the association between the differential degree of two-way directional corporate ownership linkages and the degree of inter-industry input–output dependence. The absolute value of the difference between RLINK and DLINK (ABSLINK) serves as an indicator of the differential degree of R-type and D-type linkages.

Table 6 summarizes the results of the two-industry group and three-industry group scenarios. A weaker association between the degree of ICO linkages and the degree of inter-industry input dependence exists in the manufacturing industry group than in the non-manufacturing industry group. However, the association between ICO linkages and inter-industry output dependence is stronger in the non-manufacturing group than in the manufacturing group. The parameter estimates show the same pattern in the three-industry group scenario. Manufacturing industries have a weaker association between ownership linkages and input dependence than service industries and raw material industries. Service industries show a strong association between ownership linkages and output dependence followed by raw material industries and manufacturing industries. In contrast to Proposition 2, Proposition 3 is supported only on the input dependence side.

7. Conclusion

The research reported in this paper examined the relationship between the degree of ICO linkages and input–output dependence among Canadian industry groups. From the perspective of resource dependence theory, ICO is one form of inter-organizational linkage that organizations can adopt to manage their resource dependence, including input–output dependence. While the literature testing the resource dependence hypothesis is well developed, no extant study uses data that are as complete as those we analysed—either in terms of the variety of ways in which ownership can occur, and the size of the sample. Existing studies also typically focus on manufacturing firms, or firms in a particular industry, whereas we were able to compare the relationship in primary, secondary and tertiary sectors.

Proposition 1 postulates a positive association between the degree of ICO linkages and the degree of input–output dependence among Canadian industry groups. All parameter estimates for input dependence (INPUT) and output dependence (OUTPUT) have positive coefficients. The results support Proposition 1 in regressions with different dependent variables: RLINK, DLINK, and LINK. This suggests that in aggregate firms choose ICO linkages as a way to manage their resource dependence resulting from input–output transactions with other industry groups. The results of regression analysis show that the association between the degree of ICO linkages and the degree of input

http://dx.doi.org/10.1080/23322039.2014.920269

Table 4. Parameter Estimates of Regression Models in Testing Proposition 2 in a Two-industry Group Scenario

Manufacturing industry groups						Non-manufacturing industry groups					
Variable	DF	Parameter estimate	Standard error	*t* Value	Pr>|*t*|	Variable	DF	Parameter estimate	Standard error	*t* Value	Pr>|*t*|
Dependent variable: RLINK						Dependent variable: RLINK					
Intercept	1	.00929	.00185	5.03	.000	Intercept	1	.00461	.00200	2.30	.0217
INPUT	1	.24109	.02802	8.60	.000	INPUT	1	.57168	.03431	16.66	.000
OUTPUT	1	.33146	.02712	12.22	.000	OUTPUT	1	.21648	.02605	8.31	.000
Dependent variable: DLINK						Dependent variable: DLINK					
Intercept	1	.00780	.00188	4.16	.000	Intercept	1	.00296	.00200	1.48	.1386
INPUT	1	.31318	.02844	11.01	.000	INPUT	1	.61164	.03425	17.86	.000
OUTPUT	1	.32805	.02753	11.92	.000	OUTPUT	1	.25202	.02601	9.69	.000
Dependent variable: LINK						Dependent variable: LINK					
Intercept	1	.00855	.00171	5.00	.000	Intercept	1	.00378	.00189	2.00	.0454
INPUT	1	.27713	.02592	10.69	.000	INPUT	1	.59166	.03236	18.29	.000
OUTPUT	1	.32975	.02509	13.14	.000	OUTPUT	1	.23425	.02457	9.54	.000

Table 5. Parameter Estimates of Regression Models in Testing Proposition 2 in a Three-industry Group Scenario (Dependent Variable: LINK)

Variable	DF	Parameter estimate	Standard error	*t* Value	Pr>|*t*|
Manufacturing industries					
Intercept	1	.00855	.00171	5.00	.000
INPUT	1	.27713	.02592	10.69	.000
OUTPUT	1	.32975	.02509	13.14	.000
Raw materials industries					
Intercept	1	.00480	.00328	1.47	.1436
INPUT	1	.57932	.06801	8.52	.000
OUTPUT	1	.19965	.03213	6.21	.000
Service industries					
Intercept	1	.00314	.00232	1.35	.1759
INPUT	1	.58690	.03754	15.64	.000
OUTPUT	1	.26845	.03556	7.55	.000

Table 6. Parameter Estimates of Regression Models in Testing Proposition 3 (Dependent Variable: ABSLINK)

Variable	DF	Parameter estimate	Standard error	*t* Value	Pr>|*t*|
Manufacturing industries					
Intercept	1	.01057	.00127	8.29	.000
INPUT	1	.14718	.01933	7.61	.000
OUTPUT	1	.11288	.01871	6.03	.000
Non-manufacturing industries					
Intercept	1	.00501	.00106	4.73	.000
INPUT	1	.29753	.01814	16.41	.000
OUTPUT	1	.10566	.01377	7.67	.000
Raw materials industries					
Intercept	1	.00810	.00267	3.04	.0026
INPUT	1	.28014	.05537	5.06	.000
OUTPUT	1	.14321	.02616	5.47	.000
Service industries					
Intercept	1	.00408	.00104	3.95	.000
INPUT	1	.30925	.01674	18.47	.000
OUTPUT	1	.06975	.01586	4.40	.000

dependence is stronger than that between the degree of ICO linkages and the degree of output dependence. This pattern might result from the fact that industry groups tend to adopt more ICO linkages in an input dependence scenario than they do in output dependence. Other industry groups are the only source for the focal industry group to seek its input. However, the focal industry group can sell its output to other sources such as households and governments in which the industry group cannot employ ICO linkages to manage its resource dependence.

The parameter estimates using data that exclude intra-industry linkages show a weaker association between the degree of ICO linkages and the degree of input–output dependence than do the parameter estimates using data that includes both intra-industry and inter-industry linkages. This result can be explained by the existence of alternative motivations to form ICO linkages. For example companies within the same industry group might form ownership linkages to gain economies of scale or to reduce competition.

The differences of industry groups' structural positions in the input–output structure of the Canadian economy lead to the test of Proposition 2. The test of Proposition 2 in a two-industry group scenario shows that manufacturing industries have a stronger association between the degree of ICO linkages and the degree of output dependence than do non-manufacturing industries. However, the association between the degree of ICO linkages and the degree of input dependence in manufacturing industries is weaker than that in non-manufacturing industries. The results of tests of Proposition 2 in a three-industry group scenario (raw material industries, manufacturing industries, and service industries) follow the same pattern. The regression analysis supports Proposition 2 only in the output dependence side and rejects it in the input dependence side. The output from manufacturing industries mainly goes to other industries in the economy. The strong output dependence on other industries in the Canadian economy leads manufacturing industries to seek more ICO linkages than other industries groups. For the input dependence side, fewer ICO linkages are employed in manufacturing industries than in other industries.

Proposition 3 examines the balance between R-type and D-type ICO linkages in different industry groups. Manufacturing industries stand in the middle of the value chain in the Canadian economy, leading to a balanced adoption of both types of linkages. Regression results in a two-industry group scenario (manufacturing and non-manufacturing industries) support Proposition 3 in the input dependence side and weakly reject it in the output dependence side. The parameter estimate on a three-industry group scenario shows that the association between the difference of two-way directional ICO linkages and the output dependence in the service industry is an outlier in the test of Proposition 3. The association between the difference of two-way directional ICO linkages and the output dependence in service industries is very weak because service industries' outputs are widely spread across industries in the Canadian economy.

These results confirm a positive association between the degree of ICO linkages and the degree of input–output dependence among Canadian industry groups, thus confirming the central hypothesis of resource dependence theory. That is, that Corporations employ ICO linkages as a response to manage and control their input–output dependence. The research shows that Canadian industry groups use ICO linkages more in an input dependence scenario than they do when facing output dependence. Manufacturing industries have a stronger utilization of ownership linkages in input dependence and a weaker adoption of the mechanism in output dependence than other industries do. The examination of two-way directional ownership linkages shows that manufacturing industries have a more balanced structure of ownership linkages than other industries do in the input dependence side. As for output dependence, service industries employ a more balanced structure of ICO linkages than do other industries.

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Article Information
Cite this article as: Inter-organizational linkages and resource dependence, R.B. McNaughton & B.P. Cozzarin, *Cogent Economics & Finance* (2014), 2: 920269.

Cover image
Quantum Nanotechnology building, University of Waterloo, Ontario, Canada
Source: Author

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