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Forest dependence and community well-being in rural Canada: a longitudinal analysis

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Summary

The well-being of people living in forest-dependent communities has been studied extensively, but little research has explored how this relationship has changed over time. Some theories suggest that regional differences in well-being should decrease, through the flow of capital and labour, while other work suggests that these inequalities will grow. Our research uses Census of Canada data at the census subdivision level at 5-year intervals between 1986 and 2001 to describe regional differentiation in the relationship between employment in forest sectors (logging, services, pulp and lumber) and unemployment and median family income as indicators of well-being. We found general declines, which varied somewhat by region, over time in forest dependence across the regions and changing composition of the forest industry across these sectors. The relationship between forest dependence and well-being over time varied by region, largely tied to intra-industry sector shifts.

Introduction

Although the relationship between forest dependence and the well-being of the human communities that depend on forest harvesting and processing has been a subject of great interest, few studies have investigated this relationship over time. The purpose of the paper is to describe the regional and structural aspects forest industry development in Canada and to understand how these aspects of industrial development (i.e. the relationship between forest dependence and community well-being) have changed over time. As such, our findings will serve as a base for more studies into the particular causal mechanisms at work in different regions, different times and for different sectors. Our analysis is positioned within a broader literature on uneven development (Smith, 1984) and a theory of core–periphery development in particular (Friedmann, 1972).

Forest dependence and well-being in Canada

Using conventional measures of community well-being such as income and employment rates, Stedman *et al.* (2005, 2007) examined the well-being of human communities that depend on harvesting and processing of forest products for their income. These authors found mixed results across regions, indicators of well-being and particular forestry sectors (such as lumber *vs* logging), suggesting that the effects of forest dependence are highly variable rather than consistent. The element missing from this work, and much of the work on forest dependence more generally, is that of 'time'. Does the relationship between forest dependence and well-being differ not only by indicator and region but over time? This paper responds to this gap by examining regional differences in the relationship between forest dependence and well-being over time. Our data do not permit us to make compelling causal inference; our analyses are more focused on describing the differences.

Literature review

Understanding regional differences in well-being

Our research examines how the relationship between forest dependence and well-being may change over time. The

concept of well-being is often defined by a set of measures related to subjective well-being such as life satisfaction or happiness or a set of more objective measures such as income and employment (Beckley, 1995; Bliss and Bailey, 2005). We take the latter approach to the measurement of well-being in this study, mainly because secondary data are available on these measures for communities across Canada. In this sense, our discussion of well-being is defined by a fairly narrow set of socio-economic indicators that are commonly utilized in studies of this kind (e.g. Overdevest and Green, 1995).

Development theories that explore regional differentiation or convergence in community well-being over time underpin our work (Markusen, 1987). Within this tradition, contradictory theories suggest either the exacerbation or decline of regional differences in well-being over time (We would like to note, however, that our task is not precisely the same as in traditional regional economic development models, as we are not attempting to examine overall trends in regional differences in indicators of well-being, but to examine regional trends in the relationship between community well-being and forest dependence.). Storper (1995, p. 211; see also Scott and Storper, 1986) asserts that regional distinctiveness should logically decline, based on mobility and our increased ability to transcend 'the frictions of space'. Lobao (1990), focussing on the agricultural sector, adds that neoclassical economics assumes regional disparities should be reduced over time, based on the uniformity of the development process: enterprises will locate where they can maximize profit, based both on ability to capture markets and the availability of conditions of production (i.e. raw materials, labour, etc.). Regional differences may exist but 'are thought to be relatively impermanent and do not reflect the normal operation of the economic system' (Lobao, 1990 p. 66). Thus, these factors of production will adjust – i.e. labour can migrate – and over time interregional convergence will occur.

These suggestions, however, are not consistent with theories of uneven development: Lyson and Falk (1993) note that the neoclassical modernization theory has been challenged by uneven development theory that emphasizes 'regional economic inequality as a built in and persistent structural feature . . . as core economic centres dominate less-developed peripheral regions' (p. 259), resulting in the maintenance or increase of regional distinctiveness (Storper, 1997). Lyson and Falk (1993) note that although labour and capital should flow freely, thus reducing regional differences, the history of rural regions in the US suggests quite the opposite, with regional economic divergence rather than convergence as the norm (See also Lyson, 1989). Simply put, places that are poorly off to begin with often get worse relative to their comparison places rather than narrowing this gap (Duncan, 1999).

Differences in natural resource endowments – climate, terrain and soil differences associated with mineral resources, differences in flora and fauna – even the presence or absence of public land may contribute to regional differences. Policies that respond to different assets and liabilities may be important as well (Hirschman, 1958). Bradshaw (1988) cites as an example US Western water policy (see Walton, 1992), where powerful interests responded to regional resource 'deficits' (lack of water) by implementing a complex series of technical fixes, policies and subsidies to overcome this disadvantage. The point is that these resource endowments are dynamic and can generate diverse responses, including those based in environmental and/or economic policy.

Friedmann's (1972) core–periphery model (see also Bunker, 1989) notes that investments, be they public or private, become concentrated in particular areas, setting the foundations for unequal development and the emergence of 'core and periphery' regions or firms. Core firms are large-scale facilities that dominate their product markets, whereas periphery firms are engaged in subcentre competitive and routine business operations at smaller scales and with limited resources (Averitt, 1968; Overdevest and Green, 1995). Centre firms generally pass on benefits – higher wages, benefits and jobs security to their employees. Periphery firms are not in a position to do the same. Entire regions can be described as core or periphery, and resource endowments are linked to this. Because natural resources often act as 'inputs' to industry, their potential for linking to other industries is limited, sometimes leading to uneven development. Subnational regions, countries or even world regions may be characterized in this way.

Regional differences in the relationship between resource dependence and well-being

How shall we explore developments in the forest industry using the above concepts? One key element of forestry is that land and resources as material factors of production make it difficult for capital interests to fully penetrate (for a similar articulation for agriculture, see Lobao, 1990). The biological nature of forestry makes it less attractive to capital investment: there is a high system uncertainty in terms of ecosystem dynamics and repeated fluctuations in commodity markets for many forest resources. Further, there is disjuncture between labour and production times. Bunker (1989) adds that time and space work differently in natural resource industries and agriculture than they do in industrial production. 'If production is the incorporation of energy into matter, then industrial production starts and ends at the same time as the labour that defines it' (p. 590).

These factors of production and system uncertainty can be used to examine and understand regional differences in the performance of the forest industry. The rate of growth varies dramatically by place, as do forestry policies, jointly affecting the relationship between forest dependence and well-being. The relationship is further complicated by the fact that forestry takes place on a mosaic of private and public lands, resulting in the potential for additional regional differences based not only on material endowments and policy but regional differences in ownership patterns, access and tenure arrangements. Finally, labels such as 'forest dependent' hide a great deal of intra-industry variation along the core–periphery domain discussed earlier. Previous research (Overdevest and Green, 1995; Stedman et al. 2004; Stedman *et al.*, 2005) emphasizes that different sectors 'within' the forest industry

exhibit different core/periphery conditions. For instance, research (Parkins *et al.*, 2003) shows that core industries in the forest sector are often associated with pulp and lumber activity in Canada, whereas periphery industries are often associated with logging and forest service operations (e.g. tree planting and fire protection). These so-called core industries in Canada are associated with higher educational attainment, higher employment income and lower poverty rates.

Regional differences in the Canadian forest industry

The preceding discussion suggests several factors of production to compare across regions that may affect the relationship between forest dependence and well-being. The following section provides a brief comparison overview of Canadian regions in their type of forests and growth rates based on natural resource endowments, such as soil fertility and climate, historical land tenure patterns, level and type of industry consolidation, harvest histories and the region-specific histories and policies related to these factors. Fully describing these elements, and understanding their combined effects on the well-being of forest communities, is far beyond the scope a single journal article; we will highlight a few aspects of each region that are especially relevant. For a more detailed description of regional characteristics, see Howlett (2001).

National level characterizations

Nationally, the Canadian forest industry has a large presence: the area harvested increased from 400 000 ha in 1920 to a peak of over 1 000 000 ha harvested in 1994. The most recent available statistics report a 2007 harvest level of 733 760 ha (Canadian Forest Service, 2009). Overall, 77 per cent of Canada's forest is owned by individual provinces (suggesting that inter-provincial province differences in regulations may exert strong effects), 16 per cent is federally owned and, in strong contradistinction to the US, only 7 per cent is in private hands.

Regional characterizations

This paper uses a six-region classification of Canada: (1) the Atlantic provinces (Newfoundland and Labrador, Prince Edward Island, New Brunswick and Nova Scotia); (2) Quebec; (3) Ontario; (4) the Prairie provinces (Manitoba, Saskatchewan and Alberta); (5) British Columbia (BC) and (6) The Northern Territories (Yukon Territory, Northwest Territories and Nunavut). These divisions are based on fairly unique elements as discussed below and have been used extensively in previous studies of the forest industry (Howlett, 2001; May, 2005).

Atlantic provinces

Newfoundland and Labrador contains the eastern extent of the Canadian boreal forest and represents 68 per cent of total forest land. The region is dominated by slow-growing spruce/fir systems (much considered commercially undesirable), although recent pulp and paper innovations have accelerated cut rates. Of the productive timber land on the island, 1.77 million ha (59 per cent) has been tenured to the province's two major pulp and paper companies (Newfoundland and Labrador Department of Forest Resources and Agrifoods, 2003). Newfoundland and Labrador is the only Canadian province with zero stumpage rates, resulting in low government revenues from logging.

Nova Scotia dispossessed most of its crown land to private timber interests (70 per cent of forest land is privately owned) and used to be dominated by the pulp/paper industry, with a strong presence of foreign ownership of processing facilities and land. Currently, about half the Nova Scotia forests are owned by small private woodlot owners engaged in political struggles over collective bargaining. Over the past 10 years, there was a shift from primarily a pulpwood market to a studwood and log market that produces wood chips for the pulp and paper sector (Nova Scotia Department of Natural Resources, 2008). Lumber production doubled between 1995 and 2005, but the number of sawmill businesses dropped from 322 to 235.

Well over half of the regional volume harvested comes from New Brunswick. May (2005) characterizes New Brunswick as a 'fibre farm' due to the intensive 40–60 years rotation harvest/replanting cycles of forestry. Ownership was historically concentrated: two pulp companies leased 70 per cent of crown land and also owned outright over one-third of private forest land. However, the 1960s saw an organization of smaller woodlot owners, resulting in concomitant policy reforms. This provision was lost in the 1990s, resulting in a reconsolidation of crown land. In summary, the Atlantic provinces are characterized by relatively high rates of private forest land ownership, intensive harvest, pulp and paper and concentrated ownership of processing and also raw materials.

Quebec

Quebec forestry is characterized by historical dominance of pulp–paper and concentration of ownership. Unlike Atlantic Canada, 85 per cent of 'productive' forest is 'Crown' (Provincial) land. However, although small private owners own only 12 per cent of the forest, they produce 23 per cent of the total volume of wood (May, 2005). In anticipation of 1987 reforms of the tenure system that extinguished all previously existing tenures, many 'big players became bigger' and the acquisitions prevented the smaller actors from recompeting under the new arrangement. In 1987, independent mills accounted for 72 per cent of the share of roundwood consumption in paper mill-integrated sawmills. Post-reform, this decreased dramatically to 52 per cent by 2006 (Government of Quebec, 2008).

Ontario

Intensive harvest in Ontario is relatively more recent than father east: the area harvested increased from 2000 km^2 in 1940 to 8000 km^2 in the 1980s. Similar to Quebec, the majority of forested land (81 per cent) is owned by the crown

(Ontario Ministry of Natural Resources, 2006). The concentration of industry is recent, much of it through leasing of crown lands, which increased from 58 per cent of crown land in 1986 to 70 per cent in 1993. Although Ontario appears to have less centralization of processing (i.e. there are currently ~500 mills), the top 10 per cent represents 90 per cent of production and 25 per cent is harvested by only two companies.

Prairie region

Due to settlement patterns and the development of other industries, such as agriculture and energy, forestry is a comparatively recent development in the prairie region. Forest harvest in the region as a whole is dominated by very low stumpage rates and recent improvements in technology that have fostered the harvest of relatively small hardwoods for pulp and oriented strand board. Nearly, 90 per cent of the forest is 'Crown Land', with a few large companies controlling much of the harvest from these lands. In harvest, Alberta produces far more fibre than the other Prairie provinces, although this is a relatively new phenomenon, as harvests accelerated dramatically in the early 1980s, while remaining fairly constant in Saskatchewan and Manitoba.

British Columbia

BC is distinct from any other province by virtue of its comparatively very high value and volume of wood products. About half of all wood cut in Canada is cut here. Nearly, all (95 per cent) the forest is crown land, and over 90 per cent of cutting is clear cutting. Much of this is quite recent as the cut rate tripled between 1960 and 1990, but the province also has a larger area of protected forest than any other. Nor has recent consolidation of the industry been as dramatic as in other regions: the 10 biggest forest companies have held ~60 per cent of control from 1975 to present. Historically, low stumpage rates were dramatically increased in the early 1990s, which finally meant net positive revenues being returned to the province. Due to the value of its timber resources and the steep topography harvested, BC also has very high rates of capital investment in its forest harvest and lumber industry (while other provinces concentrate their capital in industries, such as pulp and paper).

Canada's north

Overall, the forest industry has a very small presence in Canada's territories: Nunavit, Yukon and the Northwest Territories. Small slow-growing trees have led to the lack of a viable forest industry, but there is increasing pressure here, driven by technological innovation and low stumpage rates in an effort to spur economic development. Similar to the geographic expansion into 'unsuitable' areas in the provinces, there has been a threefold to fivefold increase in area and volume cut from late 1980s to the mid-1990s. Harvest volumes in the north peaked in the mid-1990s at ~600 000 m^3 and gradually declined to a harvest level of 36 000 m^3 in 2007 (Natural Resources Canada, 2009).

Research questions, data, measures and analysis

Our primary question is whether we will observe regional divergence or convergence in (1) the distribution of sectors within the forest industry and (2) in the relationship between economic dependence on each of these sectors and well-being across regions. Divergence and convergence are measured through changes in levels of forestry dependence and community well-being between the years 1986 and 2001. Bivariate and multivariate relationships between well-being indicators and levels of forest dependence are also explored, with a view to understanding the changes or retrenchments of core–periphery relationships over time.

The data in this study are from the Census of Canada reported by census subdivision (CSD), which consists of fine-level geographies that roughly correspond to municipal boundaries and rural municipal districts. Data reported for every CSD in Canada have been filtered to include a comparable subset of rural (i.e. non-census metropolitan) CSDs between 1986 and 2001, our time periods of interest (Although 2006 census data are available for this analysis, changes in measurement of key variables between census periods make direct comparisons with previous years unworkable.). The dataset was developed and maintained by the New Rural Economy (NRE) Project at Concordia University and provides a consistent platform that accounts for CSD boundary and code changes across the observation periods.

Dependence was measured as the proportion of employment income derived from an individual sector or industry. For the purpose of this study, we used a continuous measure of dependence (i.e. 0 to 100 per cent of employment income). Our focus is the forest sector, which was grouped into four main industries based on previous Canadian investigations of core–periphery relationships in the forest sector (see Stedman *et al.*, 2005; Patriquin *et al.*, 2007): logging, forest services (e.g. tree planting and fire protection), lumber and pulp. Three common census-based measures of community well-being were linked to dependence: poverty, unemployment and median family income. Measurement of these variables is constant across our time period. Our analysis proceeds in several steps: firstly, we provide descriptions of the population by region as well as well-being statistics in 1986 and 2001 and the per cent change between these observation periods. Secondly, we compare means, using a one-way analysis of variance, in mean forestry dependence (including component subsectors) between regions and over time, thus describing how the forest industry has changed over the 15-year observation period. Thirdly, we use a bivariate correlation analysis to describe the relationship between forest industry dependence (including component sectors) and unemployment/median family income for each region and time period. Finally, we use ordinary least squares (OLS) regression to explain unemployment rates in 2001 based on 1986 and 2001 forest-dependence levels (including change between the two time periods) and control variables for each region, thus isolating the causal influence of forest dependence from other potential explanations.

Results

The dataset contained 1337 comparable CSDs over the two observation periods (1986 and 2001). These CSDs were distributed regionally across Canada with 321 in the Atlantic region, 443 in Quebec, 80 in Ontario, 416 in the Prairie region, 45 in BC and 32 in the Northern Territories. Table 1 contains descriptive statistics on mean population, mean median family income, mean unemployment rate and mean poverty rates across the regions for 1986 and 2001. In general, all regions had increases in mean population and family income and decreases in unemployment and poverty between 1986 and 2001.

Regional patterns of dependence

Table 2 indicates the mean level of forest sector and individual forest industry dependence across regions in 1986 and 2001. In 1986, BC had the highest mean per cent forest dependence (25.6 per cent) and was significantly more dependent than all the other regions except Ontario (14.7 per cent). The Prairie region and the Northern Territories had significantly

Table 1: Descriptive population and community well-being statistics

	Atlantic (*N* = 321)	Quebec (*N* = 443)	Ontario (*N* = 80)	Prairies (*N* = 416)	BC (*N* = 45)	North (*N* = 32)
Mean population 1986 (#)	761.4	870.9	874.3	727.7	985.2	644.8
Mean population 2001	862.8	1060.6	1290.0	774.9	1125.6	790.8
Percent change	13.3	21.8	47.5	6.5	14.3	22.6
Median family income 1986*	31 831.4	34 428.3	37 429.4	35 481.0	34 717.3	30 061.7
Median family income 2001	35 919.4	42 028.6	46 862.4	38 249.7	37 272.8	37 468.3
Percent change	12.8	22.1	25.2	7.8	7.4	24.6
Mean unemployment rate 1986 (%)	29.6	19.4	12.0	13.3	27.7	25.0
Mean unemployment rate 2001	28.24	13.3	9.9	10.9	21.2	19.7
Percent change	−4.6	−31.4	−17.5	−18.0	−23.5	−21.2
Mean poverty rate 1986 (%)	20.3	18.8	11.2	10.9	7.1	0.0**
Mean poverty rate 2001	10.3	8.9	5.6	4.3	5.1	0.0**
Percent change	−49.3	−52.7	−50.0	−60.6	−28.2	0.0**

* 1986 Figures transformed to 2001 constant dollars by an inflation factor of 1.49 using the Canadian Consumer Price Index.
** Data suppression in smaller northern communities.

Table 2: One-way analysis of variance in mean forestry dependence across regions and time

	Atlantic (*N* = 321)	Quebec (*N* = 443)	Ontario (*N* = 80)	Prairies (*N* = 416)	BC (*N* = 45)	North (*N* = 32)
Mean forest dependence 1986 (%)	7.2a	13.1b	14.7bc	1.2d	25.6c	0.9d
Mean forest dependence 2001	**4.7**a	**9.3**b	**11.3**bc	1.4d	**20.0**c	0.6d
Mean logging dependence 1986 (%)	3.2a (44.4)	4.9a (37.3)	3.6a (24.3)	0.3b (23.0)	8.2a (32.0)	0.0b (4.5)
Mean logging dependence 2001(%)	**1.6**a (34.4)	**2.7**a (28.5)	2.6ab (23.0)	0.3bd (23.7)	8.1c (40.3)	0.2b (32.3)
Mean forestry service dependence 1986 (%)	0.3a (4.6)	0.5a (3.4)	1.0a (6.5)	0.3ab (23.8)	0.8a (3.0)	0.0b (1.1)
Mean forestry service dependence 2001(%)	**0.1**a (1.9)	0.3a (3.3)	**0.1**a (0.8)	0.2a (15.6)	1.9b (9.4)	0.4a (59.7)
Mean lumber dependence 1986 (%)	1.8a (25.4)	5.5b (41.7)	6.2b (42.4)	0.4c (32.8)	16.7d (65.1)	0.8ac (94.3)
Mean lumber dependence 2001 (%)	1.9a (40.2)	5.3b (56.8)	5.5ab (49.2)	0.6c (43.7)	**9.9**b (49.3)	0.1d (8.1)
Mean pulp dependence 1986 (%)	1.9a (25.7)	2.3a (17.5)	3.9b (26.8)	0.2b (19.7)	0.0b (0.0)	0.0b (0.0)
Mean pulp dependence 2001 (%)	**1.1**a (23.3)	**1.1**ab (11.4)	**3.0**a (26.9)	0.2bc (17.8)	0.2abc (1.1)	0.0c (0.0)

Values in rows that do not share an alphabet denote statistical difference between regions, $P < 0.05$. Values in bold indicate significant pairwise difference within that region between 1986 and 2001, $P < 0.05$.

lower mean forest dependence than the rest of the regions in Canada. A similar pattern of distribution was maintained in 2001, although forest dependence overall declined: four of the six regions (Atlantic, Quebec, Ontario and BC) experienced a significant reduction in overall forest dependence (summed across all sectors) from 1986 to 2001. In BC, mean forest dependence decreased from 25.6 per cent in 1986 to 20.0 per cent in 2001. The Prairie region was the only region where forest dependence rose, though not significantly.

How is this decrease in forest dependence distributed across sectors; i.e. how did the composition of the industry change between 1986 and 2001? Among the individual forestry sectors, in 1986, logging dependence was highest in BC, followed by Quebec, Ontario and the Atlantic region (Table 2). The Prairie region and the Northern Territories were significantly less dependent on logging. Similar to the overall pattern for the forest sector in aggregate, the regional distribution in logging dependence remained relatively unchanged in 2001 except for the Atlantic region and Quebec where significant decreases were observed. Forest services (i.e. tree planting, consulting, etc.) represent a smaller proportion of forest dependence overall, and this presence declined between 1986 and 2001, significantly so in the Atlantic region and Ontario. Somewhat in contrast to other sectors, lumber dependence maintained its presence, except in heavily lumber-dependent BC, where a very large decrease was observed (from 16.7 per cent of employment income to 9.9 per cent). Pulp dependence across the regions was relatively low in 1986 and remained so in 2001. The highest mean pulp dependence was found in Ontario, although pulp dependence declined significantly in the Atlantic region, Quebec and Ontario.

The relative composition of the forest sector (the percentage values in Table 2) changed between 1986 and 2001. Atlantic Canada, Quebec, Ontario and the Prairie region all saw robust increases in the proportion of the forest industry represented by the lumber sector (e.g. from 25 to 40 per cent in Atlantic Canada) and corresponding declines in logging, services and pulp. BC and the North Stand in direct contrast: in BC, relative dependence on lumber dropped from 65 per cent of the forest industry to 49 per cent, with relative increases in logging and services. In the north (keeping in mind that the low overall dependence makes any change more dramatic), logging dependence increased from 5 per cent of the industry to 32 per cent and services from 1 to 60 per cent and lumber dependence dropped from 94 per cent of the industry to 8 per cent.

Dependence and socio-economic well-being: bivariate relationships

We first examined the relationship between forest dependence (including component sectors) and two key well-being indicators – unemployment and median family income – across the regions using a bivariate correlation analysis. The relationship between forest industry sector dependence and unemployment shows a great deal of regional variation and change over time. In 1986, logging-dependent communities had higher unemployment in the Atlantic region and Quebec (Table 3). In stark contrast, greater logging and lumber dependence were associated with decreased unemployment in BC. However, by 2001, the relationship between logging dependence and unemployment had deteriorated: higher unemployment was associated with logging dependence in all the regions (with correlations ranging up to 0.328 in the Prairie region and 0.358 in the north) except in BC, and even here, what had been very positive outcomes (more logging associated with lower unemployment) was much weaker (from −0.381 to −0.176) and no longer significant. Forest service dependence shows similar patterns: increased dependence on forest services in 1986 is associated with higher unemployment in Quebec and lower unemployment in BC (−0.328). By 2001, forest service employment is also significantly associated with higher unemployment in Ontario (0.433) and in the Prairies (0.300). More dramatically, the association between forest service dependence and lower unemployment in BC had reversed to produce higher unemployment (0.405) in

Table 3: Correlation between forest industry dependence and unemployment

	Atlantic (N = 321)	Quebec (N = 443)	Ontario (N = 80)	Prairies (N = 416)	BC (N = 45)	North (N = 32)
1986						
Logging dependence	**0.196**	**0.357**	0.126	0.047	**−0.381**	−0.204
Forestry service dependence	−0.007	**0.143**	−0.002	0.059	**−0.328**	−0.204
Lumber dependence	−0.061	0.040	−0.003	0.022	**−0.361**	0.095
Pulp dependence	−0.047	−0.036	−0.002	−0.005	na	na
2001						
Logging dependence	**0.203**	**0.427**	0.217	**0.328**	−0.176	**0.358**
Forestry service dependence	−0.044	**0.112**	**0.433**	**0.300**	**0.405**	−0.063
Lumber dependence	**−0.206**	0.057	0.094	0.038	−0.142	−0.157
Pulp dependence	**−0.168**	−0.076	−0.085	0.009	−0.050	na

na = Not applicable. Values in bold denote significant correlation $P < 0.05$.

2001. Lumber dependence generally was not associated with unemployment in 1986, except in BC, where more dependence on the lumber sector was associated with reduced unemployment. This relationship disappeared by 2001, but – countering the overall trends – we see lower unemployment associated with dependence on lumber and pulp in Atlantic Canada.

Similar patterns are revealed for median family income as for unemployment (Table 4). In 1986, logging dependence is associated with lower income in the east (Atlantic and Quebec) and higher income in BC. These patterns remained stable across time, although by 2001, logging dependence is also significantly associated with lower income in the prairie region. As with unemployment, dependence on forest services produces worse outcomes in 2001 than in 1986: in Ontario and the prairie region, no relationship in 1986 shifted to negative (lower income) by 2001. In BC, the positive effect (0.291) had become strongly negative (−0.353). For lumber and pulp, we see an emergence over time of modestly positive relationships (higher income) in Atlantic Canada.

Dependence and socio-economic well-being: OLS regression

We conducted an OLS regression analysis to examine the factors associated with unemployment rates in 2001 for five of the six regions (Table 5) (we excluded the north because of large amounts of missing data (We also recognize that interpretations for Ontario and BC are tentative because of relatively few degrees of freedom in the

Table 4: Correlation between forest industry dependence and median family income

	Atlantic (N = 321)	Quebec (N = 443)	Ontario (N = 80)	Prairies (N = 416)	BC (N = 45)	North (N = 32)
1986						
Logging dependence	**−0.032**	**−0.107**	0.379	−0.063	**0.341**	0.168
Forestry service dependence	−0.005	**−0.051**	0.188	−0.012	**0.291**	0.168
Lumber dependence	0.017	−0.032	0.206	0.094	**0.386**	0.018
Pulp dependence	0.142	0.123	0.444	0.032	na	na
2001						
Logging dependence	**−0.021**	**−0.169**	0.173	**−0.131**	**0.276**	**−0.108**
Forestry service dependence	−0.006	**−0.045**	**−0.216**	**−0.141**	**−0.353**	−0.011
Lumber dependence	**0.109**	−0.032	0.085	0.008	0.117	0.137
Pulp dependence	**0.154**	0.156	0.318	0.063	0.032	na

na = Not applicable. Values in bold denote significant correlation $P < 0.05$.

Table 5: Multivariate regression predicting 2001 unemployment

Dependent variable: unemployment rate 01	Atlantic		Quebec		Ontario		Prairies		BC	
	B	Standard B	B	Standard B	B	Standard B	B	Standard B	B	Standard B
(Constant)	**13.10**		0.59		3.88		−0.32		4.16	
Logging dep 01	**0.33**	**0.12**	**0.32**	**0.22**	−0.03	−0.03	**0.81**	**0.10**	0.11	0.09
Service dep 01	−0.87	−0.05	−0.06	−0.01	**1.86**	**0.20**	**0.57**	**0.05**	0.30	0.07
Lumber dep 01	**−0.45**	**−0.17**	−0.04	−0.04	0.01	0.02	−0.01	0.00	−0.21	−0.21
Pulp dep 01	0.06	0.01	−0.02	−0.01	**−0.49**	**−0.53**	0.11	0.03	−0.65	−0.06
Logging dep 86	−0.07	−0.04	**0.10**	**0.09**	0.28	0.22	**−0.35**	**−0.08**	0.03	0.04
Service dep 86	−0.13	−0.01	0.31	0.06	**0.59**	**0.21**	**−0.37**	**−0.06**	−0.61	−0.11
Lumber dep 86	0.09	0.03	0.01	0.01	0.02	0.03	0.02	0.00	0.22	0.35
Pulp dep 86a	−0.22	−0.07	0.08	0.04	0.37	0.43	0.05	0.01		
% < grade 9 education 01	**0.47**	**0.30**	**0.19**	**0.18**	**0.16**	**0.21**	0.06	0.05	0.11	0.07
% of pop 0–14 01	−0.37	−0.11	−0.02	−0.01	−0.09	−0.08	**0.19**	**0.16**	0.25	0.13
Population 01	**0.00**	**−0.11**	0.00	−0.04	0.00	−0.03	0.00	−0.01	0.00	−0.18
Aboriginal	5.88	0.09	**7.28**	**0.15**	**9.86**	**0.41**	**13.86**	**0.52**	8.10	0.32
Unemployment rate 86	**0.49**	**0.43**	**0.36**	**0.41**	**0.28**	**0.31**	**0.15**	**0.17**	0.18	0.24
d.f.	286		389		68		390		42	
F	**22.57**		**27.97**		**9.36**		**91.76**		**4.47**	
Adjusted R	0.50		0.47		0.62		0.75		0.50	

dep = dependence; d.f. = degrees of freedom. Values in Bold denote significant correlation $P < 0.05$.

* The variable '1986 Pulp' was automatically deleted from the regression analysis in SPSS for BC due to a constant or missing correlation.

model (68 and 42 cases, respectively))). We include in our model the level of dependence on each of the four forest sectors in 1986 and 2001, 1986 unemployment rate and control variables such as CSD population, education, age dependency ratio and whether the CSD had a significant aboriginal population. These variables were added to the model as factors such as the size of a community and the average education level of the community would have an effect on changes in our dependent variables. They are controlled in this model to gain more insights into the unique effects of change in forest industry dependence of community well-being.

The models showed generally good predictive ability, explaining from 47 per cent of the variation in 2001 unemployment (in Quebec) to 75 per cent (in the Prairie region). Net of all other variables in the model, we see robust effects of unemployment levels in 1986 on 2001 unemployment, suggesting the presence of persistent employment patterns over time. In contrast, we see relatively modest independent effects of 1986 forest sector dependence on 2001 unemployment (suggesting that the effects of historical dependence may have contributed to 1986 unemployment levels but not directly to 2001 unemployment). We had a number of cross-region consistencies: logging dependence increased unemployment rates in Atlantic Canada, Quebec and the Prairie region. Forest services dependence increased unemployment in Ontario and the Prairie region. In contrast, increased lumber dependence reduced unemployment only in Atlantic Canada, and pulp dependence reduced unemployment only in Ontario. A number of control variables were also significant: net of other factors in the model, aboriginal CSDs had higher unemployment, as did CSDs with low educational attainment.

Summary and discussion

In general, the period 1986–2001 saw a decline in overall forest dependence across the regions, ranging from a 35 per cent decline in Atlantic Canada to a negligible increase in the Prairie region. The composition of the forest industry changed somewhat as well, although (unlike for forest dependence as a whole) these changes varied by region. Logging dependence declined (as a proportion of the total forest industry) in more established regions of the east (Atlantic and Quebec), held steady in central Canada (Ontario and the Prairies) and increased in the west (BC) and north (Canada's Territories) where the industry is still emerging. Forest services employment generally declined except in BC and the north (the latter where the industry is growing rapidly and new investments are being made). Lumber dependence increased everywhere except in BC and the north, and pulp dependence held relatively steady except for Quebec, where it declined slightly from its historical dominance.

Another key question to our analysis is the relationship between forest industry dependence and well-being. Here, we are able to describe the trends and offer some potential interpretations of the results; readers are advised that our secondary data analysis does not permit definitive causal explanation, and these explanations remain tentative. Logging dependence and unemployment were correlated similarly in the east and central Canada (Atlantic, Quebec and Ontario) across the 15-year span, perhaps owing in part to the relative maturity of the logging industry across these regions. However, the relationship became more negative (logging becoming more associated with unemployment over time) in BC and the north. In BC, this may be associated with the capital-intensive nature of the industry and the progressive substitution of capital for labour. In contrast, namely the other 'peripheral' sector – forest services – the relationship between dependence and unemployment worsened for nearly all of Canada; similar results were obtained for median family income. In contrast, the relationship between well-being and lumber and pulp dependence (the more core sectors) was much more consistent over time and region.

Our multivariate regression results suggest forest dependence is a major driver of unemployment. Logging dependence in 2001 is associated with higher unemployment in most of Canada, and 1986 logging dependence also plays an independent role in Quebec and the Prairie provinces as well, suggesting a lasting outcome of established historical relationships. Dependence on peripheral sectors plays a role in well-being: Forest services employment in 2001 is associated with higher unemployment in Ontario and the Prairie provinces; 1986 services dependence also plays an independent role in Ontario and the Prairie provinces. In contrast to the generally negative effect of peripheral sectors, there were no corresponding positive effects on well-being of core sectors of pulp and lumber.

Our core question examines theories of modernization, expressed via convergence, *vs* uneven development (reflected in divergence) as related to the forest industry and its component sectors. Crucially, we fundamentally see an overall decline of the importance of the forest industry as a proportion of employment income: employment in Canada was less characterized by forest-based extraction and processing relative to other industries. The experience of Canada 'as a whole' thus is consistent with theories of modernization that emphasize development as entailing a shift away from the extraction and processing of raw materials. Only in the Prairie region and in the far north, where the forest industry is relatively new and plays a minor role in the economy, is subject to specific policies designed to foster the growth of the industry and has benefited from recent technological developments that permit the processing of small diameter trees, was the presence of forestry maintained or enhanced in the 15-year study period.

The composition of the forest industry is significant to discussions of development as well and shows interesting regional variation, namely the core–periphery relationship. Following Overdevest and Green (1995) and Parkins *et al.* (2003), we consider the pulp industry as a 'core' sector (characterized by high capital investment, product differentiation, technology and relatively high wages); logging and services as the most peripheral (characterized by

relatively lower wages and undifferentiated labour) and lumber representing a midpoint between these poles. When aggregated this way, a coherent story begins to emerge: based on the regional differences over time in composition of the industry, the forest industry became less peripheral in eastern Canada in the 15-year study period, as logging and services declined substantially, with this decline offset by concomitant increases in the lumber industry. In contrast, BC and Canada's territories saw increased relative dependence on these peripheral sectors.

The relationship between forest industry dependence and well-being indicators – and how this relationship varies across place and time – is another potentially important expression of uneven development *vs* modernization. Most of the meaningful effects we observe are on the peripheral rather than the core end of the spectrum. The relationship between forest services dependence (our first periphery sector) and well-being, as indicated by unemployment and median family income, deteriorated for nearly all of Canada. This suggests – consistent with core–periphery theory – that this form of dependence leads to worsening economic conditions over time. However, the relationship between logging dependence (another peripheral sector) and well-being varied regionally: logging was increasingly (over time) associated with negative outcomes in the very areas where logging was increasing relative to other forest sectors (BC and the north), suggesting the increased periphery of the forest industry overall, as peripheral sectors partially replaced core sectors (in BC) or started from scratch (in the north). That the relationships between the more core sectors (lumber and pulp dependence) were fairly consistent over time suggests – in combination with the findings above – that peripheral sectors may become more peripheral but that core sectors do not necessarily concomitantly become more core. This supports our earlier suggestion that the forest industry as a whole is becoming more peripheral over time.

Our analyses here are intended to provide a broad introduction to the regional and temporal expression of the forest industry, and its relationship to the well-being of the human communities that harvest and process it. Overall, Canada appears to be moving away from peripheral industries (forestry overall) and peripheral sectors (logging and services) within the forest industry. However, our findings of strong regional and intersector variation in the presence and performance of the forest industry emphasize the need for in-depth characterizations of the industry. Although we have taken some small steps towards explaining these particular patterns, providing detailed analyses for each of them is beyond the scope of a single article, especially given the high inter-provincial variation in the forest resource, its dispossession and tenure and associated policies. Future research should make use of our initial findings to initiate case study-based work that examines these trajectories in greater depth.

Conflict of interest statement
None declared.

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