Freight Day V

Modelling Firm Growth and Outsourcing

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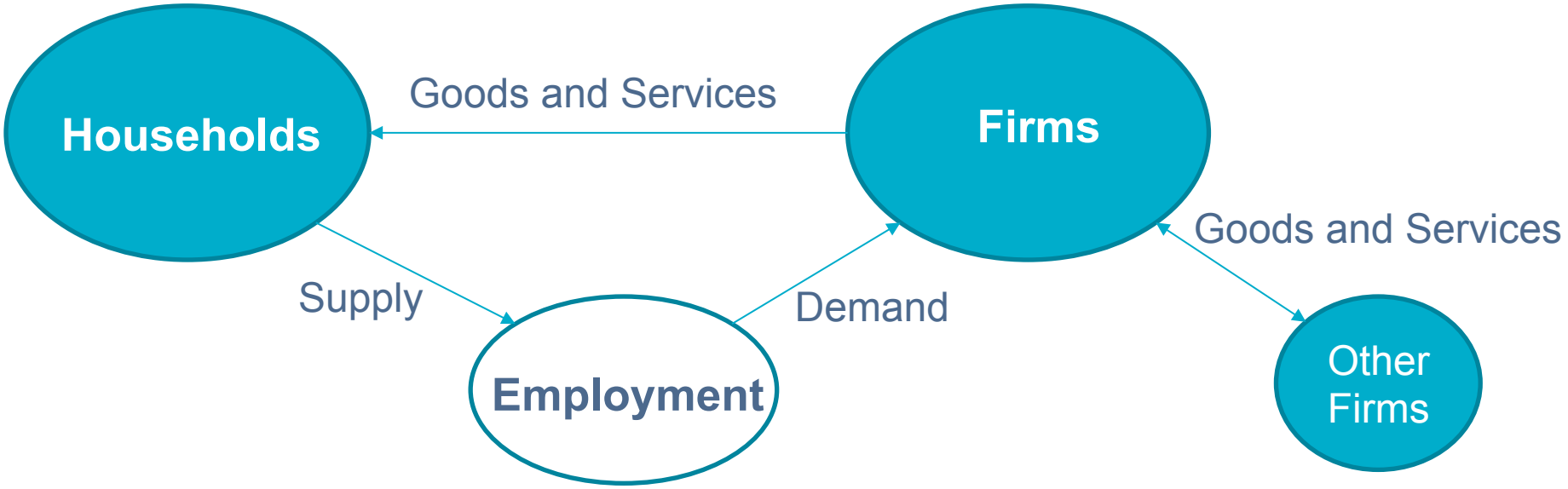
Overview

- Introduction
- Research objective
- Data sources
- Firm growth model results
- Outsourcing of freight activities model results
- Conclusions

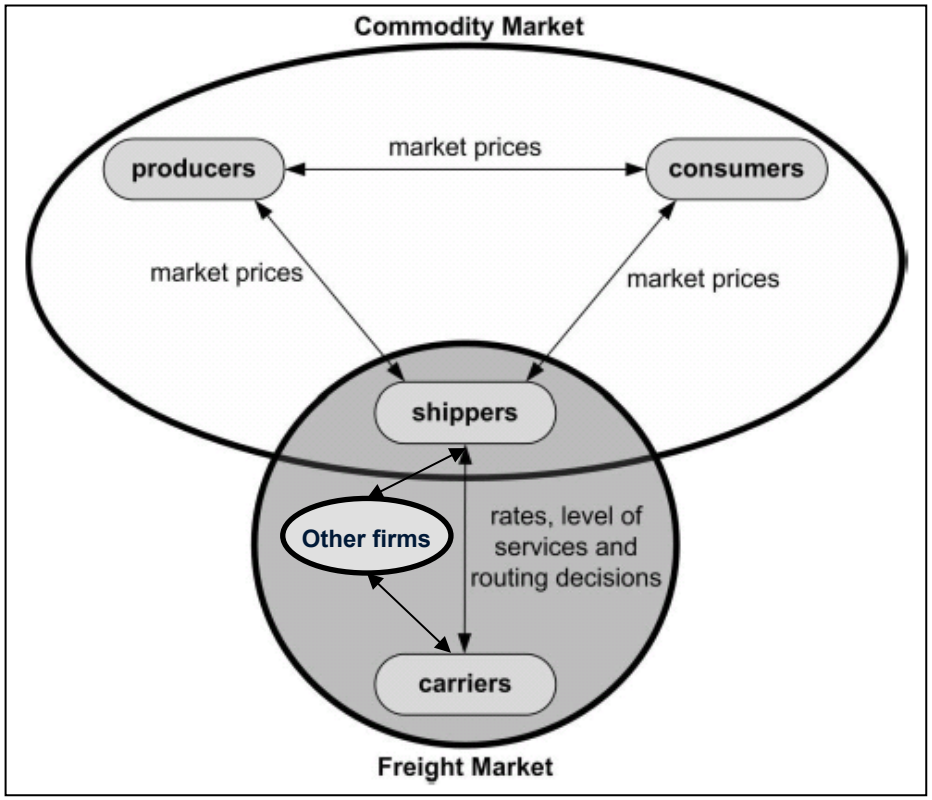
Introduction

- Behavioural freight transportation modelling helps to enhance the quality of freight and logistics decision assessments.
- Agent-based models allows for tracking of individual agent decisions and explicit modelling of interrelated behaviour.
- Two primary interacting agents are households and firms.



Introduction

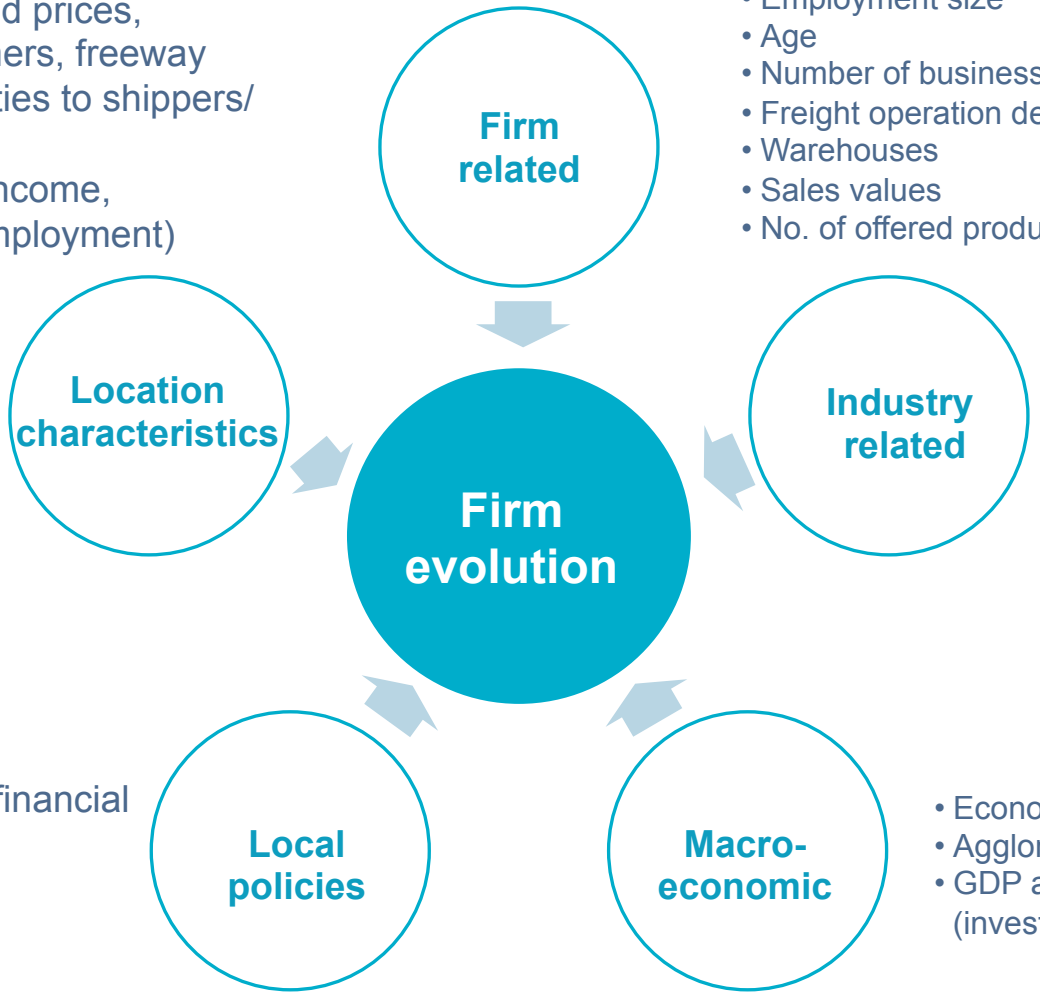
- Firms are identified as the agents interacting within the freight system.



*Adopted from Harker and Friesz, 1986

Introduction

- Geographic (land prices, targeted customers, freeway access, proximities to shippers/ carriers)
- Demographic (income, education, unemployment)



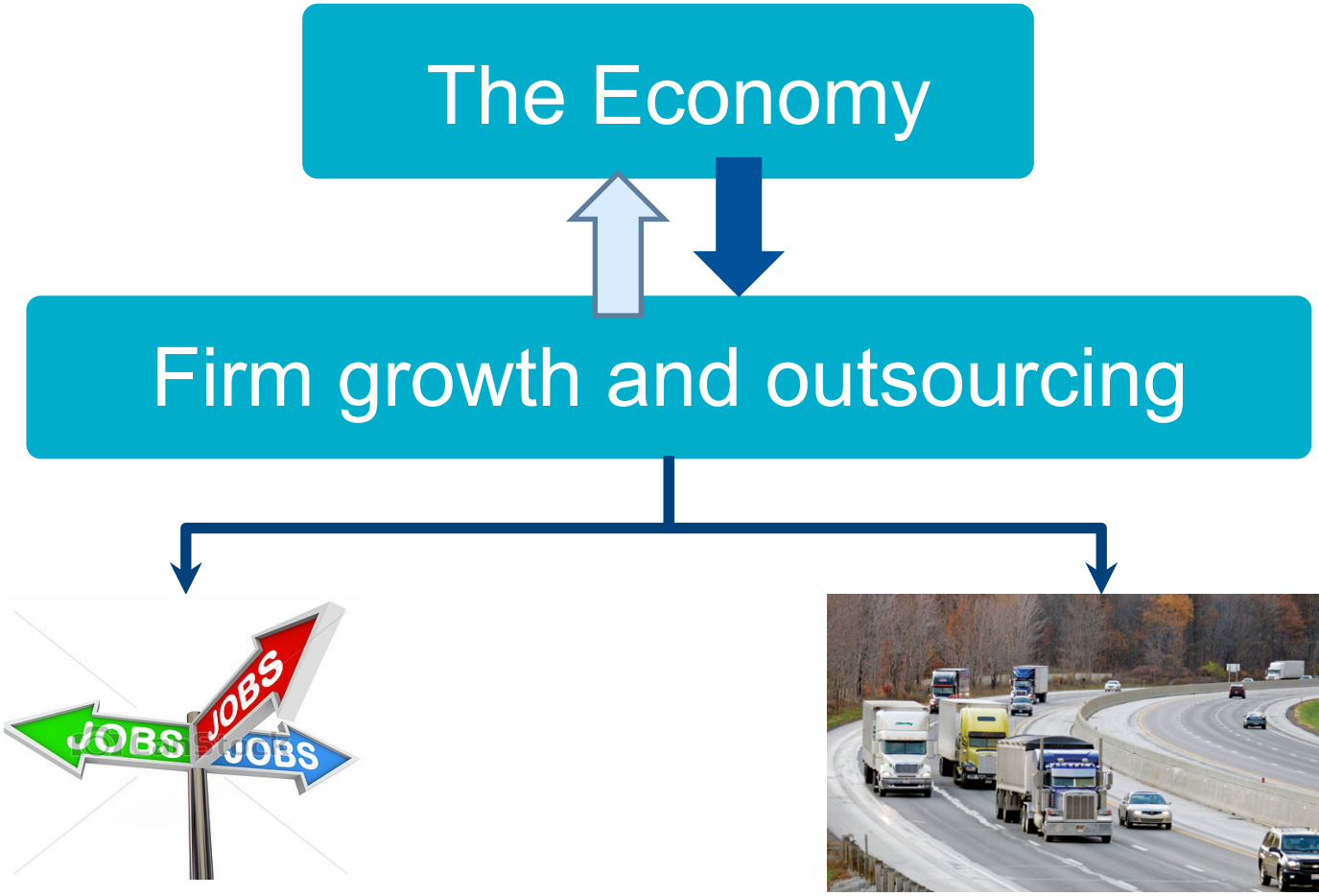
- Employment size
- Age
- Number of business establishments
- Freight operation decisions
- Warehouses
- Sales values
- No. of offered products/services

- Age of the industry
- Market competition
- Size of the industry
- Technological advancements and innovations

- Government financial incentives
- Tax rates and regulations

- Economies of scale
- Agglomeration economies
- GDP and access to capitals (investment potentials)

Introduction



Job Market

Land use and Transportation

Research objectives

1

Firm growth modelling of Canadian firms

- For single location, small-sized firms
- Growth of the number of employees
- Simultaneous growth of employment and other firm assets

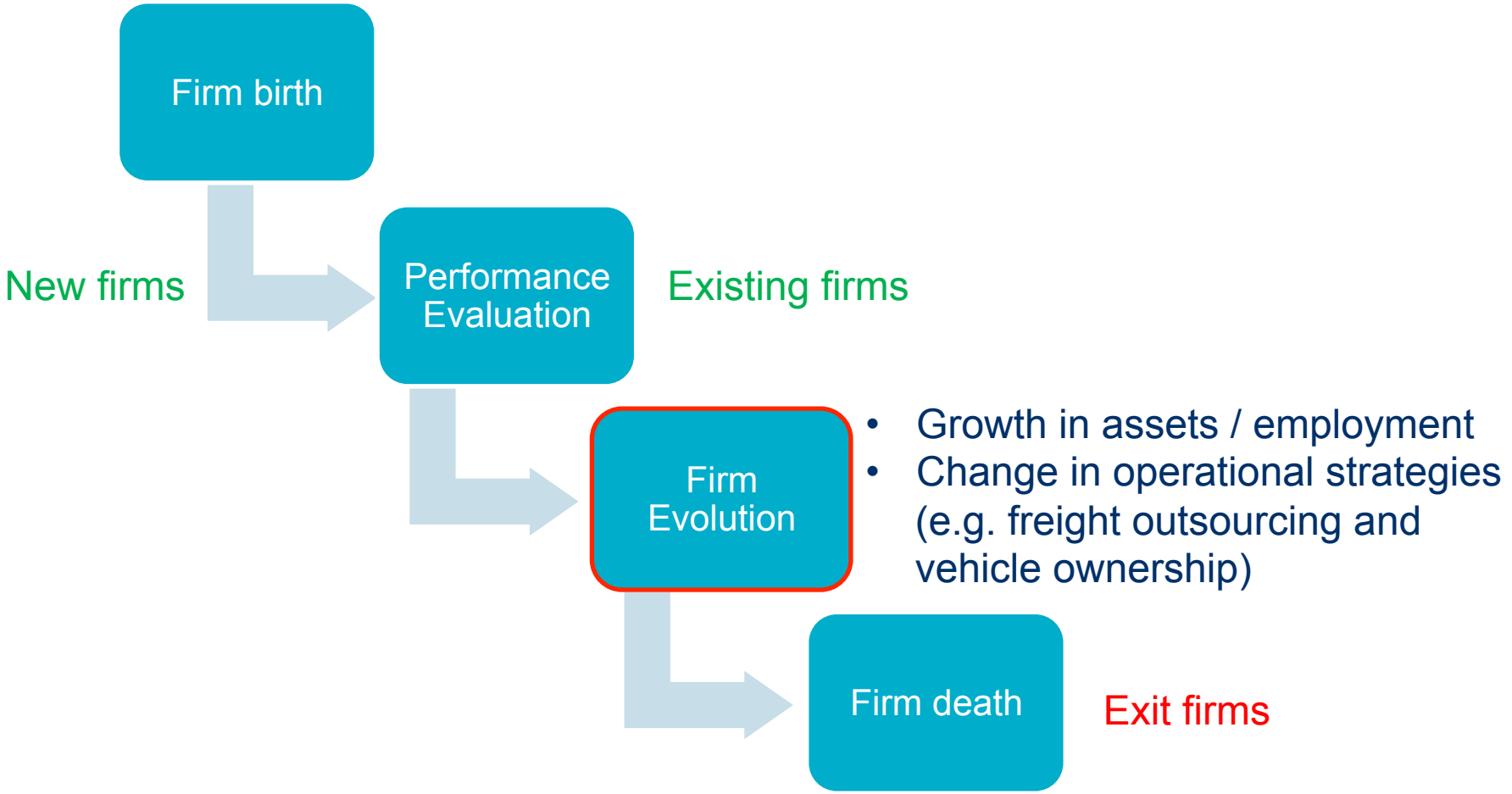
2

Models of outsourcing of freight related activities of Canadian manufacturers

- Outsourcing of goods production
- Outsourcing of logistics and distribution

Research objectives

Modules of the Firmographic Engine of Canada



Data sources

Firm growth

- Longitudinal Employment Analysis Program linked to T2 forms (T2 –LEAP): 2001-2012

Outsourcing of freight activities

- Survey of Innovation and Business Strategies (SIBS): 2009 and 2012 data sets

Statistics Canada Statistique Canada

Data sources

Longitudinal Employment Analysis Program linked to T2 forms (T2 –LEAP)

- Contains information of sales, gross profits, equity and assets for all incorporated firms in Canada with the employment and payroll data from LEAP
- The database can be used to study firm dynamics, industry turnover and productivity growth, as well as the relationship between firm financing and performance

Statistics Canada Statistique Canada

Firm Growth

Vehicle Fleet

Number of Employees

Firm Growth

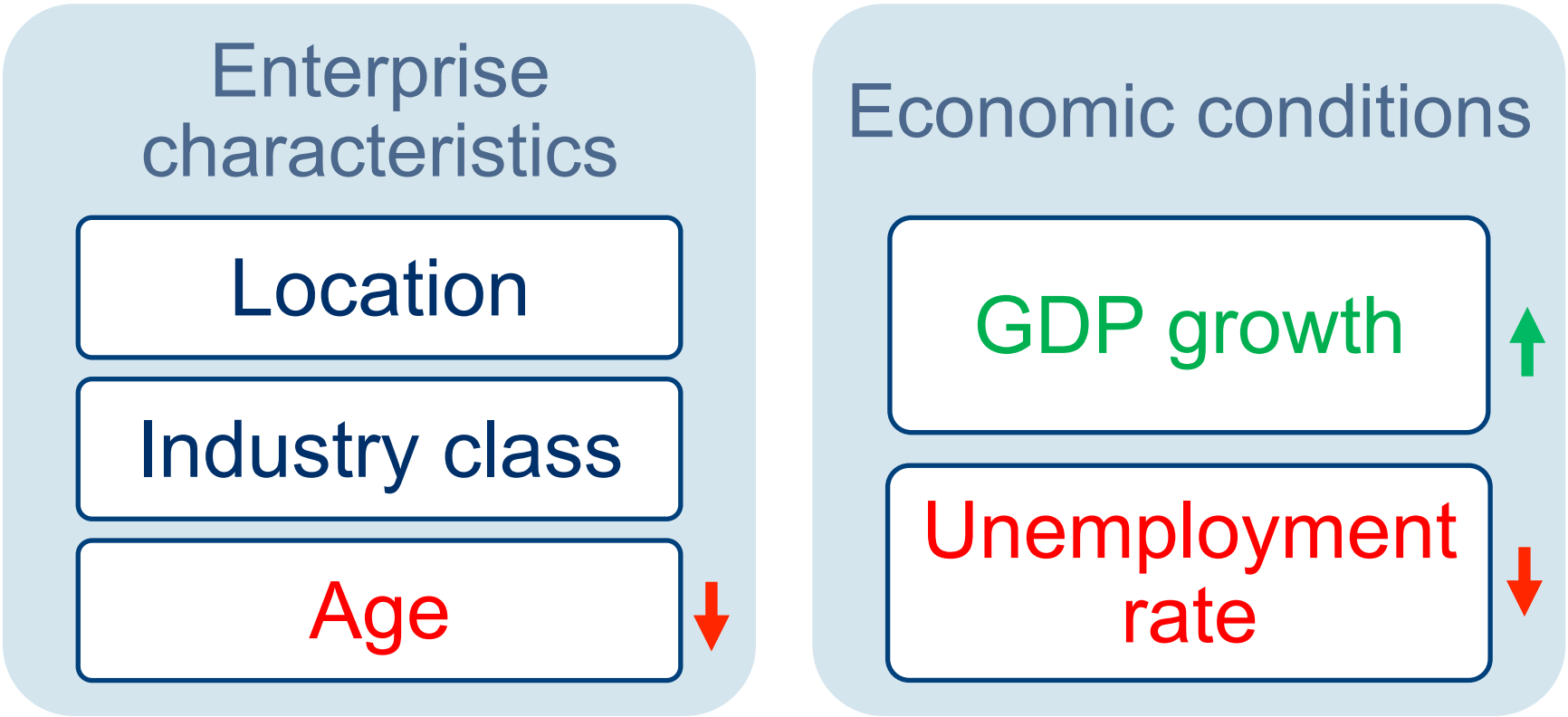
Machinery and Equipment

Locations and Facilities

Market share, sales values, and profits

Firm growth: model results

Number of employees: Microsimulation model of employment change rate



Negative impact *Various impacts*

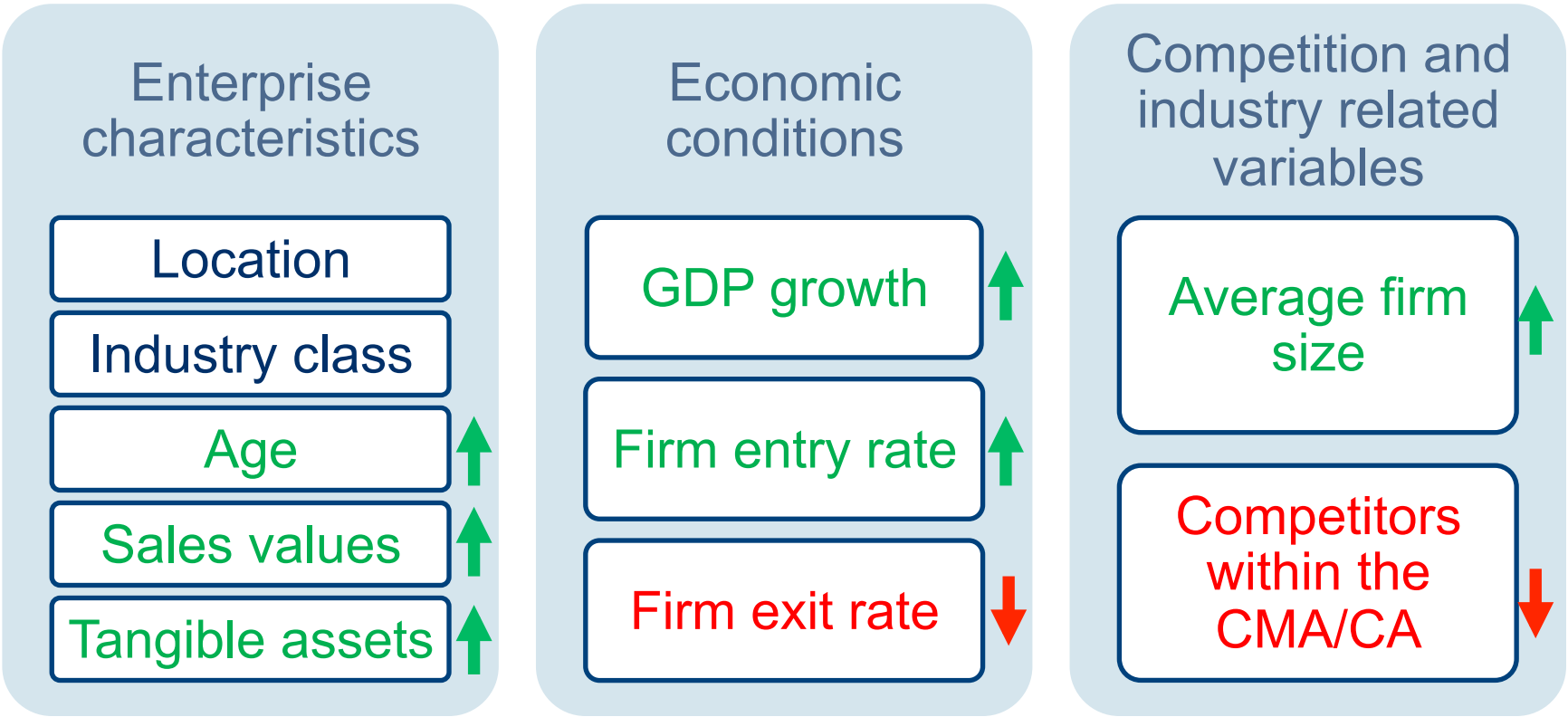
Positive impact

Firm growth: model results

	Variables	Coef.
	Age(log value)	**-0.147**
Province	Ontario	-0.015
	Alberta	-0.016
	British Columbia	-0.007
Industry	Agriculture, forestry, fishing and hunting	0.031
	Mining, quarrying, and oil and gas extraction	0.046
	Utilities	0.192
	Construction	**0.050**
	Manufacturing	**0.061**
	Wholesale trade	0.032
	Retail trade	0.048
	Information and cultural industries	0.064
	Finance and insurance	0.027
	Real estate and rental and leasing	0.029
	Professional, scientific and technical services	-0.019
	Administrative and support, waste management and remediation services	0.047
	Arts, entertainment and recreation	0.053
	Accommodation and food services	0.092
	Other services (except public administration)	0.034
Economic conditions	**Change in GDP by industry (%)**	**0.002**
	Unemployment rate by province (%)	**-0.001**
	_cons	1.372

Firm growth: model results

Number of employees: behavioural model



Negative impact *Various impacts*

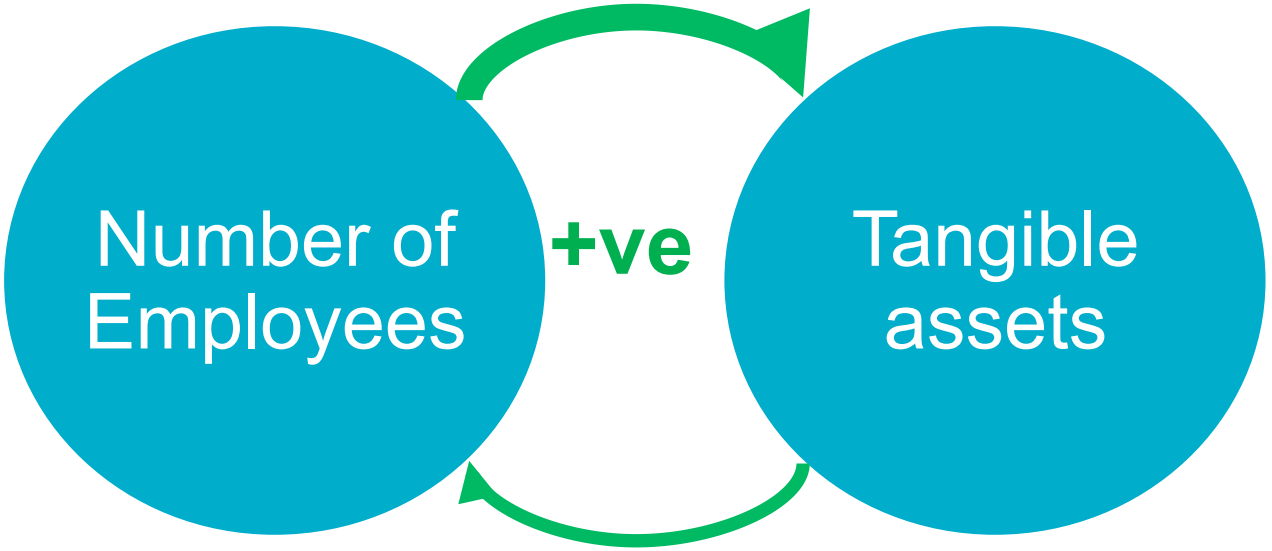
Positive impact

Firm growth: model results

	Variables	Coef.	P>|t|
	Age (log value)	0.040	0.000
	Tangible assets (log value)	0.045	0.000
	Sales values (log value)	0.510	0.000
Province	Ontario	-0.003	0.022
	Quebec	0.046	0.000
	Alberta	-0.127	0.000
	British Columbia	0.011	0.000
	Atlantic Canada (NS, NB, PE,NF)	0.138	0.000
Industry	Agriculture, forestry, fishing and hunting	-0.324	0.000
	Mining, quarrying, and oil and gas extraction	-0.210	0.000
	Utilities	0.167	0.000
	Construction	-0.013	0.001
	Manufacturing	0.301	0.000
	Wholesale trade	-0.110	0.000
	Retail trade	0.032	0.000
	Transportation and warehousing	-0.056	0.000
	Information and cultural industries	0.053	0.000
	Finance and insurance	0.028	0.000
	Real estate and rental and leasing	-0.153	0.000
	Professional, scientific and technical services	0.084	0.000
	Administrative and support, waste management and remediation services	0.280	0.000
	Arts, entertainment and recreation	0.412	0.000
	Accommodation and food services	0.725	0.000
	Other services (except public administration)	0.278	0.000
Economic conditions	Change in GDP by industry (%)	0.003	0.000
	Firm entry rate	0.049	0.000
	Firm exit rate	-0.008	0.000
	Number of counterparts within the CMA/CA level (log)	-0.012	0.000
	Average firm size by industry (log)	0.023	0.000
	_cons	1.504	0.000

Firm growth: model results

Simultaneous growth of tangible assets and number of employees



Outsourcing of Freight Activities

Data sources

Outsourcing of freight activities

- Cross-sectional data set for 2009 and 2012

Enterprise structure

Strategic focus and business strategies

Business practices and relationship with suppliers

Operational tactics

Main products, market structure, and competition

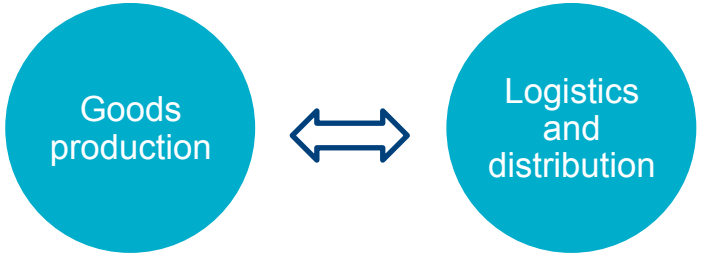
Relocation activities

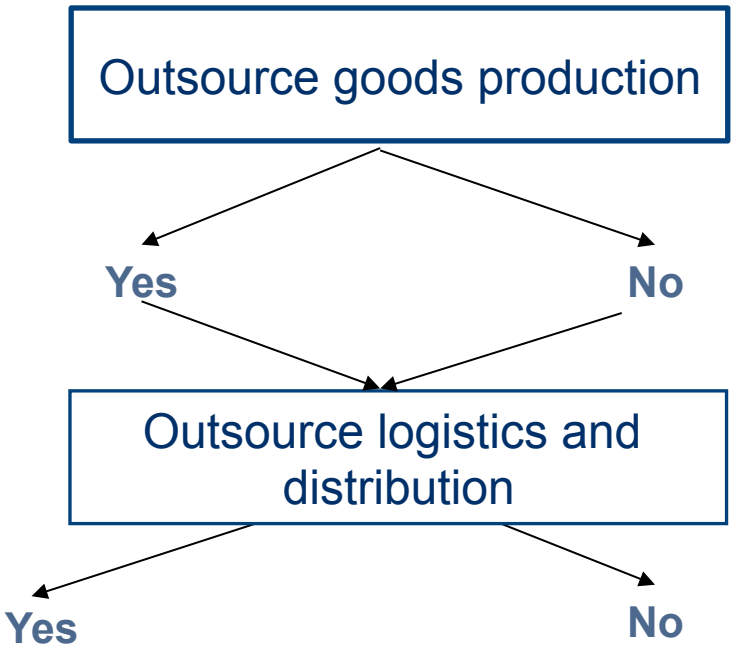
Innovation practices
- Advanced technology use
- International activities
- Government support programs

Growth of the Economy

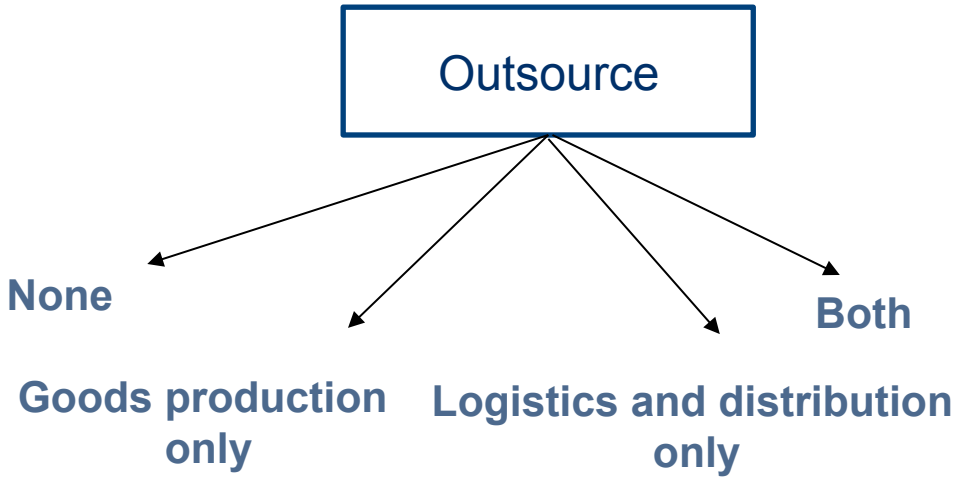
Statistics Canada Statistique Canada

Outsourcing of Freight Activities





Multilevel structure



One level structure

Outsourcing of Freight Activities: Results

- Logistics and distribution: overall

Positive Impact	Negative Impact
Growth of GDP (%)	Strategic focus of introducing new or significantly improved organizational and management practices
Outsource of goods production	
Large and medium sized firms (emp. >100)	
Focus on gross/margin operating growth	
The use of advanced automated material handling technologies	
Tax credits government programs	
Direct exports	

Outsourcing of Freight Activities: Results

- Logistics and distribution: international outsourcing

Positive Impact	Negative Impact
Outsource of goods production (intl.)	Long term strategy of mass market
Large sized firms (emp. >250)	Canada being the main market for highest selling goods/services
International activities	
Multinational competition	
Direct exports	

Outsourcing of logistics and distribution

		Microsimulation model			Behavioural model			International outsourcing model		
	Variables	**Coeff.**	**P >|Z|**	**Odds ratio**	**Coeff.**	**P >|Z|**	**Odds ratio**	**Coeff.**	**P >|Z|**	**Odds ratio**
	_cons	-1.090	0.000	0.336	-1.79	0.000	0.167	-2.617	0.000	0.073
Industry	Beverage and Tobacco Products	0.670	0.014	1.960	1.092	0.001	2.980	--	--	--
	Textile products	--	--	--	-0.340	0.124	0.712	--	--	--
	Apparel, leather and allied products	-0.348	0.093	0.706	-0.367	0.096	0.690	--	--	--
	Wood products	-0.440	0.015	0.644	--	--	--	--	--	--
	Plastics and Rubber Products	--	--	--	0.308	0.041	1.360	--	--	--
	Non-metallic Mineral Products	-0.548	0.008	0.578	--	--	--	--	--	--
	Computer and Electronic Products	-0.467	0.003	0.627	-0.569	0.001	0.567	--	--	--
	Furniture and Related Products	--	--	--	0.330	0.072	1.390	--	--	--
Size	Medium-sized firm (100-250 employee)	0.413	0.000	1.511	0.217	0.024	1.242	--	--	--
	Large-sized firm (>250 employee)	0.516	0.000	1.675	0.250	0.021	1.280	0.443	0.065	1.558
Location	Ontario	0.242	0.001	1.273	--	--	--	--	--	--
Economic Indicators	GDP growth on naics-3 level	--	--	--	0.009	0.022	1.009	--	--	--
Other operational strategies	Outsource of goods production	--	--	--	1.415	0.000	4.115	--	--	--
	Opened a new production faility	--	--	--	0.467	0.000	1.595	--	--	--
	Closed an existing production facility	--	--	--	0.355	0.002	1.426	--	--	--
Use of innovation , advanced technologies and government programs	The use of advanced communication technologies	--	--	--	0.245	0.018	1.278	--	--	--
	Process innovation in logistics and distribution	--	--	--	-0.270	0.013	0.764	--	--	--
	Government tax credit programs	--	--	--	0.140	0.097	1.151	--	--	--
Long term stratgy and strategic focus	Mass market strategy	--	--	--	--	--	--	-0.602	0.128	0.548
	Gross/margin operating growth	--	--	--	0.181	0.053	1.198	--	--	--
	Organizational and management practices	--	--	--	-0.130	0.104	0.878	--	--	--
International activities	Outsource goods (internationally)	--	--	--	--	--	--	2.090	0.000	8.087
	International activities	--	--	--	--	--	--	0.841	0.001	1.327
	Canada being the main market	--	--	--	--	--	--	-0.480	0.029	0.619
	Competition from multinational firms	--	--	--	--	--	--	0.599	0.021	1.821
	Direct exports	--	--	--	0.217	0.011	1.242	0.433	0.097	1.541

Outsourcing of Freight Activities: Results

- Good production: overall

Positive Impact
Number of products and services
Outsource of logistics and distribution
Employees with university degrees(%)
Focus on operating cost
Focus on market share growth
Focus on sales of new products
Process innovation of new manufacturing methods
Number of competitors

Negative Impact
Mass market strategy
Strategic focus of introducing new or significantly improved goods and services
Large sized firms (emp. >250)

Outsourcing of Freight Activities: Results

- Good production: international outsourcing

Positive Impact	Negative Impact
Outsource of logistics and distribution (intl.)	Head office location in Canada
Number of product lines	Expansion of logistics facilities
International subsidiaries	Canada being the main market
Product innovation	

Outsourcing of goods production

		Behavioural model			International outsourcing model		
	Variables	Coef	P>|z|	odds ratio	Coef	P>|z|	odds ratio
Industry	_cons	-2.978	0.000	0.051	-0.029	0.937	0.972
	Food Manufacturing	-1.213	0.000	0.297	--	--	--
	Beverage and Tobacco Products	--	--	--	-1.434	0.114	0.238
	Apparel, leather and allied products	0.668	0.001	1.951	3.253	0.003	25.856
	Wood products	-0.773	0.002	0.462	--	--	--
	Printing and Related Support Activities	--	--	--	-1.378	0.039	0.252
	Petroleum and Coal Products	--	--	--	--	--	--
	Chemical Manufacturing	-0.835	0.000	0.434	--	--	--
	Plastics and Rubber Products	-0.424	0.017	0.655	--	--	--
	Non-metallic Mineral Products	-1.011	0.000	0.364	--	--	--
Production size	# of products and services (log)	0.068	0.000	1.070	--	--	--
	# of product lines (log)	--	--	--	0.190	0.068	1.209
Firm characterestics	Large-sized firm (>250 employee)	-0.306	0.008	0.736	--	--	--
	Employees with university degrees (%)	0.007	0.003	1.007	--	--	--
	The head office location in Canada	--	--	--	-1.451	0.000	0.234
Long term strategy and strategic focus	Mass market strategy	-0.310	0.039	0.734	--	--	--
	Improved goods/services	-0.218	0.017	0.804	--	--	--
	Gross/margin operating growth	0.297	0.005	1.345	--	--	--
	Market/customer share growth	0.191	0.034	1.211	--	--	--
	Sales of new products	0.208	0.024	1.231	--	--	--
Other operational strategies	Outsource logistics (internationally)	1.330	0.000	3.780	--	--	--
	Expand production facility by M&A	--	--	--	1.052	0.009	2.863
	Close or contract caoacity of logistics facilties	0.447	0.001	1.564			
	Expand logistics by M&A	--	--	--	-2.074	0.000	0.126
	Close logistics facilities	0.355	0.086	1.426			
Competiton	Number of competitors 3-10	0.328	0.007	1.389	--	--	--
	Number of competitors >10	0.341	0.010	1.406	--	--	--
Innovation	Product innovation	--	--	--	0.477	0.049	1.611
	Process innovation of new manufacturing methods	0.218	0.002	1.243	--	--	--
International activities	Outrouce logistics (internationally)	--	--	--	2.164	0.000	8.708
	International subsidiaries	--	--	--	0.925	0.001	2.522
	International activities	0.660	0.000	1.935	--	--	--
	International suppliers	0.392	0.023	1.480	--	--	--
	Canada being the main market	--	--	--	-0.496	0.039	0.609

Conclusions

- Firm growth models and outsourcing decisions are the underlying modules of the Firmographic Engine of Canada.
- Firm growth is largely affected by economic conditions, competition, industry dynamics, and firm age.
- Outsourcing of freight activities are affected by economic conditions, firm strategic focus, production size, advanced technologies and innovation practices, and government programs.

Thank You

Questions?

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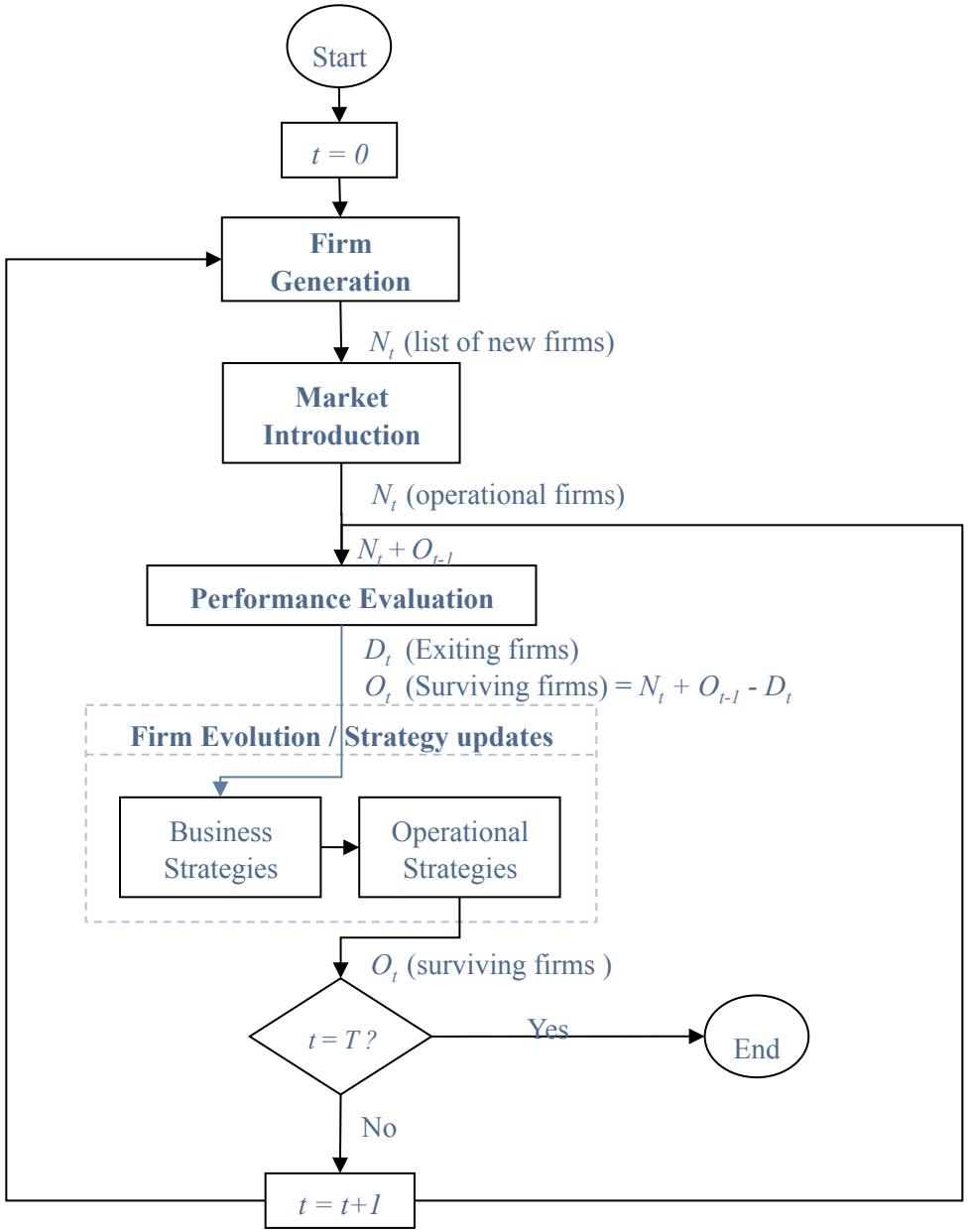
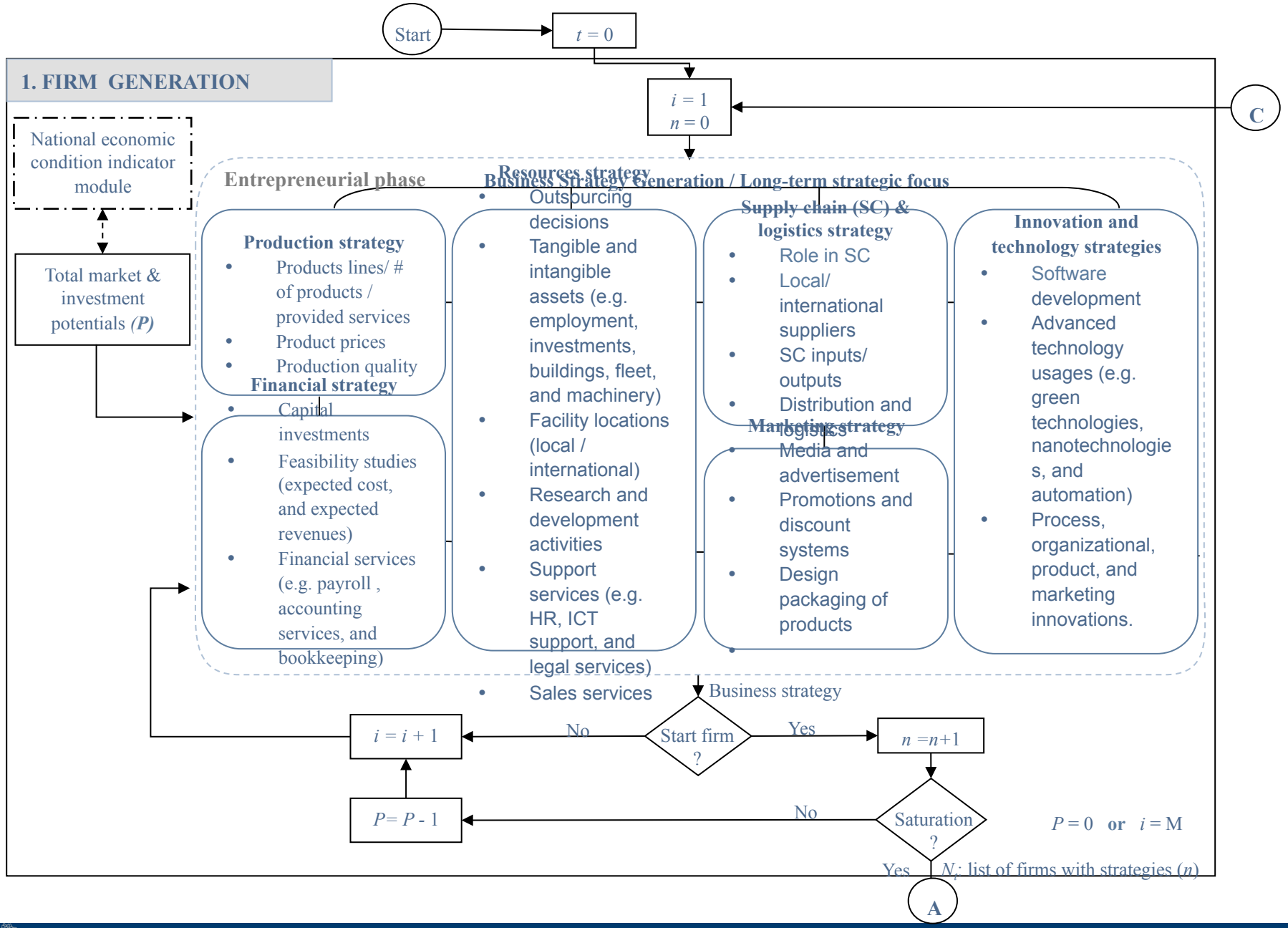
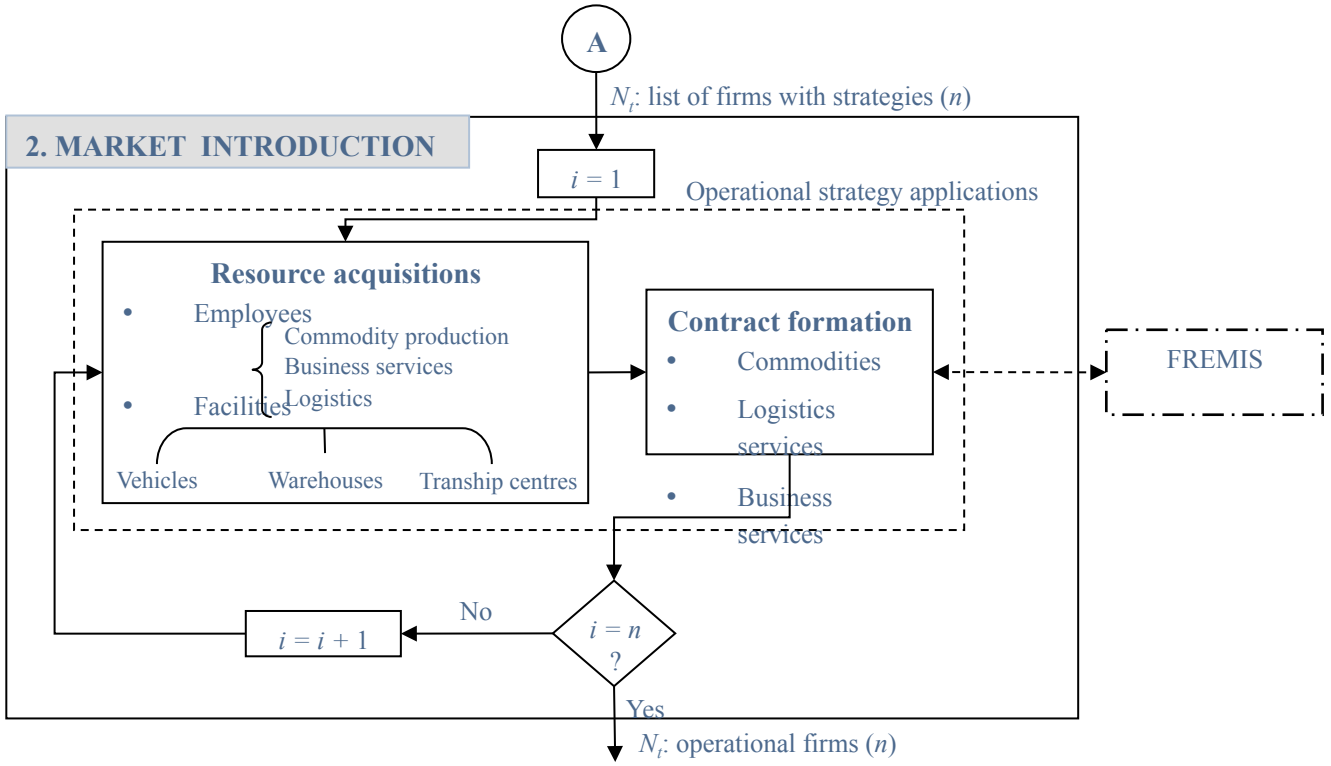
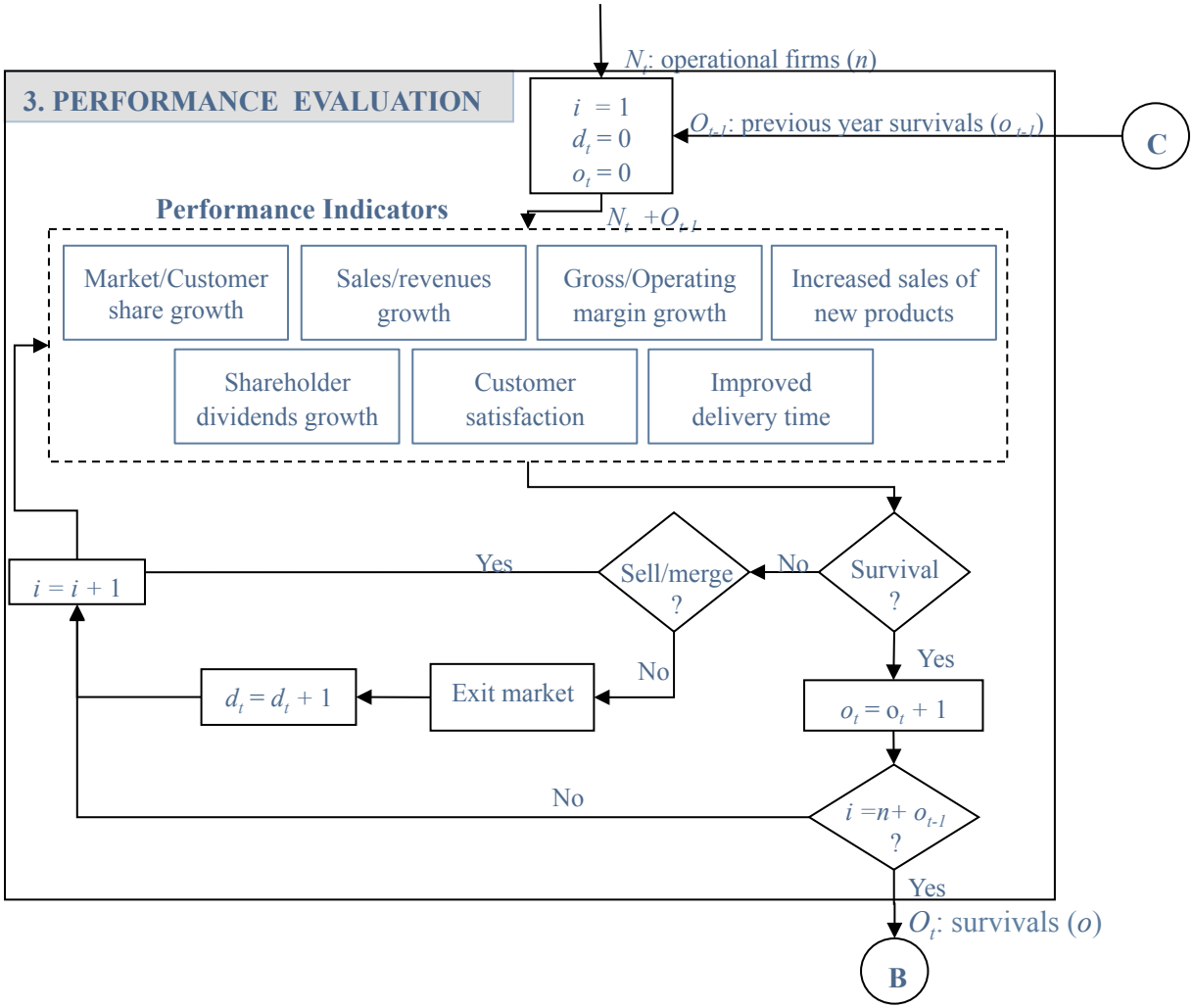
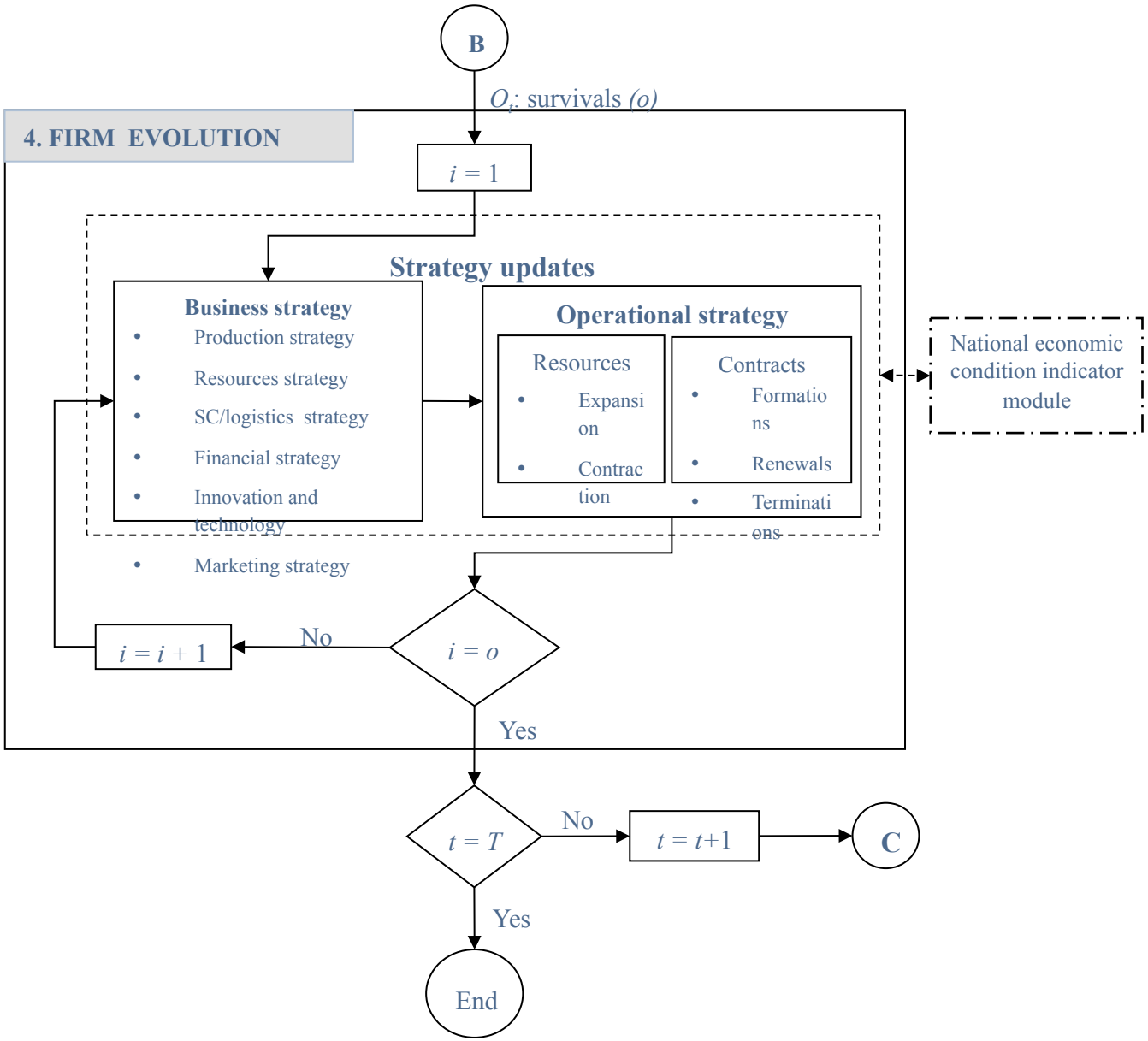

Start
t = 0
Firm Generation
N_t (list of new firms)
Market Introduction
N_t (operational firms)
N_t + O_t-1
Performance Evaluation
D_t (Exiting firms)
O_t (Surviving firms) = N_t + O_t-1 - D_t
Firm Evolution / Strategy updates
Business Strategies
Operational Strategies
O_t (surviving firms)
t = T ?
Yes
End
No
t = t+1


Start
$t = 0$
1. FIRM GENERATION
$i = 1$
$n = 0$
C
National economic condition indicator module
Total market & investment potentials (P)
Entrepreneurial phase
Business Strategy Generation / Long-term strategic focus
Production strategy
Products lines/ # of products / provided services
Product prices
Production quality
Financial strategy
Capital investments
Feasibility studies (expected cost, and expected revenues)
Financial services (e.g. payroll , accounting services, and bookkeeping)
Resources strategy
Outsourcing decisions
Tangible and intangible assets (e.g. employment, investments, buildings, fleet, and machinery)
Facility locations (local / international)
Research and development activities
Support services (e.g. HR, ICT support, and legal services)
Sales services
Supply chain (SC) & logistics strategy
Role in SC
Local/ international suppliers
SC inputs/ outputs
Distribution and logistics
Marketing strategy
Media and advertisement
Promotions and discount systems
Design packaging of products
Innovation and technology strategies
Software development
Advanced technology usages (e.g. green technologies, nanotechnologies, and automation)
Process, organizational, product, and marketing innovations.
Business strategy
Start firm ?
No
Yes
$i = i + 1$
$n = n+1$
$P = P - 1$
Saturation ?
No
Yes
$P = 0$ or $i = M$
N_t: list of firms with strategies (n)
A


A
N_t: list of firms with strategies (n)
2. MARKET INTRODUCTION
$i = 1$
Operational strategy applications
Resource acquisitions
Employees
Facilities
Commodity production
Business services
Logistics
Vehicles
Warehouses
Tranship centres
Contract formation
Commodities
Logistics services
Business services
FREMIS
No
$i = i + 1$
$i = n$?
Yes
N_t: operational firms (n)


N_t: operational firms (n)
3. PERFORMANCE EVALUATION
$i = 1$
$d_t = 0$
$o_t = 0$
O_{t-1}: previous year survivals (o_{t-1})
C
Performance Indicators
$N_t + O_{t-1}$
Market/Customer share growth
Sales/revenues growth
Gross/Operating margin growth
Increased sales of new products
Shareholder dividends growth
Customer satisfaction
Improved delivery time
Survival ?
No
Sell/merge ?
Yes
$i = i + 1$
No
Exit market
$d_t = d_t + 1$
Yes
$o_t = o_t + 1$
$i = n + o_{t-1}$?
No
Yes
O_t: survivals (o)
B

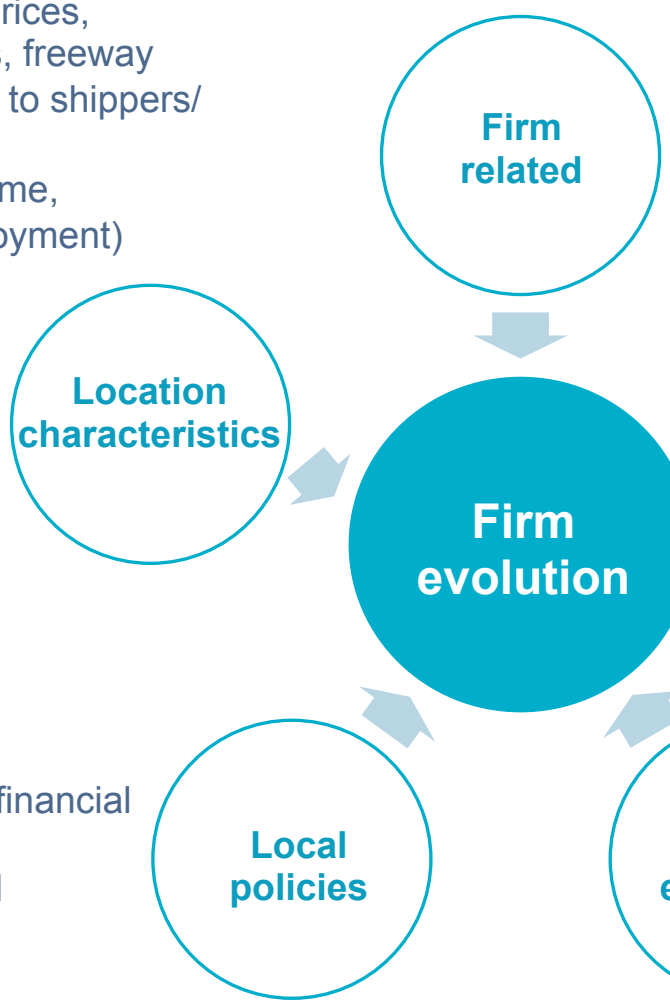

B
O_t: survivals (o)
4. FIRM EVOLUTION
i = 1
Strategy updates
Business strategy
Production strategy
Resources strategy
SC/logistics strategy
Financial strategy
Innovation and technology
Marketing strategy
Operational strategy
Resources
Expansion
Contraction
Contracts
Formations
Renewals
Terminations
National economic condition indicator module
i = o
No
i = i + 1
Yes
t = T
No
t = t+1
C
Yes
End

Government support programs for innovation related actvities

- Tax credit programs
- Government export incentives and services
- Government training programs
- Government grants
- Government procurements
- Hiring recent graduates
- Access to government research facilities
- Government market information services

Introduction

- Geographic (land prices, targeted customers, freeway access, proximities to shippers/ carriers)
- Demographic (income, education, unemployment)



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