Talent, technology and tolerance in Canadian regional development

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This article examines the factors that shape economic development in Canadian regions. It employs path analysis and structural equation models to isolate the effects of technology, human capital and/or the creative class, universities, the diversity of service industries and openness to immigrants, minorities and gay and lesbian populations on regional income. It also examines the effects of several broad occupations groups—business and finance, management, science, arts and culture, education and health care—on regional income. The findings indicate that both human capital and the creative class have a direct effect on regional income. Openness and tolerance also have a significant effect on regional development in Canada. Openness towards the gay and lesbian population has a direct effect on both human capital and the creative class, while tolerance towards immigrants and visible minorities is directly associated with higher regional incomes. The university has a relatively weak effect on regional incomes and on technology as well. Management, business and finance and science occupations have a sizeable effect on regional income; arts and culture occupations have a

Le talent, la technologie et la tolérance dans le développement régional au Canada

Cet article examine les facteurs contribuant au développement économique dans les régions canadiennes. Les résultats d'une analyse des pistes causales et d'une modélisation par équations structurelles ont permis de distinguer les effets sur les revenus régionaux de la technologie, du capital humain et/ou de la classe créative, des universités, de la diversité au sein de l'industrie des services, mais aussi de l'esprit d'ouverture envers les immigrants, les minorités et la population gay et lesbienne. L'analyse porte également sur les effets sur les revenus régionaux de certains domaines professionnels tels que les affaires et les finances, l'administration, les sciences, les arts et la culture, l'éducation et les services de soins de santé. Il en ressort que les facteurs du capital humain et de la classe créative ont un effet direct sur les revenus régionaux. L'ouverture d'esprit et la tolérance jouent également un rôle direct dans le développement régional au Canada. Alors que l'ouverture d'esprit envers les populations gay et lesbienne est un facteur déterminant du capital humain et de la classe créative, les résultats font état d'une association

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significant effect on technology; health and education occupations have no effect on regional income.

Key words: Canada, human capital, creative class, occupations, tolerance, technology, income, regional development

positive entre la tolérance envers les immigrants et les minorités visibles et les revenus régionaux élevés. Les établissements universitaires ont peu d'influence sur les revenus régionaux ainsi que sur la technologie. Les domaines de l'administration, des affaires et des finances et des sciences ont des effets plus marqués sur les revenus régionaux, tandis que ceux des activités culturelles et artistiques se font sentir sur la technologie. Les secteurs de la santé et de l'éducation n'exercent aucune influence sur les revenus régionaux.

Mots clés : Canada, capital humain, classe créative, professions, tolérance, technologie, revenu, développement régional

Introduction

What are the drivers of regional economic development in Canada? Traditionally, the answer has been jobs. The availability of high-quality, high-paying employment opportunities has long been seen as central to the ability of regions to attract people and raise incomes. With the globalization of manufacturing and the movement of many manufacturing jobs to lower cost locations, technology and entrepreneurship have come to be seen as increasingly important sources of regional development. Others point to the role of human capital in regional economic growth arguing that a key element is the ability of regions to attract and retain highly educated, highly skilled people. More recent approaches emphasize the roles played by urban amenities, quality of life, energetic artistic and cultural scenes and openness to diversity in regional development.

This article examines the role of technology, talent or human capital and tolerance in Canadian regional development. It seeks to shed light on four related issues. First, what are the relative contributions of technology and human capital—two factors identified in the broad literature—on the development of Canadian city regions? Second, what is the relative contribution of two alternative measures of human capital—one based on education and the other based on occupations, namely creative occupations—on regional development in Canada? Third, what is the relative contribution of regional institutions—in terms of universities, service diversity and levels of tolerance—on levels of technology and human capital? And fourth, how does the system of relationships among these factors and variables ultimately work to shape income level across Canadian regions?

Our research methodology builds upon and extends earlier research by Florida *et al.* (2008b) and Mellander and Florida (2009) on the United States and Sweden. However, the Canadian context is different in many aspects (Lipset 1990). Canada is a large country with a relatively small, highly urban population. With a recent influx of immigrants it is both culturally and geographically diverse. As a consociational nation, Canada is populated by several distinct cultural groups—Anglophone, Francophone and Aboriginal, as well as new immigrants. Stretching from the Atlantic to the Pacific to the Arctic oceans, Canadian regions differ greatly in natural resources and climate. Canada's regions are physically and socially heterogeneous. Wellstead's (2007) examination of the contemporary staples thesis finds that the Canadian economic geography is a mix of Schumpetarian and Ricardian competitive states. Thus, understanding economic development in Canada requires understanding the factors that shape growth across heterogeneous Canadian regions. The fact is, most of the regional development literature has a strong focus on US regions, which may in the end have very different structures and processes compared to what we can identify in Canadian regions.

Our research seeks to add to the understanding of regional development in Canadian regions.

To shed light on these issues, we present a stage-based general model of regional development. This stage-based model structure enables us to isolate the direct and indirect effects of these factors in the overall system of regional development. We use structural equations and path analysis models to examine the independent effects of human capital, the creative class, technology, tolerance and other factors identified in the literature on both regional wages and incomes. We examine these issues via a cross-sectional analysis of 46 geographic regions in Canada. Our modelling approach is designed to address relations between our explanatory and dependent variables in a Canadian regional context. It will also enable us to make comparisons with earlier similar studies for US regions.

Theory and Concepts

This section introduces our theoretical and conceptual framework. It begins with a discussion of the factors that have been found to shape Canadian regional development and then moves onto broader, but more abstract, conceptualizations of the underlying factors that shape regional development in general.

Theories of Canadian regional development

Innis (1956) was a strong proponent of development theories designed uniquely for a place. His argument was that any comprehensive theory would need a strong foundation supported by the unique characteristics of a situation. He claimed that a theory developed in Europe would not be applicable or relevant for Canada. It is hardly coincidence then that his 'staples' thesis was the first significant development theory that specifically addressed Canada's unique conditions. The theory was a modified version of export base theory and claimed that Canada's development was a response to certain 'staple' resources, and the demand for these resources decided the success of a region (Innis 1956). The theory was used to explain regional disparities within the country, a problem that contradicted neoclassical theories.

The staples thesis was prominent until the 1960s, at which point academics began to challenge certain aspects of it that failed to explain regional disparities (Savoie 1997). Regional development in Canada was approached for a long time through the lens of regional disparities. Examining and understanding these disparities was thought to be the path through which regional development would occur (Savoie 1997). For a brief period, Perroux's growth pole theory became popular and was applied within the Canadian context (Savoie 1997). Innis' staples thesis was still relevant in the early 1990s as Barnes reexamined the theory in light of post-Fordism and flexible specialization (Barnes 1996). Bradfield in the late 1980s wrote a book detailing the most prominent theories that have affected Canadian policy. Again staples theory played a prominent role, as did the issue of regional disparities (Bradfield 1988).

The overwhelming focus on regional disparities is no doubt in response to the unique physical and cultural situations within Canada. Like Innis, Bradfield (1988) argued for the creation of distinct country-specific development theories. Bradfield also stressed the importance of developing theories that not only looked at economic gain, but cultural, social and political costs as well. He felt that 'cultural differences can impose economic costs, either to overcome the difference or as a penalty for ignoring them' (Bradfield 1988). Geographers have increasingly included culture as a key element in development theories.

Geographical literature on regional development in Canada has progressed significantly over the last two decades as the Canadian economy and its regions have evolved. Theories have focused far less on regional disparities, and much more attention has been paid to local and regional characteristics that can foster growth. Barnes *et al.* (2000) reiterate earlier sentiments expressed by Barnes that economies need to be understood as local and contingent. It is clear that Canadian geographers have become aware of the historical settings and narrative of place. This has encouraged Canadian geographers to comprehensively adapt popular theories of economic development for Canada. As Barnes *et al.* (2000) acknowledge, globalization has made place more important, not less, and this has led to the creation of regional development theories that focus on innovation and creativity as the drivers of growth.

Creativity and Canadian regional development

The idea of the creative city in the Canadian context was examined by Gertler (2001) who looked at the change in the flow of people, capital and ideas over time. Gertler linked the urbanization of Canada's spatial form (1945–1975) to rising wages, the post-war housing boom, car ownership and significant infrastructure investment post-war. Limited research and case studies have been conducted on regional innovation systems and clusters within Canada (Holbrook and Wolfe 2000). Recent work has led to the development of a Canadian specific cluster methodology, that more appropriately acknowledges Canada's unique characteristics (Spencer *et al.* 2009).

Florida's creative class theory (2002a), which was first analytically applied to the Ontario context by Gertler *et al.* (2002) with unique results reflecting the differences in Canada's occupational composition. Slack *et al.* (2003) conducted a detailed report discussing the importance of the city–region to economic and regional development in Ontario, highlighting many of the social and economic challenges faced by the province. The idea has been further expanded upon with the creative city concept and its application to cities nationwide. Duxbury (2004) provides examples of how policy makers from Toronto to Halifax are adopting many of the indicator statistics developed for American metropolitan areas by Florida. Stolarick and Florida's (2006) analysis of the Montréal region documented the linkages between technology, talent, tolerance and creativity in the region. Smith and Warfield's (2008) case study of creative values associated with the Vancouver region did not find the city to be a paradigm example of creative theory. They did, however, stress the importance of creativity and its connectivity to economic results. Hall and Kahn (2008) examined the relation between immigrants and high-tech regions, and found that immigrants in larger Canadian regions with high levels of high-tech concentrations have significantly lower income earnings than immigrants in midsized and smaller regions. Peripheral regions are struggling to maintain their position within the Canadian geographic hierarchy (Polèse and Shearmur 2006).

Human capital and economic development

There is an enormous body of literature that has sought to explain the factors that drive economic growth (Solow 1956; Romer 1986, 1987; Barro 1991; Barro and Sala-i-Martin 1997; Barro and Lee 2000). Solow (1956) identified the role of technology as an exogenous factor. Romer's 'new growth theory' (1986, 1987, 1990) identified the endogenous accumulation of knowledge as the primary engine of economic growth (see also Grossman and Helpman 1991; Aghion and Howitt 1992).

Empirical studies by Barro (1991), Rauch (1993), Simon and Nardinelli (1996) and Simon (1998), all confirm the relationship between human capital and growth at the national level. Several studies (Rauch 1993; Audretsch and Feldman 1994; Feldman 1999; Duranton and Puga 2003) have also shown the link between national economic growth and the distribution of knowledge in large urban regions. Large, dense areas create an environment in which knowledge can move quickly and at a low cost between firms and individuals. This results in an increase in knowledge flows and knowledge exchange, which in turn gives rise to new knowledge and new goods and productions (Jacobs 1969; Kremer 1993; Carlino *et al.* 2001).

Glaeser (2000) provides empirical evidence on the correlation between human capital and regional economic growth. Firms locate to gain competitive advantages, rather than letting suppliers and customers determine location choice. Firms seek out areas of high human capital concentration. Studies by Florida (2002b) and Berry and Glaeser (2005) find that human capital is becoming more concentrated and there are strong reasons to believe that this division will continue, affecting not only regional growth levels, but also housing values (Gyourko *et al.* 2006; Shapiro 2006). Capturing the effects from human capital is tricky for many reasons. There is now an emerging debate over alternative levels of human capital. Most economists argue for a traditional measure based on educational attainment. Others (Florida 2002a; Markusen 2004; Gabe 2006; McGranahan and Wojan 2006) suggest an alternative measure based on occupation. Several studies (Marlet and Van Woerkens 2004; Gabe 2006; Florida *et al.* 2008a; Mellander and Florida 2009) have found that occupational

measures can and do outperform educational attainment measures in accounting for some aspects of regional development.

Alternative Measures of Human Capital: Education versus Occupation

Our research keys into this reasonably open question in the current debate: How to best measure and account for human capital? Laroche and Mérette (2000) note that no satisfactory measure of human capital exists for Canada, that education as the measure of human capital fails to capture all the activities related to knowledge acquisition that occur in the country. The broadness of the measure also prevents nations or regions from identifying specific types of human capital or talent. Education measures potential talent or skill but does not measure actual skill as it is utilized and consumed by the economy.

We look explicitly at an alternative measure of human capital based on occupation, which we suggest, provides a potentially more robust measure of human capital capable to capture what people do as opposed to what people know. The models we develop below enable us to isolate the effects of human capital, the creative class and also of individual creative occupations on regional development. Previous research (Florida *et al.* 2008b) has found that these two types of human capital and creative occupations affect regional development by operating through different channels. Human capital, that research found, had a bigger effect on regional income, a broad measure that includes wages plus gains, rents, interest, transfers and the like, while creative occupations affect wages. We include both measures initially in this analysis.

Factors affecting the distribution of human capital

The second key issue in the current debate involves identifying the factors that shape the geographic distribution of human capital measured either way—by educational attainment or as creative occupations. Most economists conceptualize human capital as a stock or endowment, which belongs to a place in the same way that a natural resource might. But the reality is that human capital is a *flow*, a highly mobile factor that can and does relocate. Gertler (2001) notes the importance that the flow of people has had on shaping the Canadian urban landscape. The flow of people from one region to the next has major policy implications that can only be properly understood from a well-rooted theory of individual migration. In Canada, the current flow of people—both native and foreign born—tends to be from the Atlantic and Prairie provinces to Ontario, Alberta and British Columbia (Edmonston 2002). Our research examines the factors that shape this flow and determine the divergent levels of human capital and the creative class—education and skill—across Canadian regions.

Four possible answers to the question of human capital mobility or flow have been offered. The first argues that the distribution of education and skill is affected by the distribution of amenities. Roback (1982) expanded the traditional neoclassical model of migration to include not only the response to wages and land rent but to quality-of-life amenities as well. Glaeser *et al.* (2001) find that consumer and personal service industries, such as restaurants, theatres and museums tend to be localized and thus demand geographical closeness between producer and consumer. Beyond service and consumer goods, Glaeser highlights the importance of other amenities, such as public goods, aesthetics and transportation. Lloyd and Clark (2001) impart a strong emphasis on the role of lifestyle—in the form of entertainment, nightlife, culture and so on—in attracting talent. Shapiro's (2006) detailed study of regional productivity growth finds that 'roughly 40 percent of the employment growth effect of college graduates is due to quality of life', the rest being caused by enhanced productivity growth.

The second approach offered by Berry and Glaeser (2005) is that the concentration of human capital builds off itself. Places with an initial advantage tend to build upon that strength to see increases over time. The presence of major research universities has been found to be a key factor in this set of initial advantages as well in both the production and distribution of human capital. The distribution of education and skill need not be coincident with the distribution of universities (Florida 2002a; Berry and Glaeser 2005). While some regions with great universities

have large concentrations of talent, others operate as producers of human capital, serving as unrewarded exporters of highly educated people to other regions (Florida *et al.* 2006). Florida (2005) argues that the geographic assembly line connection from education to innovation and economic outcomes *in that same locale* may no longer hold. This is a result of the increased mobility of highly skilled and talented people within countries and even across national borders. The quality of a region's post-secondary institutions is no guarantee it can hold on to its educated and skilled people. The university is neither a *necessary* nor *sufficient* condition for attracting educated and skilled populations to a region or even holding on to the ones it produces.

The third approach is that the mobility of human capital is a response to the availability of jobs (Bartel 1979; Carlino and Mills 1987; Blanchard and Katz 1992). The economic reasoning is straightforward. Individuals who are perfectly rational will relocate to regions with the greatest economic opportunity—highest wages and largest labour markets. Ferguson *et al.* (2007) find that in the Canadian context this is more or less true for rural regions. Urban centres in Canada are similar to those in the United States, where it is a combination of amenities and economic factors that determine the location decision of individuals (Ferguson *et al.* 2007). This is in agreement with Wellstead's (2007) heterogeneous depiction of Canadian economic geography.

Diversity, openness and tolerance

The final approach to the factors that influence the flow of talent among regions argues that tolerance and openness to diversity affect the level and geographic distribution of education and skill. Jacobs (1961) and Beckstead and Brown (2003) have argued that firm-based diversity is associated with economic growth, but Jacobs also argued that diversity of individuals is important as well. Recent research has focused on the role of demographic diversity in economic growth. Ottaviano and Peri (2005) show how diversity among individuals, in the form of immigrants, increases regional productivity. Noland (2005) finds that tolerant attitudes towards gays and lesbians are associated with both positive attitudes towards global economic activity and international financial outcomes. Florida and Gates (2003) find a positive association between concentrations of gay households and regional development. Florida (2002a, 2002b, 2002c) further argues that tolerance—specifically 'low barriers to entry' for individuals—is associated with geographic concentrations of talent, higher rates of innovation and regional development. The more open a place is to new ideas and new people, the larger the net it casts in the global competition for talent; in other words, the lower its entry barriers for human capital—the more talent it will likely capture.

There is considerable debate over the salience of these measures, approaches and findings. Clark (2003) finds that the relationship between the Gay Index and regional development holds only for regions with large populations. Glaeser (2004) ran linear regressions with human capital, the Gay Index and the Bohemian Index and found that the effects of human capital overpower the effects of these other tolerance measures when looking at change in population between 1990 and 2000. Florida (2004a, 2004b) counters that these frameworks and models are insufficient and do not capture the interactions among the system of factors that act on regional development. He suggests a general model of regional development according to the 3Ts of economic development: technology, talent and tolerance. He argues that each alone is necessary but insufficient in generating regional development. All three must act together with substantial and balanced performance to result in higher levels of development.

It is important to state at the outset that our model does not argue for a mechanistic relationship between regional tolerance (measured as concentrations of artists and gays or immigrants) and regional development. Rather, we argue that tolerance or openness to diversity makes local resources more productive and efficient by acting through four key mechanisms.

Low barriers to entry. High concentrations of bohemian, gay/lesbian and immigrant populations reflect low barriers to entry for human capital. Such locations will have advantages in attracting a broad range of talent across racial, ethnic and other lines, increasing the efficiency

of human capital accumulation. Page (2007) provides the basis for a general economic theory of tolerance and improved economic outcomes. He finds that not only does cognitive diversity lead to better decision making but that it is associated with identity diversity, the diversity of people and groups, which enable new perspectives. He finds that diversity broadly understood is linked with higher growth and rates of innovation. Work by Florida *et al.* (2008a, 2008b) and Mellander and Florida (2009) on nations, such as the United States, Sweden and China, illustrates that the tolerance factor might influence the distribution of talent and technology in different ways. In addition, there is a national subjectivity to what is regarded as tolerance.

Knowledge spillovers and human capital externalities. Larger bohemian and gay populations signal underlying mechanisms that increase the efficiency of knowledge spillovers and human capital externalities that Lucas (1988) identifies as the primary engine of economic growth. Recent studies (Markusen and Schrock 2006; Currid 2007) note the role of artistic networks as conduits for the spread of new ideas and knowledge transfer across firms and industries. Stolarick and Florida (2006) demonstrate the importance of 'spill acrosses'—interaction between bohemians and the traditional technology community. Concentration of artists and gays/lesbians thus reflects the regional mechanisms that tend to accelerate human capital externalities and knowledge spillovers.

Signals of openness and meritocracy. Significant artistic, gay/lesbian and immigration populations reflect regional values that are open minded, meritocratic, tolerant of risk and oriented to self-expression. Inglehart and Norris (2003) and Inglehart and Welzel (2005) have noted the correlation between values and GDP growth at the national level. In research over four decades and across more than 60 countries, Inglehart and Norris (2003) and Inglehart and Welzel (2005) identify tolerance or what they call 'self expression' to be a core element of a new value system associated with higher levels of GDP and economic growth. They note that openness of people towards gay and lesbian populations is the best indicator of overall tolerance. People in tolerant places are not happier because they themselves are tolerant but due to the general level of tolerance experienced in society. Psychological studies (Amabile 1996; Stenberg 1999; Fredrickson 2001) indicate that this is associated with higher levels of creativity, innovation and entrepreneurial behaviour. Lucas (1988) explicitly notes the similarities in values and orientation as 'creative' actors between technological and entrepreneurial labour and artistic and cultural populations.

Resource mobilization. Locations with larger artistic, gay and immigrant populations signal underlying mechanisms that increase the productivity of entrepreneurial activity. Traditional economic institutions have tended to marginalize these groups thus requiring them to mobilize resources independently and to form new organizations and firms. We suggest that regions where these groups have migrated and taken root reflect underlying mechanisms that are more attuned to mobilization of such resources for entrepreneurship and new firm formation. These four factors, when taken together, improve the efficiency and productivity of regional human capital, innovation and entrepreneurship.

We also note that according to our theory, tolerance, universities and consumer service amenities need not operate exclusively or in competition with each other. Rather, we suggest that they are likely to have complementary effects on the geographic distribution of education and skill. Tolerance, universities and consumer amenities act on regional economies through direct and indirect channels, as they effect the concentration of talented and skilled people in regions.

Model

A schematic picture of our general model for the system of regional development is outlined in Figure 1. The model allows us to overcome several limitations of previous studies. First, it considers regional development as a system of relationships. It allows us to test the independent effects of human capital, the creative class,

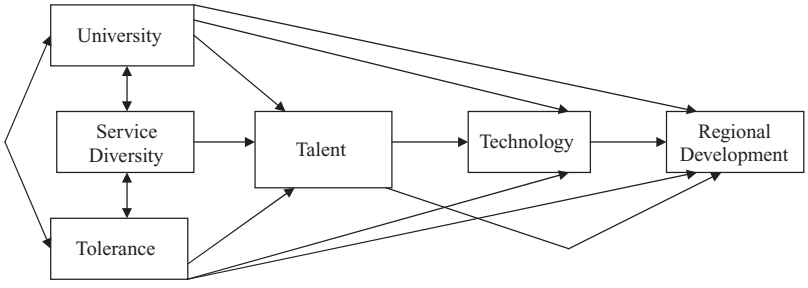


Figure 1
Model of key regional development paths

technology and tolerance on regional development. Second, it allows us to test for, and identify more precisely, the role of educational human capital versus the creative class on regional wages and incomes. Third, it allows us to parse the effects on wages and income, and to identify the factors that act on regional labour productivity and regional wealth. And fourth, it enables us to parse the effects of tolerance, consumer services and universities in the distribution of human capital and the creative class, which in turn act on regional wages and income. The arrows identify the hypothesized structure of relationships among the key variables. The model is based on earlier work by Florida *et al.* (2008b). The model has been modified to include two relationships that were insignificant in the United States. For Canada, it was found that there were strong relationships between tolerance and technology and tolerance and our overall development indicators. This model will enable us to make comparisons between the earlier results shown for the United States. It is important to note that our path models do not imply empirical causality or unidirectional relationships. As Simon (1954) notes, the unidirectional arrows in our paths are not meant to imply unidirectional causality, but associative relationships that might work in both directions. Our theory, however, leads us to believe that the causal ordering of the relationships flows more or less in the direction of the arrows, and we will analyze these relationships using data that are temporally consistent with our theoretical assertions.

Variables and Methods

We now describe the variables in the empirical model. The variables cover 46 Census Metropolitan Areas (CMAs) and Census Agglomerations (CAs) in Canada. The small number of observations is not optimal, but the study includes *all* Canadian CMAs and some of the more populous CAs. The number of observations is, in other words, a reflection of the Canadian economic geography. This analysis is based on a *population* and not a sample. Although the technique being applied (structural equation modelling) is more robust with a greater number of observations, Canada has a limited number of cities. While a finer geography would create more observations, it would not be compatible with our underlying theory that is regional. The lower number of observations limits the value of the chi-square-based goodness of fit tests for the overall model, but does not otherwise impact the analysis or results.

All variables in equations 1 and 2 are for the year 2001, while the dependents in equation 3 (Regional Development) are from 2006. The reason for those differences in time is that we do not expect the full effect to come in the same year, but rather some years later. We will also test and report for changes in income levels between the years 2001 and 2006. Descriptive statistics for all measures and variables are provided in Table 1. These numbers are based on the 46 regions included in our analysis, and not the Canadian totals (which we, however, would expect to be very similar).

Table 1
Descriptive statistics—all regions

	Observations	Mean	Standard deviation	Minimum	Maximum
Talent					
BA or above	46	0.170	0.054	0.097	0.310
Creative class	46	0.302	0.045	0.227	0.449
Super-creative core	46	0.162	0.029	0.112	0.270
Creative professionals	46	0.140	0.019	0.108	0.180
Decomposed creative occupations					
Managers	46	0.064	0.013	0.043	0.100
Business and finance	46	0.032	0.007	0.022	0.050
Science	46	0.059	0.017	0.034	0.127
Health	46	0.043	0.008	0.027	0.064
Education/social science	46	0.079	0.013	0.056	0.111
Arts and culture	46	0.024	0.007	0.015	0.040
Regional characteristics					
University (faculty)/1,000	46	2.299	1.973	0.000	8.445
Self-expression	27	0.982	0.394	0.494	1.906
Mosaic index	46	0.126	0.089	0.009	0.437
Visible minorities	46	0.072	0.979	0.006	0.369
Service diversity	46	210.93	13.92	186	233
Effect					
Technology	46	0.831	0.353	0.349	1.788
Average income	46	35,007	3,816	28,823	48,878
Average employment income	46	35,146	4,060	29,075	48,931

Outcome variables

It is common in studies of regional development to use factors like population change or job growth as measures of development. But those measures are quite crude in that they cannot specify the quality of development. Not all jobs are created equal; some pay a good deal more than others. Regions increasingly specialize in different kinds of economic activity, and therefore different kinds of jobs (Barbour and Markusen 2007). When we say 'regional development', what we really want to know is the overall level of development and living standards of a region. We thus need to know how much people in a region earn and the total income of the region. Based on earlier research (Florida *et al.* 2008b), we use two measures of regional development as outcome variables: average income and average employment income, but will also include changes in income levels.

Average income. This includes employment income, income from government programs, pension income, investment income and any other money income received by persons age 15 or older in 2005 as collected by Statistics Canada in 2006.

Average employment income. This variable refers to total income received by persons 15 years of age and older. It includes wages and salaries, net income from a nonfarm unincorporated business and/or professional practice and net farm self-employment income in 2005, as collected by Statistics Canada in 2006.

Employment incomes and total incomes are related. For Canada, the correlation coefficient between them is 0.974. Still, earlier studies for the United States (Florida *et al.* 2008b) have shown a considerable difference between the two across regions. As we noted earlier, wages are a good proxy for regional productivity (Becker 1962, 1993), while income is a good proxy for regional wealth.

Average income change 2001 to 2006. We include an additional variable based on changes in income between the years 2001 and 2006. The data are from Statistics Canada for year 2001 and 2006, but reflect the period 2000–2005.

Human capital or talent variables. The next class of variables concern talent. As noted above, our research uses several different measures for talent.

Human capital. This variable is the measure based on educational attainment, measured as the share of the regional labour force with a bachelor's (four-year university) degree and above. It is from the 2001 Canadian Census.

Creative class. We use several definitions of the creative class, based on occupation. Each of them is measured as the share of the regional labour force. All data are from the Census of Canada for the year 2001. Following Florida (2002a), we examine the effects of the creative occupations or the 'creative class', defined as those in which individuals 'engage in complex problem solving that involves a great deal of independent judgment and requires high levels of education or human capital'. The original creative class measure includes the following major occupational groups: computer and math occupations; architecture and engineering; life, physical and social science; education, training and library positions; arts and design work; and entertainment, sports and media occupations, as well as other professional and knowledge work occupations including management occupations, business and financial operations, legal positions, health care practitioners, technical occupations and high-end sales and sales management.

Statistics Canada defines occupation according to National Occupational Classification (NOC), which is different from the classification system used by the Bureau of Labor Statistics in the United States. This creative class measure will be adjusted according to the Canadian definitions. However, they are still defined based on the complex problem solving and independent judgment conditions.

Super-creative core. Florida (2002a) defines the super-creative core as: computer and math occupations; architecture and engineering; life, physical and social science; education, training and library positions; arts and design work; and entertainment, sports and media occupations. We define the super-creative core as follows: Professional occupations in natural and applied sciences, technical occupations related to natural and applied sciences (referred to as 'Science'), judges, lawyers, psychologists, social workers, ministers of religion, and policy and program officers, paralegals, social services, workers and occupations in education and religion, n.e.c. ('Education and Social Science'), Professional occupations in art and culture, technical occupations in art, culture, recreation and sports ('Arts and Culture').

Creative professionals. Florida (2002a) includes the following professional occupations in the creative class: management occupations, business and financial operations, legal positions, health care practitioners, technical occupations, and sales management. We include the following occupations: senior management occupations, specialist managers, other managers (referred to as 'managers', professional occupations in business and finance, finance and insurance administration occupations ('business and finance'), professional occupations in health, nurse supervisors and registered nurses, technical and related occupations in health ('health').

We also analyze key creative occupations separately: managers, business and finance, science, health, education and social science and arts and culture.

Technology variables

Techpole. We include a technology variable to account for the effects of technology on regional development. This technology variable is the product of the location quotient and regional share for Canadian High-Tech industry employment. The techpole ranks CMA and CA by multiplying regional: (1) regional high-tech industrial employment as a percentage of regional employment; by (2) the national high-tech employment as a percentage of national employment. This is based on Canadian Business Patterns data from Statistics Canada for the year 2001.

Variables that affect the distribution of human capital or talent

To examine the question of what accounts for the geographic distribution of educated and skilled populations, we include three key variables reflecting the current literature.

Tolerance. We use three measures for tolerance—the self-expression index, visible minorities and the mosaic index.

Self-expression index. This variable combines the concentration of self-identified partnered or married gay and lesbian households and the concentration of individuals employed in the arts, design and related occupations. Both are location quotients. The self-expression index is the average of the two. The data are from the Canadian Census for 2001. The data from 2001 are only available from Statistics Canada for the 27 CMAs.

Visible minorities. We will also employ a measure based on the visible minority share of the population. Visible minorities are defined as 'persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in color' according to The Employment Equity Act. These data are from Canadian Census for the year 2001.

Mosaic index. This variable is the share of population that is foreign-born immigrants to Canada. The data are from Canadian Census for the year 2001.

Other variables

Universities. This variable measures number of university professors per capita. University professors teach courses to undergraduate and graduate students and conduct research at universities and degree-granting colleges. It is based on NOC data from the 2001 census. There are many ways to measure the university effect, and at earlier stages of this work, we did try other variables (e.g., fixed effects for larger universities, students, researchers only, etc). This research led us to find that faculty per capita is the best measure we can come up with given the context. This is a proxy for the ability to produce talent in the form of human capital, and at the same time a proxy for the connection to the industry. If, for example, we used grants oriented towards spin-offs, that would only work as a proxy for the university–industry link, and the primary interest is the relationship between the strength of local university presence and regional talent levels.

Service diversity. We use the diversity of consumer service firms as our proxy for regional amenities. This variable reflects the number of service industries represented within the metropolitan region that could be regarded as attractive to consumers. It is based on 2001 industry data from the Statistics Canada.

Methods

We use path analysis and structural equations to examine the relationships between variables in the model. In order to analyze the dynamics between this set of variables adequately, structural equation modelling (SEM) is used. Structural equation models may be thought of as an extension of regression analysis and factor analysis, expressing the relationship between variables through a set of linear relationships, based upon their variances and co-variances. In other words, structural equations replace a (usually large) set of observable variables with a small set of unobservable factor constructs, thus minimizing the problem of multicollinearity (Jöreskog 1973). The parameters of the equations are estimated by the maximum likelihood method.

It is important to stress that the graphic picture of the structural model (Figure 1) expresses direct and indirect correlations, not actual causalities. Rather, the estimated parameters (path coefficients) provide information of the relation between the set of variables. Moreover, the relative importance of the parameters is expressed by the standardized path coefficients, which allow for interpretation of the direct as well as the indirect effects. We do not assume any causality among university, tolerance and service diversity but rather treat them as correlations.

From the relationships depicted in the model (Figure 1), we estimate three equations:

$$\ln\text{Talent} = \beta_{11}\ln\text{University} + \beta_{12}\ln\text{ServiceDiversity} + \beta_{13}\ln\text{Tolerance} + e_3 \quad (1)$$

Table 2
Talent and occupations, correlation coefficients

	Human capital	Creative class
Managers	0.679**	0.748**
Business and finance	0.609**	0.630**
Science	0.732**	0.827**
Health	0.281	0.320*
Education and social science	0.601**	0.654**
Arts and culture	0.830**	0.855**
Technology	0.774**	0.757**
Income	0.512**	0.507**
Employment income	0.516**	0.502**

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

$$\ln\text{Technology} = \beta_{21}\ln\text{University} + \beta_{22}\ln\text{Tolerance} + \beta_{24}\ln\text{Talent} + e_2 \quad (2)$$

$$\ln\text{Regional Development} = \beta_{31}\ln\text{University} + \beta_{33}\ln\text{Tolerance} + \beta_{34}\ln\text{Talent} + \beta_{35}\ln\text{Technology} + e_1 \quad (3)$$

Findings

We now turn to our findings. We begin by examining the effects of the two primary talent measures—human capital and the creative class. We then provide the findings for specific occupations.

Table 2 summarizes the results of the correlation analysis of occupation and outcome variables with the traditional human capital and our creative class. The correlation coefficient between conventional human capital (educational attainment) and the creative class (what people do) is 0.914. While there is a high correlation between these two groups in Canada's 46 largest urban areas, Mellander (2009) finds that only one out of four people within the creative class in Sweden held a university degree of three years or more. This illustrates that a university degree by no means is a prerequisite for a creative occupation but that the probability of having a creative occupation increases with the education level.

Human capital and the creative class are closely related to most key occupational groups. In many cases, both human capital and the creative class are highly correlated with both the same occupational variables and outcome variables, For example, human capital and creative class have a strong relationship to arts and culture occupations (0.830 and 0.855), while both have a weak correlation with health occupations. These results imply that both measures, human capital and creative class, are associated with regional outcomes in Canada. However, the work by Florida *et al.* (2008b) shows that even if the two groups collocate and are similarly related to different occupational subgroups, they tend to work differently in the structural equation context that will be used in the empirical part of this article.

If we turn to the relationship between various talent measures and regional income, we see that little difference between the relationships between human capital and the creative class with income and employment income can be found. In earlier studies of the United States (Florida *et al.* 2008b), human capital was found to be more closely related to regional income levels, while the creative class is more closely related to wages. However, as Table 2 shows, this is not the case in Canada. Both human capital and creative class have similar relationships to both income and employment incomes. The correlation coefficient for human capital and income is 0.512 and employment income is 0.516. The correlation for the creative class and income is 0.507 and employment income, 0.502. We will therefore, from here on, only focus on average income levels and changes in those, and exclude employment income (wages) from the analysis.

Findings from path analysis and structural equations

To further gauge the differential effects of human capital and the creative class on regional development measured using regional income levels, we now turn to the key findings from the structural equations models and path analysis. We ran separate models for human capital, the creative class and the super-creative core.

The models examine the effects of the different measures of human capital and the

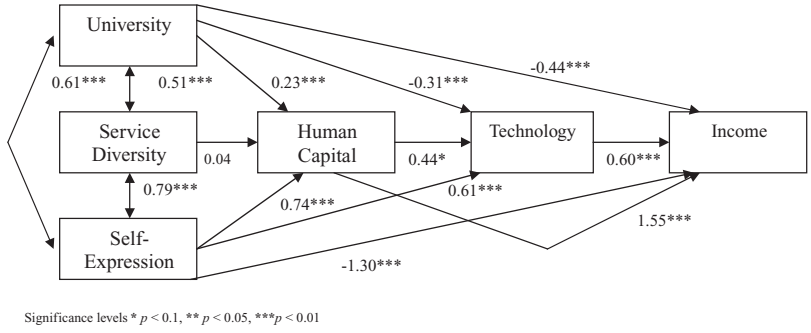


Figure 2
Path analysis for human capital and self-expression

creative class on income, and also isolate the effects of three key factors—tolerance, service diversity and universities—on the level and geographic distribution of human capital and the creative class as well on income. A path analysis is provided for each model based on the standardized β-coefficients, while the unstandardized β-coefficients will be presented in the related tables. This standardized coefficient is based upon the regression where all the variables in the regression have been standardized first by subtracting each variable's mean and dividing it by the standard deviation associated with each variable. These coefficients can be used to analyze the relative importance of the explanatory variables in relation to the dependent variable. We ran the models for both average income levels and for income change between 2001 and 2006, and report the results for each below.

Figure 2 is the path analysis for human capital. Human capital has a sizeable and significant direct effect on income. It also has a significant direct effect on technology, while technology also has a significant direct effect on income. Looking at the factors that affect the distribution of human capital, tolerance (i.e., the self-expression index) has the largest effect. The university variable is also positive and significant on talent, while service diversity has no significant effect on the distribution of talent. The self-expression variable also has a strong relationship to technology. It is also interesting to notice the negative and significant relationships for both the university and self-expression variables and regional income. The relationship between the university variable and technology is also negative and significant in relation to technology. This could be caused by a multicollinearity effect, but in a bivariate correlation with technology it is still only weakly related (0.344 at the 0.05 level). The university variable lacks a significant bivariate relation with income as well. Generally speaking, regional income is positively and significantly explained by human capital and technology.

When we run the models with change in regional income levels between 2001 and 2006, none of the explanatory variables are significant. In other words, the distribution of talent, technology and the university factor did not have an impact on the average income growth during the subsequent five years.

Figure 3 summarizes the path analysis for the creative class. Generally speaking the relationships are similar to those for human capital. The creative class has a significant direct effect on regional income, but the relationship between it and technology is insignificant. The relationship between the creative class and self-expression is somewhat stronger than in the human capital model. The university variable is insignificant on the creative class, technology and income.

Table 3 provides the results for SEM models for human capital and the creative class. The R^2 values for equations 1 and 2 are between 0.72 and 0.87. However, those factors together explain

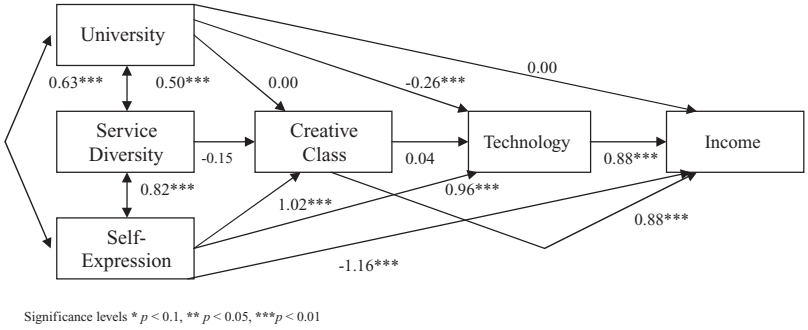


Figure 3
Path analysis for the creative class and self-expression

Table 3
Structural equation modelling (SEM) results for human capital, creative class and self-expression

	Human capital			Creative class		
Income	**Talent**	**Technology**	**Income**	**Talent**	**Technology**	**Income**
Variables	Eq 1	Eq 2	Eq 3	Eq 1	Eq 2	Eq 3
Self-expression	0.508***	2.549***	−0.323***	0.323***	3.937***	−0.282***
Service diversity	0.199			−0.335		
University	0.060***	−0.495***	−0.041***	0.000	−0.422**	0.000
Talent		2.672*	0.560***		0.560	0.677***
Technology			0.036***			0.052***
Observations	46	46	46	46	46	46
R^2	0.872	0.722	0.665	0.812	0.740	0.528

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

Table 4
SEM results including visible minorities

	Human capital			Creative class		
Income	**Talent**	**Technology**	**Income**	**Talent**	**Technology**	**Income**
Variables	Eq 1	Eq 2	Eq 3	Eq 1	Eq 2	Eq 3
Visible minorities	0.094***	0.007	0.043***	0.014	0.072	0.056***
Service diversity	1.395***			1.022***		
University	0.132***	−0.091	−0.035**	0.039***	−0.027	−0.023**
Talent		1.033***	0.199***		1.674***	0.350***
Technology			−0.009			−0.021
Observations	46	46	46	46	46	46
R^2	0.758	0.439	0.539	0.545	0.463	0.560

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

less in equation 3 where the R^2 value is approximately 0.53–0.67 (Table 4). The overall results suggest a strong direct relationship between both human capital and the creative class and income. They also suggest a strong relationship between tolerance (measured by the self-expression index) and both talent measures, technology and regional income.

When we run the models for income change, the creative class and the self-expression variables both become significant at a 0.05 level. This is an interesting result. While the conventional human capital measure had no effect on income change, the distribution of creative class occupations in combination with higher levels of self-expression levels are associated with increases in income levels across Canadian regions. This suggests that creative class occupations have a larger effect on changes in regional incomes than does the human capital level measured as educational attainment.

Immigrants and visible minorities

We now substitute the self-expression index with variables for visible minorities and the mosaic index (Table 5, Figures 4 to 6).

Figure 4 is the path analysis for visible minorities. Human capital continues to have a strong relationship with income, as well as technology. The visible minorities' variable performs somewhat differently than self-expression. It is both positive and significant in relation to income. Its effect on human capital is weaker than that for self-expression and it is not significantly related to technology. Both the university and service diversity variables are positively related to human capital in this model. When we run the model with change in income levels, we again find no effect from either human capital or visible minorities.

Figure 5 is the path analysis for visible minorities and the creative class. The creative class remains positively and significantly related to income. Visible minorities are significantly related to regional income levels, but not to the

Table 5
SEM results including the mosaic index

	Human capital			Creative class		
Income	**Talent**	**Technology**	**Income**	**Talent**	**Technology**	**Income**
Variables	Eq 1	Eq 2	Eq 3	Eq 1	Eq 2	Eq 3
Mosaic index	0.074**	0.151	0.051***	0.038	0.072**	0.063***
Service diversity	1.892***			1.103***		
University	0.129***	−0.502*	−0.051**	0.038**	−0.065	−0.019*
Talent		5.934***	0.216***		9.307***	0.360***
Technology			0.000			0.000
Observations	46	46	46	46	46	46
R^2	0.734	0.666	0.569	0.545	0.633	0.577

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

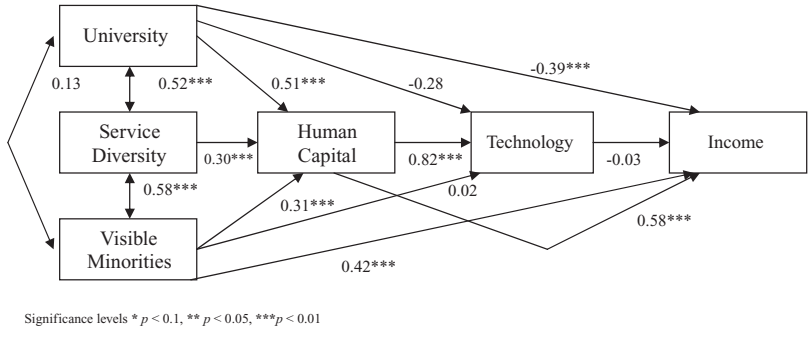


Figure 4
Path analysis for human capital and visible minorities

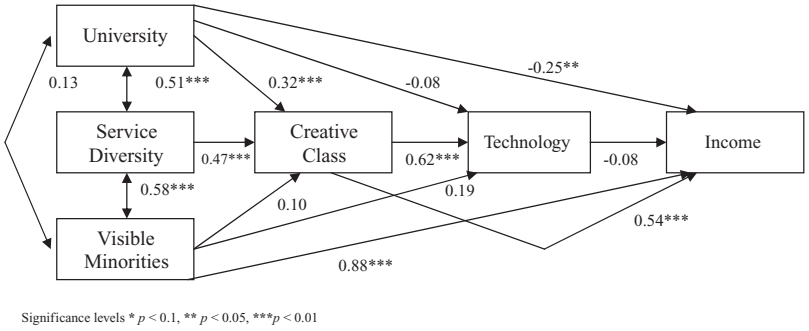


Figure 5
Path analysis for creative class and visible minorities

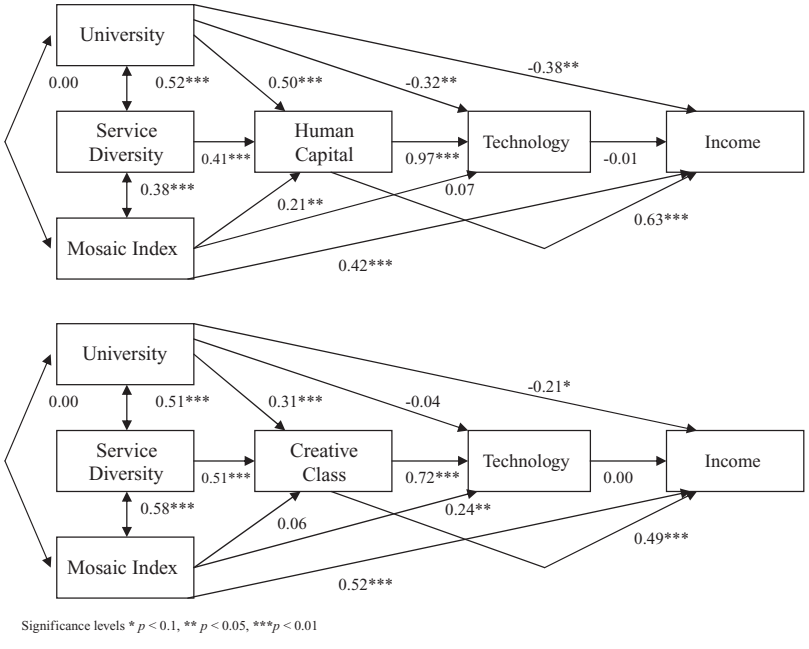


Figure 6
Path analysis for human capital, creative class and the mosaic index

creative class. Thus, visible minorities appear to work directly on income rather than on or through the creative class. Recall that the visible minority measure is positive and significant in relation to human capital. A possible explanation is that while visible minorities possess higher education, they are relatively concentrated in non-creative class jobs.

Figure 6 summarizes the results for the mosaic index. The creative class continues to

have a direct effect on income and technology. The mosaic index is positively and significantly related to human capital, technology and income but not the creative class. This suggests that immigrants tend to have direct effects on technology and income but not on or through the creative class. When we run the model for income change, neither the mosaic index nor the creative class variable is significantly related to income growth. This indicates that the creative class only has a positive impact on income growth in regions with higher levels of self-expression.

The super-creative core

We now use our general model to examine the role of the two main groups that make up the creative class—the super-creative core and creative professionals. We then turn to specific occupational groups: managers, business and finance, science, health, education and social science and arts and culture (Table 6, Figures 7 to 8).

We start with the results for the super-creative core. Figure 7 shows the key findings from the path analysis.

The super-creative core has no direct effect on income. It has a positive and significant effect on technology in just one of the two models. In turn, it is shaped by the self-expression index but not the mosaic index. The university variable is positively and significantly related to super creatives in one of the two models. When we run the model with income change, we find that the super-creative core is insignificantly related to regional income change.

Figure 8 provides the path analysis for creative professionals. There is a positive and significant relationship between creative professionals and income and a slightly stronger one between them and technology. In the model with the self-expression index, the relationship between creative professionals and the university is weak. But when we substitute the mosaic index, the university factor becomes slightly significant, and

Table 6
SEM results for the super-creative core and creative professionals

	Self-expression			**Mosaic index**		
	Super-creative core			**Super-creative core**		
Income	**Talent**	**Talent**	**Talent**	**Talent**	**Technology**	**Income**
Variables	Eq 1	Eq 1	Eq 1	Eq 1	Eq 2	Eq 3
Tolerance	0.398***	−0.006	−0.006	−0.006	3.676***	−0.242***
Service diversity	−0.781**	1.179***	1.179***	1.179***		
University	0.003	0.051***	0.051***	0.051***	−0.433**	−0.008
Talent					1.496	0.649***
Technology						0.050***
Observations	46	46	46	46	46	46
R^2	0.774	0.477	0.477	0.477	0.730	0.594
	Creative professionals			**Creative professionals**		
Income	**Talent**	**Talent**	**Talent**	**Talent**	**Technology**	**Income**
Variables	Eq 1	Eq 1	Eq 1	Eq 1	Eq 2	Eq 3
Tolerance	0.236***	0.236***	0.236***	0.031*	0.413*	0.048***
Service diversity	0.056	0.056	0.056	0.995***		
University	−0.010	−0.010	−0.010	0.024*	0.138	−0.015
Talent					8.430***	0.299**
Technology						0.013
Observations	46	46	46	46	46	46
R^2	0.653	0.653	0.653	0.513	0.543	0.549

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

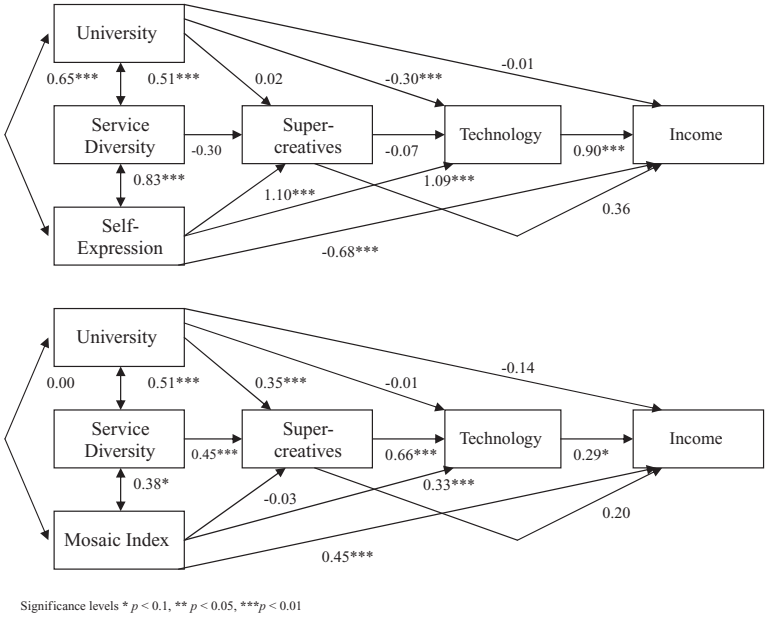


Figure 7
Path analysis for the super-creative core

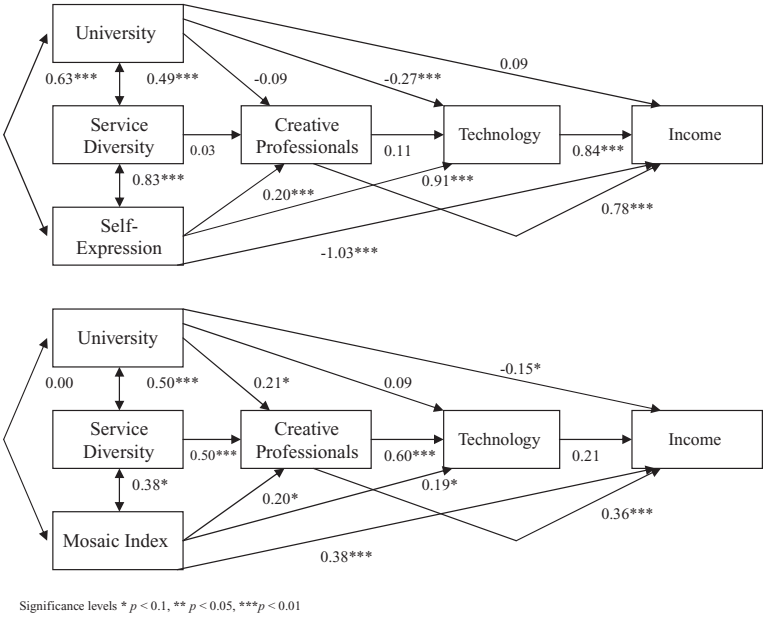


Figure 8
Path analysis for the creative professionals

the relationship between creative professionals and technology becomes stronger. The mosaic index has a positive and significant effect on income, while the self-expression index is negative and significant.

Interestingly, when we run the model for income change, we find a significant relationship for creative professionals. This stands in contrast to the result for super creatives. The result holds both in combination with the self-expression index and the mosaic index. This indicates that the group of creative professionals appears to have a significant impact on both absolute income levels as well as changes in income levels over time where super-creatives do not.

Occupations and regional development

We now turn to our findings for more specific occupational groupings, 'decomposing' the creative class into its constituent occupations to probe for their separate effects on regional incomes. Below, we summarize the results of SEM and path analyses for each of the major occupational groups, technology and wages. Table 7 provides the key results of the SEM models, while Figures 9A–F present the findings for the path analysis. Two representations are shown for each occupational group for which the Tolerance variable has been changed. The variables chosen are based on significance.

Basically, we find positive and significant direct relationships between three of the six occupational groups and income—management occupations, business and finance occupations and scientific occupations. We find no significant relationship for heath, education or arts and culture occupations on income. However, these three occupations can be said to have an indirect effect on regional incomes working through technology.

The findings suggest that management occupations are most strongly associated with income. The coefficients for management occupations are significant in models with both the self-expression and the mosaic index. The correlation coefficient between management occupations and income is also high (0.673). Scientific occupations also have a strong association with income. In the model, which includes the mosaic index, it becomes slightly stronger than that for management occupations with an R^2 value of 0.621, compared to 0.572 for management occupations. Business and finance occupations are also positively associated income in the path structure, but only in models with the self-expression index. Arts and culture occupations are weakly related to income in a bivariate context (0.335, significant at the 0.05 level). Health and education occupations have no significant direct relation with regional average income, and are not even correlated to income in a bivariate context (-0.192 and -0.004).

When we substitute regional income levels with income change, we find a positive and significant relation for business and finance (0.386) and health (0.392) when combined with the self-expression index. When the mosaic index is employed, only business and finance is significant (0.404). The result for health occupations is also worth noting. While health-related occupations show no significant relation to current regional income levels, they are associated with regional income growth.

The findings also indicate the consistent role played by tolerance in regional talent formation. The self-expression index is closely related to each and every one of the occupational groups, and has its strongest effect on management occupations. The mosaic index is weaker, and is negative or not significantly related to science, health, education, and social science and arts and culture occupations.

The tolerance variables are also positively and significantly related to technology. Both the self-expression index and the mosaic index are strongly related to the technology variables, often being stronger than the relationships between the individual occupation groups and technology. We find that the tolerance measures play different roles in relation to regional income. The mosaic index is frequently positive and significant, while the self-expression index is either negative or insignificant. It is also interesting to note the role of the service diversity measure. When used together with the self-expression index it is negative or insignificant, but when used with the mosaic index it is frequently positive and significant.

The effect of the university variable is relatively weak across almost all occupational groups with the exception of health and education

Table 7
SEMs for key occupational groups

	Self-expression			Mosaic index		
	Managers			Managers		
Tolerance Income	**Talent**	**Technology**	**Income**	**Talent**	**Technology**	**Income**
Variables	Eq 1	Eq 2	Eq 3	Eq 1	Eq 2	Eq 3
Tolerance	0.319***	2.956***	−0.172***	0.068**	0.204	0.043***
Service diversity	0.388			1.477***		
University	−0.063**	−0.368**	0.021	−0.004	0.337**	−0.006
Talent		2.795**	0.407***		6.434***	0.258***
Technology			0.035***			0.007
Observations	46	46	46	46	46	46
R^2	0.544	0.776	0.582	0.461	0.621	0.572
	Business and finance			**Business and finance**		
Income	**Talent**	**Technology**	**Income**	**Talent**	**Technology**	**Income**
Variables	Eq 1	Eq 2	Eq 3	Eq 1	Eq 2	Eq 3
Tolerance	1.218*	3.280***	−0.127*	0.070***	0.318	0.048***
Service diversity	0.178*			1.655***		
University	−0.084*	−0.481**	0.012	−0.007	0.373**	−0.007
Talent		1.803*	0.227**		5.083***	0.097
Technology			0.044***			0.019**
Observations	46	46	46	46	46	46
R^2	0.484	0.757	0.462	0.513	0.510	0.509
	Science			**Science**		
Income	**Talent**	**Technology**	**Income**	**Talent**	**Technology**	**Income**
Variables	Eq 1	Eq 2	Eq 3	Eq 1	Eq 2	Eq 3
Tolerance	0.570***	3.086***	−0.120	−0.015	0.716***	0.071***
Service diversity	−0.997			1.950***		
University	−0.073**	−0.445**	−0.008	0.009	−0.268**	−0.005
Talent		1.905**	0.177**		4.823**	0.248***
Technology			0.041**			−0.005
Observations	46	46	46	46	46	46
R^2	0.827	0.671	0.499	0.262	0.703	0.621
	Health			**Health**		
Income	**Talent**	**Technology**	**Income**	**Talent**	**Technology**	**Income**
Variables	Eq 1	Eq 2	Eq 3	Eq 1	Eq 2	Eq 3
Tolerance	0.122	3.679***	−0.082	−0.063**	0.744***	0.055***
Service diversity	−1.313*			−0.270		
University	0.083***	−0.104	0.001	0.083***	0.769***	−0.066
Talent		−3.313***	−0.022		−2.447	−0.004
Technology			0.052***			0.025***
Observations	46	46	46	46	46	46
R^2	0.294	0.826	0.377	0.340	0.357	0.495
	Education and social science			**Education and social science**		
Income	**Talent**	**Technology**	**Income**	**Talent**	**Technology**	**Income**
Variables	Eq 1	Eq 2	Eq 3	Eq 1	Eq 2	Eq 3
Tolerance	0.212***	4.197***	−0.062	−0.013	0.914***	0.054***
Service diversity	−1.024**			0.136		
University	0.061***	−4.269***	−0.002	0.087***	0.606**	−0.001
Talent		2.716	−0.019		−0.253	−0.061
Technology			0.049***			0.025***
Observations	46	46	46	46	46	46
R^2	0.530	0.803	0.368	0.441	0.321	0.501

Continued

Table 7
Continued

	Arts and culture*			Arts and culture		
Income	**Talent**	**Technology**	**Income**	**Talent**	**Technology**	**Income**
Variables	Eq 1	Eq 2	Eq 3	Eq 1	Eq 2	Eq 3
Tolerance	0.286***	2.123***	−0.043	0.027	0.427**	0.057***
Service diversity	1.301**			2.622***		
University	0.000	−0.251	−0.003	0.036	−0.054	0.001
Talent		2.577**	−0.070		4.758***	−0.118*
Technology			0.052***			0.036***
Observations	46	46	46	46	46	46
R^2	0.683	0.694	0.375	0.591	0.623	0.524

NOTE: The tolerance factor is only proxied by the gay index and not the bohemian index in this case to rule out collinearity problems with the talent group of arts and culture.
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

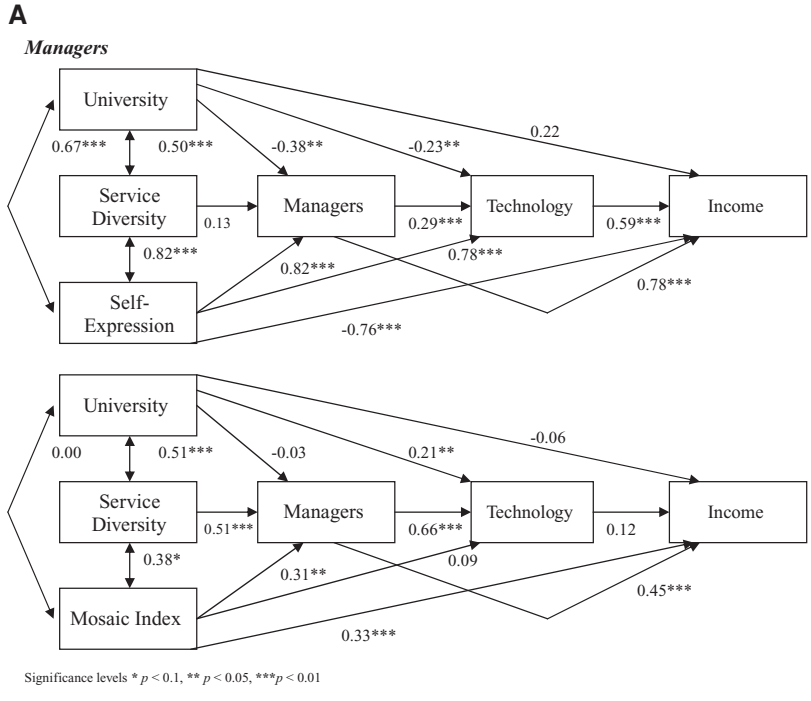
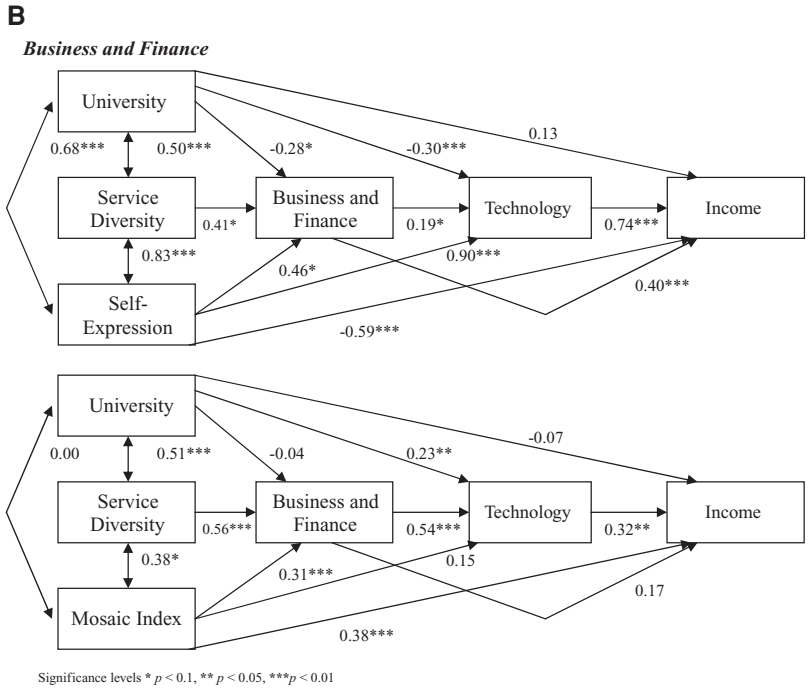


Figure 9
(A) Path analysis for managers; (B) Path analysis for business and finance professionals; (C) Path analysis for science professionals; (D) Path analysis for health professionals; (E) Path analysis for the education and social science professionals; (F) Path analysis for arts and culture professionals

and social science—two groups that are quite closely related to the university as employer. Surprisingly, the university variable is also in general weakly associated with technology. It becomes significant in the cases where talent plays no role. This may be an artifact of a relative overestimation because of the missing talent–technology link.



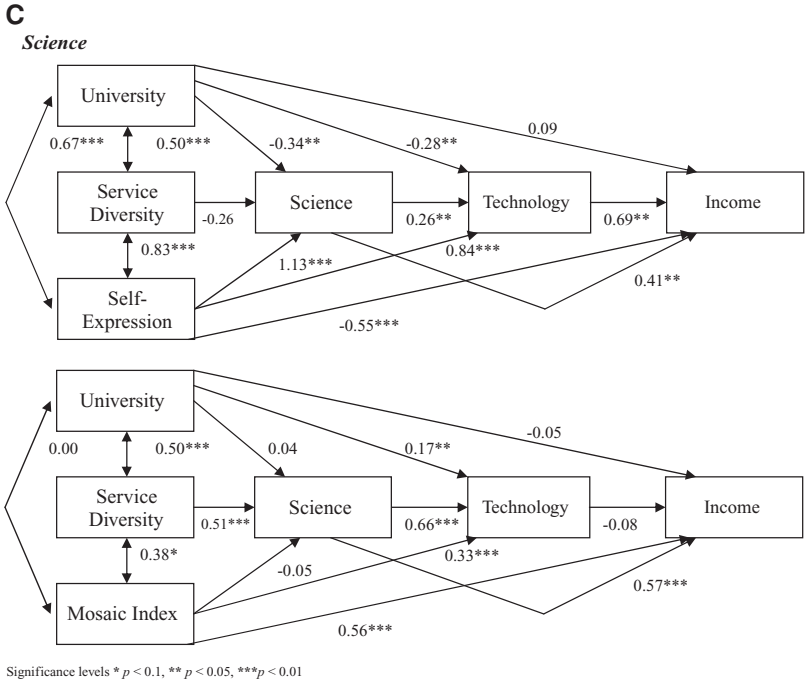
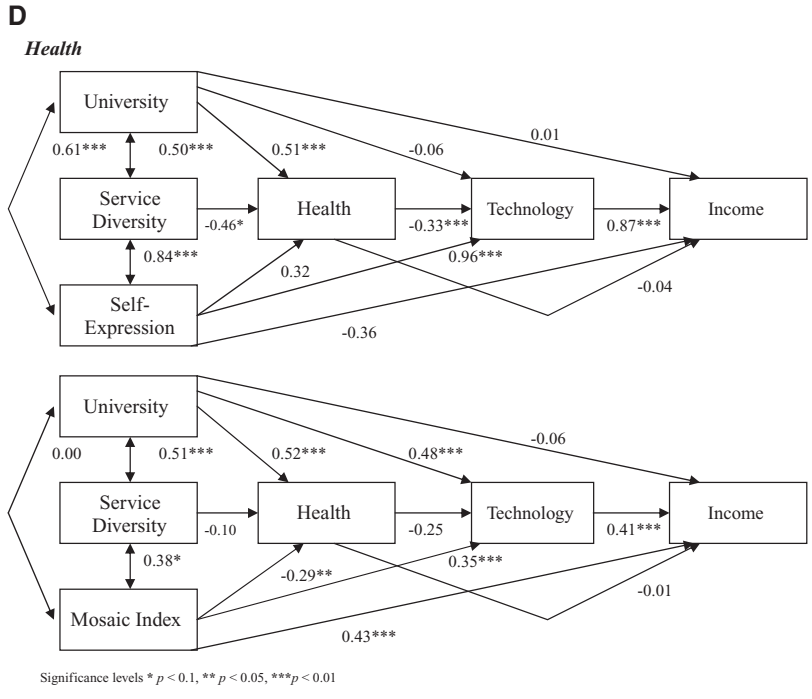


Figure 9
Continued



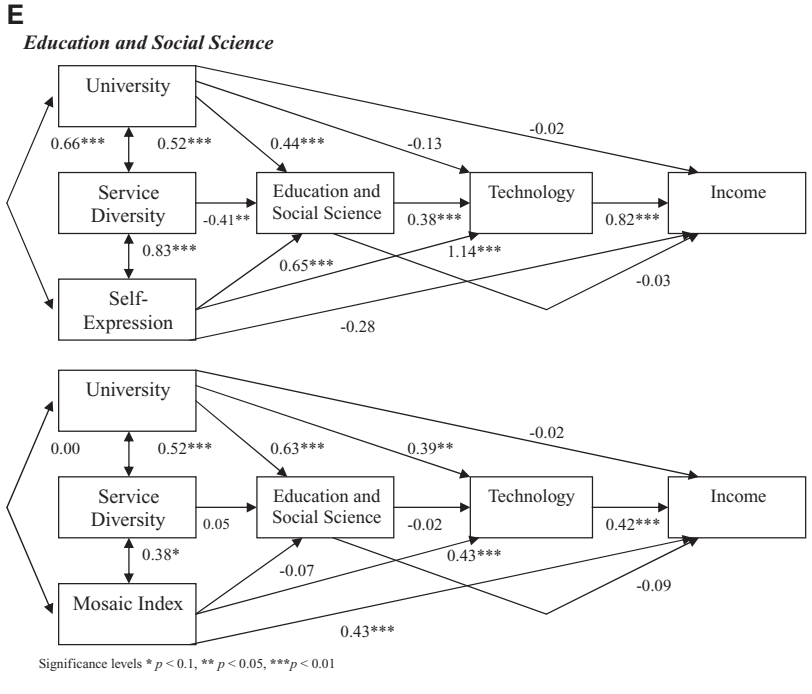


Figure 9
Continued

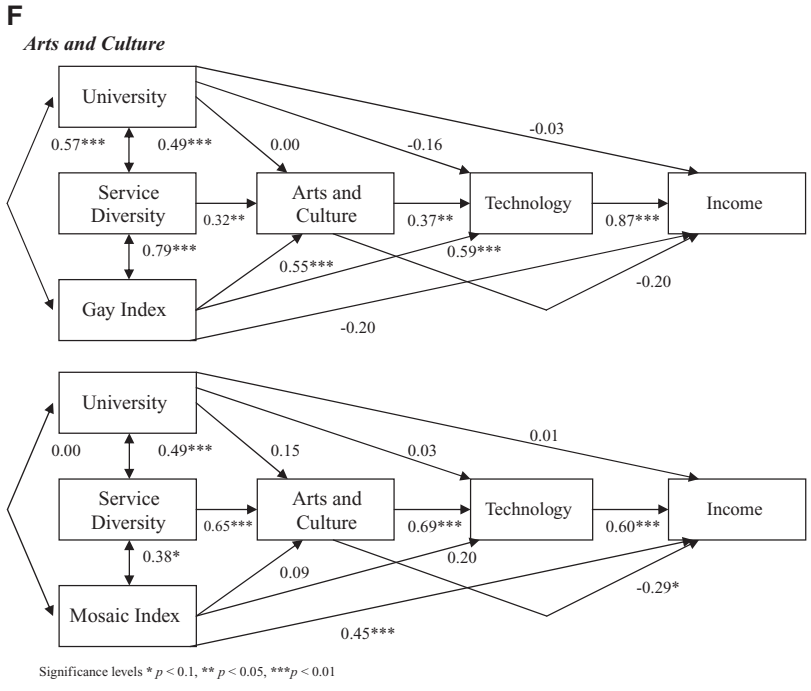


Figure 9
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Conclusions

Our research has provided an empirical examination of the factors that shape regional development in Canada. Specifically, we explored the role of human capital and the creative class, as well as technology, on regional incomes. We also examined a series of factors—universities, tolerance and service diversity—on talent and on regional income and on income change. We provided an analysis of the role of specific occupational groupings on income as well.

Our research generated several key findings. First, our findings shed light on the effects of two different measures of talent or human capital on regional development—educational attainment and creative occupations. Generally speaking, our findings show that both measures are strongly associated with regional development (measured as regional income level) in Canada, when we looked at the factors that affect change in regional incomes between 2001 and 2006, the creative class variable was significant while the human capital variable was not.

The findings suggest that the educational human capital measure has a significant effect on technology, while the creative class does not. Of the two main groups that make up the creative class, creative professionals are more strongly related to regional income. If we compare these results with the outcome for the US analysis (Florida *et al.* 2008b), we can conclude that human capital is weaker than the self-expression index in order to explain technology in Canada. For the United States, these two factors were equally strong in relation to technology.

Second, our findings show that technology plays an important role in Canadian regional development. The technology variable has a positive and significant effect on income in models with the self-expression index. In these models, this technology effect holds alongside both human capital and the creative class, though it is relatively stronger in models with the latter.

However, the effect of technology on income becomes insignificant in models with visible minorities and the mosaic index—variables, which have a strong direct effect on income. We are led to conclude that technology affects regional development in conjunction with the self-expression variables (that is openness to gays and bohemians). Recent work by Hall and Kahn (2008) has shown how immigrants in tech-intensive larger Canadian regions have significantly lower income earnings than immigrants in midsized and smaller regions. These results suggest a weaker relation between technology and incomes in regions with a higher share of immigrants. The results for Canada are similar to the ones for the United States (Florida *et al.* 2008b). However, in the United States, the relation between technology and income levels tends to stay significant, also in a multivariate analysis including immigration-related variables.

Third, our findings shed light on the role of specific occupations in Canadian regional development—management; business and finance; science; health; education and social science; and arts and culture occupations. Management and scientific occupations have the strongest association with regional income, while business and finance occupations also are associated with regional income. Arts and culture occupations have a strong association with technology, roughly the same strength as for scientific occupations.

However, we find that the effects of these occupational groups on incomes to be weaker compared to the results from comparable studies of the United States (Florida *et al.* 2008b) using a similar methodology. This can partly be explained by differences between the Canadian and the United States' occupational definitions. But it may also be a pattern of lower productivity levels, since wage levels tend to be a reflection of those, and in the Canadian case the wage and income levels are closely related. Human capital theory postulates that wages rise with the level of knowledge or skill (Becker 1964, 1993; Mincer 1974). Optimally, wage levels should be in proportion to the stock of human capital, since this affects the value of workers' marginal product. However, wages are set by the regional *supply and demand* for labour and in order to increase wage levels based on talent, industry must have a need for this in order to be willing to pay for it. Health and education occupations have no significant relationship to regional income. This is in line with the findings of previous studies of the United States (Florida *et al.* 2008b) and Sweden (Mellander and Florida 2009).

Fourth, our findings shed light on the differential role played by tolerance, universities and service diversity on regional development. Of the three, our findings indicate that tolerance plays by far the most significant role, acting directly on both talent production and regional income. We also find that different measures—and kinds—of tolerance affect regional development in different ways. The self-expression index is positively associated with both talent variables and with technology. The two other measures of tolerance—visible minorities and the mosaic index—have a direct significant and positive link to income levels.

We thus find that openness to or tolerance of gays and bohemians and visible minorities and immigrants operate on regional development through distinctive channels. The former appears to operate indirectly on income through the channel of regional talent, signaling for regional openness to or attractiveness for talent, as well as through regional technology; while the latter operates more directly on income.

The results for tolerance differ from the US results (Florida *et al.* 2008b), where only the self-expression index was found positive and significant in relation to talent and technology, but immigration-based measures showed a negative and significant relation with those variables. At the same time, the self-expression index in Canada shows a negative and significant relation to income, while this is significant and positive for most of the cases in the United States. The results make us believe that immigration groups in Canada are better absorbed into more productive economic activities, but it is not necessarily through higher education, creative occupations or high-tech jobs.

Fifth, our findings indicate that the university's role in Canadian regional development is relatively weak. It has a positive and significant relation to human capital but is insignificant in relation to the creative class. The university has little association to technology or regional income. There are several reasons why this may be

so. It may reflect the flow of talent between regions. Certain regions may provide research and education, which is then exported to other regions that perform more commercial functions. It is a signal that the universities that produce talent may not keep the talent in the region. It might also reflect a university focus on education and talent as opposed to commercially relevant research or startup firms. The results for the university factor are in line with the results from earlier studies for the United States (Florida *et al.* 2008b), where the university variable in general was strong in relation to talent, but only weakly associated with technology and income levels. While we know that many universities, especially in the United States, have quite extensive relations to industry, this does not seem to be a general pattern across regions, neither in the United States nor in Canada, but that the university mainly plays the role as the talent producer.

In short, our findings shed new light on the ways that Canadian regional development is shaped by the 3Ts of technology, talent and tolerance. Talent in the form of human capital and the creative class is strongly associated with regional income. Technology affects regional income alongside human capital, the creative class and openness to gays and bohemians. The university's role in technology development and regional income is relatively weak. This suggests an ongoing policy challenge to find new and better ways for connecting Canadian universities more directly to regional talent, technology and income. Tolerance is a strong suit in Canadian regional development providing considerable direct and indirect effects on talent and regional income. Tolerance towards gays and bohemians is strongly associated with both human capital and the creative class, while tolerance in the form of openness to immigrants and visible minorities is strongly related to regional income. The effects of these forms of tolerance on income are greater than that played by technology. This suggests that Canada's experiment in opening up to immigration is paying significant economic development dividends.

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Supporting Information Available Online

Supporting information including a list of CMAs and CAs included in the study; a complete list of occupational subgroups and correlations to technology, income and employment income; and scatter plots of talent *versus* income, talent *versus* tolerance and occupations *versus* average incomes is available at: www.martinprosperity.org and www.prosperityinstitute.se as well as on Wiley Interscience.

Canadian CMAs and CAs* Included in the study

All Occupational Subgroups and Correlations to Technology, Income and Employment Income

Figure A: Talent versus income
Figure B: Talent versus tolerance
Figure C: Occupations versus average incomes

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