# Inside the Black Box of Regional Development:
## Human Capital, the Creative Class and Tolerance

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## *Abstract*

While there is a general consensus on the importance of human capital to regional development, debate has emerged around two key issues. The first involves the efficacy of educational versus occupational measures (i.e. the creative class) of human capital, while the second revolves around the factors that effect its distribution. We use structural equation models and path analysis to examine the effects of these two alternative measures of human capital on regional income and wages, and also to isolate the effects of tolerance, consumer service amenities, and the university on its distribution. We find that human capital and the creative class effect regional development through different channels. The creative class outperforms conventional educational attainment measures in accounting for regional labor productivity measured as wages, while conventional human capital does better in accounting for regional income. We find that tolerance is significantly associated with both human capital and the creative class as well as with wages and income.



**JEL:** O3 R1 R2 J24

**Key words:** Human Capital, Creative Class, Tolerance, Wages, Income, Regional Development

*Much of life is "creative" in much the same way that is "art" and "science" …To an outsider it even looks the same. A collection of people doing pretty much the same thing, each emphasizing his own originality and uniqueness.* (Lucas, 1988, p. 40)

## *Introduction*

What *really* drives economic development? It is complex question, so it is not surprising that lots of opinions and answers have been offered. If you ask the typical person on the street, they will tell you the key is jobs. Seems to jibe with common sense: When a place attracts new jobs, more wealth and other good things follow. This conventional wisdom is the backbone of a good deal of economic development policy, as economic developers scramble to lure companies to their towns. Others say technology is key. Pointing out places like Silicon Valley, they say success lies in a high-tech cluster of great research universities, abundant venture capital and entrepreneurial startup companies. But according to current thinking and research in economics, geography and social science broadly, the underlying driver of economic development is highly skilled and educated people - what some call talent and what economists and social scientists frequently refer to as human capital. Places that have more of it thrive, while those with less stagnate or decline.

The central role played by human capital in economic development has been documented both in large-scale studies of national economic performance (Barro, 1991) and across regions the US and other advanced countries (Rauch, 1993; Simon and Nardinelli, 1996; Simon, 1998). It is also clear from recent studies that human capital levels are diverging, and the differences are growing larger and more pronounced across regions (Berry and Glaeser, 2005).

Our research focuses on two key questions over which there remains considerable debate. The first concerns how best to understand and measure human capital. The standard measure for human capital is educational attainment, usually the share of a population with a bachelor's degree and above. But, recent studies show that this measure captures only a part of a person's capability which reflects accumulated experience, creativity, intelligence, innovativeness, and entrepreneurial capabilities as well as level of schooling. One line of research (Florida, 2002, 2004b) suggests an alternative measure for human capital, based on the occupation, specifically a set of occupations that make up the “creative class” including science, engineering, arts, culture, entertainment, and the knowledge-based professions of management, finance, law, healthcare and education. Comparative studies show that the creative class measure outperforms conventional human capital measures in accounting for regional development in Sweden (Mellander and Florida, 2006) and the Netherlands (Marlets and Van Woerken, 2004).

If we understand that human capital drives economic growth and we also know that human capital levels are becoming more divergent or uneven, this begs a second question: Exactly what are the factors that shape the distribution of human capital in the first place? On this score, three different competing theories have been offered. The first argues that universities play a key role in creating initial advantages in human capital, which becomes cumulative and self-reinforcing over time (Glaesar et al, 2005). The second argues that amenities play a role in attracting and retaining highly-educated, high-skill households (Glaeser, 1993; Glaeser et al, 2001; Shapiro, 2006; Clark, 2003). The third theory argues that tolerance and openness to diversity are important (Florida, 2002a, b, c). We suggest that these three approaches need not be seen as mutually exclusive. It is more likely that these factors play complementary roles in the distribution of talent and in regional development.

To shed light on these issues, we present a stage-based general model of regional development. In the first stage, we examine how factors such as tolerance, universities and consumer service amenities effect the location of talent (measured as human capital and the creative class). In the second stage, we look at how the concentration of talent in turn affects technology. And in the third stage, we examine the effects of technology, talent, and tolerance on both regional wages and income. 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 331 geographic metropolitan regions in the United States, and test explicitly for the effects of regional size.

Our modeling approach is designed to address a significant weakness of previous studies of the effects of human capital and the creative class on regional development. Most of these studies use a single equation regression framework to identify the direct effects of human capital and other factors on regional development. The findings of these studies, not surprisingly, indicate that human capital outperforms other variables. But that does not mean that other variables do not matter. First of all, something has to effect the distribution of human capital in the first place. It may well be that some variables that have not performed well in other studies exert influence by operating through human capital and thus indirectly effect regional development, or that certain variables operate through different channels. By using a system of equations our model structure allows us to parse the direct and indirect effects of key variables on each other as well as on regional development. Furthermore, our model is based on a strong *a priori* theory of the relationships between and among key variables as they shape regional development.

Our results inform three main findings. First, we find that human capital and the creative class play different but complimentary roles in regional development. The creative class – or occupational skill – operates through the channel of wages and exerts its effect on regional labor productivity. Human capital – or education – operates by increasing regional income and wealth.

Second, we find that certain occupations effect regional development to a greater degree than others. Education and healthcare have relatively small association with regional development, while occupations like computer science, engineering, management and business and financial operations evidence much higher levels of association. A particularly interesting finding is the relatively high levels of association between artistic and entertainment occupations and regional labor productivity. These occupations which are typically seen as consumers of local resources appear to effect regional productivity to a significant degree when other key factors are controlled for.

Third, we find that tolerance is significantly associated with both human capital and the creative class and also with regional wages and income. Universities and consumer services also affect the regional distribution of human capital and the creative class, but substantially less so than tolerance. These three factors do not operate in competition with one another, but tend to play complementary roles in the geographic distribution of human capital and the creative class and in regional development broadly.

## *Theory and Concepts*

The literature on economic development is vast. Solow (1956) noted the effect of technology on economic growth. Solow's model treated technology as exogenous and not effected by the marginal rate of substitution between capital and labor. Ullman (1958) noted the role of human capital in his work on regional development. Jacobs (1961, 1969) emphasized the role of cities and regions in the transfer and diffusion of knowledge; as the scale and diversity of cities increase, so do the connections between economic actors that result in the generation of new ideas and innovations. Andersson (1985a, b) explored the role of creativity historically in regional economic development, stressing the importance of knowledge, culture, communications, and creativity, while arguing that tolerance also plays a role in stimulating creativity in cities and regions. Romer's (1986, 1987, 1990) endogenous growth model connected technology to human capital, knowledge, and economic growth. Invention in the neoclassical framework is no longer exogenous, but a purposeful activity demanding real resources.

Lucas (1988) further developed and explicitly identified the role of human capital externalities in economic development. Building on Jacobs' and Romer's work, Lucas (1988) highlighted the clustering effect of human capital, which embodies the knowledge factor. He recognized the role of great cities, which localize human capital and information, create knowledge spillovers, and become engines of economic growth. Cities reduce the cost of knowledge transfer, so ideas move more quickly, in turn giving rise to new knowledge more quickly.

A wide range of empirical studies have documented the role of human capital in regional growth. Barro (1991), Rauch (1993), Simon and Nardinelli (1996) and Simon (1998) all confirm the relation between human capital and growth on a national level. Glaeser (2000) provides empirical evidence on the correlation between human capital and regional economic growth. Firms locate in areas of high human capital concentration to gain competitive advantages, rather than letting suppliers' and customers' geography alone dictate their location. Other studies find that human capital is becoming more concentrated (Florida, 2002b; Berry and Glaeser, 2005), and there are reasons to believe that this division will continue, affecting not only regional growth levels, but also housing values (Shapiro, 2005; Gyourko, Mayer, Sinai, 2006).

The current debate revolves around two key issues. The first is how best to measure and account for human capital. Traditionally, human capital has been measured as education and training, simply because those are seen as the most important investments in human capital. The conventional measure of human capital is educational attainment – generally, the share of the population with a bachelor's degree and above. The educational attainment measure, it has been pointed out, leaves out a small but incredibly influential group of entrepreneurs, like Bill Gates or Michael Dell, who for various reasons did not go to or finish college. The fact of the matter is that these two entrepreneurs and many others like them have added immense value to the US and global economies through their skill even though they would not make the cut of the standard education attainment measure of human capital. Furthermore, the educational attainment measure is broad, and therefore does not allow for nations or regions to identify specific types of human capital or talent. Education measures potential talent or skill, but occupation provides a potentially more robust measure of utilized skill - that is how human talent or capability is absorbed by and used by the economy. While studies have shown that education is one way of improving the productivity of labor, other factors such as creativity, intelligence, and on-the-job knowledge and accumulated experience function interchangeably with education in effecting labor productivity (Smith, Carlsson and Danielsson, 1984). Education provides an underlying level of capability, but such capability has to be converted into productive work. Thus occupation is the mechanism through with education is converted into skill and labor productivity.

For these reasons, others have argued that occupation is a better and more direct measure of skill. Recent studies (Mellander and Florida, 2006; Marlets and Van Woerken, 2004) find that occupational measures significantly outperform conventional educational attainment in accounting for regional development in Sweden and in the Netherlands. Using occupations as a measure for skill has the additional advantage of allowing one to isolate the effects of specific occupations on income and regional labor productivity in terms of wages. Our models enable us to isolate the effects of human capital, the creative class and also of individual creative occupations on regional development

Furthermore, there are good theoretical reasons to expect that human capital and creative occupations - education and skill – effect regional development through different channels. 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. Wages are thus set by the regional *supply and demand* for labor. More to the point, as pay for work, wages are directly related to regional labor productivity. In this context, we use the aggregate for wages as well as for knowledge. On a micro level this may be distributed unevenly. Two regions can reach the same wage levels based on (1) a homogenous labor force or (2) a labor force consistent of high and low knowledge labor that together reach the same result. But at the aggregate level, the regional wage level will reflect the regional labor productivity.

Income is a composite measure which includes wages plus gains, rents, interest, transfers and the like. On average wages make up about 70 percent of US income. If wages measure regional labor productivity, income reflects regional wealth. In this sense, income is less place-dependent. For example, there are a lot of rich people in regions like Southern Florida, but they made their money elsewhere. Income is much more easily moved between regions. Furthermore, non-wage sources of income such as capital gains, interest, subsidies and the like have little to do with regional skill or the ability of a region to utilize skill in production. Our models test for the effects of human capital, the creative class, and individual occupations on both regional wages and incomes.

The second key issue in the current debate is over the factors that affect the geographic distribution of human capital or the creative class in the first place. Since we know that these sorts of talent are associated with economic development, and we also know that they are spread unevenly, it is important to understand the factors that account for their varied geography. 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. The key question then becomes: What factors shape this flow and determine the divergent levels of human capital and the creative class - education and skill - across regions?

Three different answers to that question have been offered. The first approach offered by Glaesar and his collaborators (2005) is that human capital builds off itself. Places with an initial advantage tend to build on and gain from that advantage. 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. Yet, the distribution of education and skill need not be coincident with the distribution of universities. While some regions with great universities have large concentrations of talent, others operate mainly in the production of human capital, serving as exporters of highly educated people to other regions (Florida et al, 2006). Florida (2005) argues that the geographic 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 educated people within countries and even across borders. However good a region's educational system might be, it is no guarantee it can hold on to its educated and skilled people. One way to think of the university is as a necessary but insufficient condition for attracting educated and skilled populations to a region or even holding on to the ones it produces.

The second approach argues that the distribution of education and skill is affected by the distribution of amenities. Roback (1982) expanded the traditional neoclassical model, where migration occurs in response to wage levels and land rent to include quality-of-life amenities. Glaeser, Kolko and Saiz (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. Lloyd and Clark (2001) as well as Florida (2002a, b, c) stress the role of lifestyle – in the form of entertainment, nightlife, culture, and so on – in attracting educated populations. Florida (2002c) introduces a measure of observed locational preferences of the producers of artistic and cultural amenities, the "bohemian index," and found it to be associated with concentrations of human capital and innovation.

Shapiro's (2006) detailed study of regional productivity growth finds that "roughly 60 percent of the employment growth effect of college graduates is due to enhanced productivity growth, the rest being caused by growth in quality of life".

The third 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 Quigley (1998) 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. Immigrants have complimentary skills to native born not because they perform different tasks, but also because they bring different skills to the same task. A Chinese cook and an Italian cook will not provide the same service nor good; neither will a German-trained physicist substitute perfectly for a U.S.-trained one. Noland (2005) finds that tolerant attitudes toward gay and lesbians are associated with both positive attitudes toward global economic activity and international financial outcomes. Florida and Gates (2001) find a positive association between concentrations of gay households and regional development. Florida (2002) 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 – in other words, the lower its entry barriers for human capital – the more education and skill 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 high population regions. 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, an admittedly crude measure of economic development. Florida (2004a, 2004b) counters that these frameworks and models are crude 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 or gays) and regional development. Rather, we argue that tolerance or openness to diversity makes local resources more productive and efficient acting through four key mechanisms. First, locations of bohemian and gay 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. Diversity broadly construed, he finds, is associated with higher rates of innovation and growth.

Second, 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, 2006, 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 "spill-acrosses" that can be generated by the interaction between bohemians and the traditional technology community. Greater concentrations of artists and gays thus reflect regional mechanisms that accelerate human capital externalities and knowledge spillovers.

The third mechanism for making local resources more productive is that artistic and gay populations reflect regional values that are open-minded, meritocratic, tolerant of risk, and oriented to self-expression. Inglehart et al (2003, 2005) has noted the correlation between self-expression values and GDP growth at the national level, In detailed research tracking more than 60 countries over four decades, Inglehart (2003, 2005) identifies tolerance or what he calls "self-expression" to be a core element of a new value systems associated with higher levels of GDP and economic growth. He notes that openness toward to gay and lesbian population is the best indicator of overall tolerance. Psychological studies (Amabile, 1996; Stenberg, 1999; Fredrickson, 2001) indicate that self-expression is associated with higher levels of creativity, innovation and entrepreneurial behavior. Lucas (1988) explicitly notes the similarities in values and orientation as "creative" actors between technological and entrepreneurial labor and artistic and cultural populations.

Fourth, locations with larger artistic and gay populations signal underlying mechanisms which increase the productivity of entrepreneurial activity. Because of their status as historically marginalized groups, traditional economic institutions have been less open and receptive to bohemian and gay populations thus requiring them to mobilize resources independently and to form new organizations and firms. We thus suggest that regions where these groups have migrated and taken root reflect underlying mechanisms which are more attuned to mobilization of such resources, 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. Universities, consumer amenities, and tolerance act on regional economic development directly, as well as indirectly, via their effects on the levels of educated and skilled people. Also, there may be reasons to believe that these factors are affected by the size of regions (McGranahan and Wojan, 2006). Larger regions by virtue of their size and market reach may be able to support more of these options. We test explicitly for the effects of region size across various permutations of the model.

## *Model*

A schematic picture of our general model for the system of regional development is outlined in Fig.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, technology, and tolerance on regional development. Second, it allows us to test for and more precisely identity the role of educational human capital versus the creative class on regional wages and incomes. Third, it allows us to parse the effects of wages and income, and to identify the factors that act on regional labor 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.

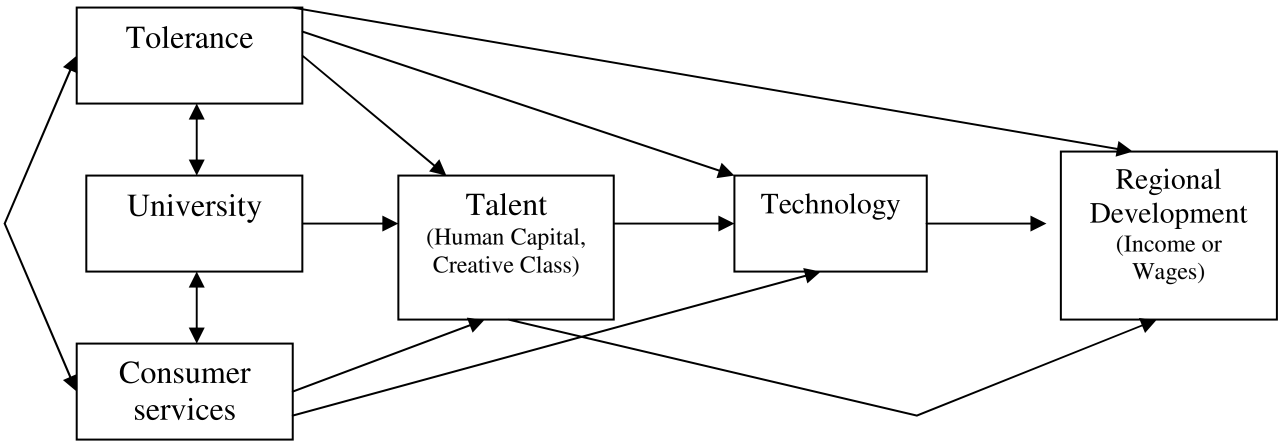



**Figure 1:** Path model of the regional development system

## *Variables*

We now describe the variables in the empirical model. The variables cover all 331 metropolitan statistical areas in the U.S., and are for the year 2000. Descriptive statistics for all measures and variables are provided in Table 1.

**Table 1:** Descriptive Statistics

| | *Mean* | *Standard Deviation* | *Minimum* | *Maximum* |
|---|---|---|---|---|
| BA or above | 23.72 | 7.43 | 11.05 | 52.38 |
| Creative class | 20.30 | 5.88 | 8.55 | 42.73 |
| Supercreative | 7.86 | 3.14 | 1.77 | 25.20 |
| University | 2.11 | 2.00 | 0 | 11.93 |
| Tolerance | 0.876 | 0.281 | 0.44 | 2.87 |
| Consumer services | 221.43 | 23.49 | 41 | 253 |
| Technology | 0.701 | 2.253 | 0.00 | 29.96 |
| Wages | 13.428 | 3.700 | 5.153 | 30.311 |
| Income | 20.607 | 3.972 | 9.899 | 51.462 |

**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 (Markusen, 2004, 2006). 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 what the total income of the region is. We use two measures of regional development as outcome variables: wages and incomes. It is important to remind readers of the differences between the two. Wages are remuneration for work. Most economists suggest that wages are thus a good proxy for regional labor productivity. Income includes wages but also earnings from interest, capital gains, self-employment income, transfers and so on. Wages exclude non-earned income.

***Wages:*** This measure is based on the sum of the wages and salaries and based on total money earnings received for work performed as an employee in the region. This measure includes wages, salary, armed forces pay, commissions, tips, piece-rate payments, and cash bonuses earned before deductions were made for taxes, bonds, pensions, union dues, etc. It is measured on a per worker basis and is from the 2000 US BLS.

***Income:*** Income is the sum of the amounts reported separately for wage or salary income including net self-employment income; interest, dividends, or net rental or royalty income or income from estates and trusts; social security or railroad retirement income; Supplemental Security Income (SSI); public assistance or welfare payments; retirement, survivor, or disability pensions; and all other income . It is measured on a per capita basis and is from the 2000 US Census.

Wages and incomes are related (see Table 2 and see Fig 2).The correlation coefficient between them is 0.723. Still there are considerable differences among regions. As we noted earlier, wages are a good proxy for regional productivity, while income is a good proxy for regional wealth. To get a better handle on this, we looked at the wage-to-income ratio across regions. The higher the score, the relatively larger the share of their total regional income or wealth comes from wages, in other words a relatively large share of their total regional income or wealth comes from labor productivity. Regions with a lower score are more dependent on capital gains accrued elsewhere or on non-wage income streams. The differences are considerable, ranging from more than 90 percent wages to around 20 percent wages in resort destinations. Our models enable us to look into the effects of both wages and income on regional development, and also at the factors that affect each of them.

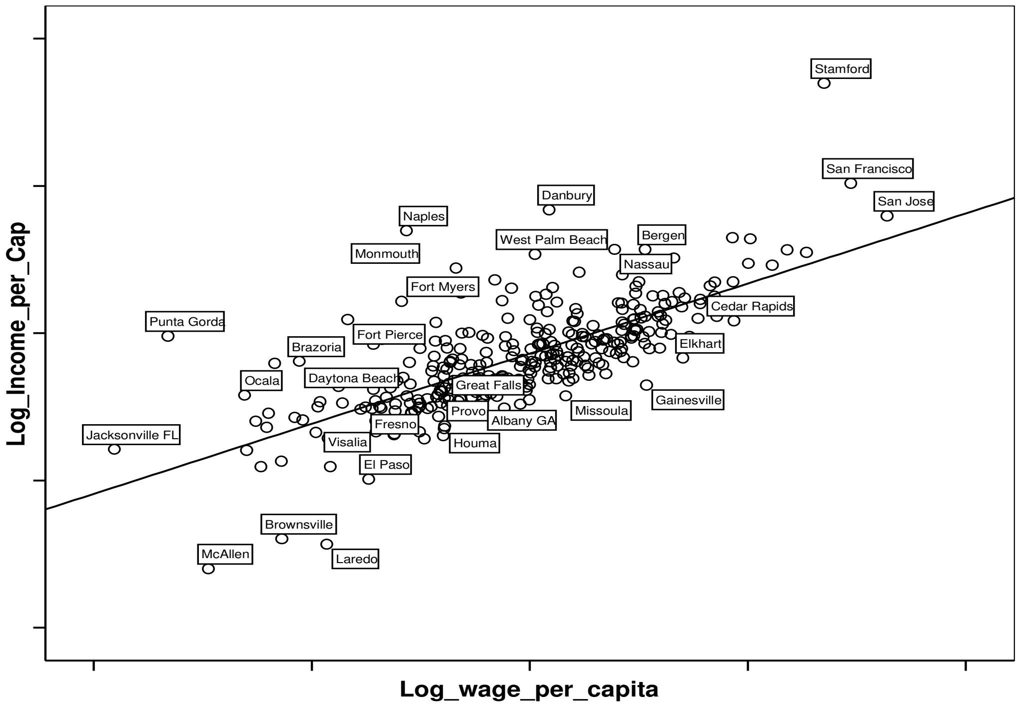



**Fig. 2:** Scatter-graph of regional wages and income

***Human Capital:*** This variable is the conventional measure based on educational attainment, measured as the percentage of the regional labor force with a bachelor's degree and above. It is from the 2000 US Census.

***Creative Class:*** We use several definitions of the creative class based on occupation. Each of them is measured as share of the regional labor force. All data is from the US Bureau of Labor Statistics for the year 2000. 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." Specifically, it 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, healthcare practitioners, technical occupations, and high-end sales and sales management. McGranahan and Wojan (2006) utilized BLS data on the actual skill content of tasks to recalculate creative class occupations on a slightly narrower basis. We also include this revised definition of the creative class in our analysis (see Appendix Table 1 which shows results consistent with those presented below).

**Super-creative Core:** We include a variable to test for the effects of the super-creative core, a narrower group of creative occupations which Florida (2002a) defines as those which involve more intense use of creativity on the job: computer and math occupations; architecture and engineering; life, physical, and social science; education, training, and library positions; arts and design work; and selected entertainment, sports, and media occupations. We also include McGranahan and Wojan's (2006) revised definition.

**Individual Creative Occupations:** We also completed analysis for each of the major clusters of creative occupations: computer and math; architecture and engineering; life and physical science; management; business and financial specialists; arts, design, media and entertainment; education; law; and healthcare.

The relation between our two primary measures of talent - human capital and the creative class - is illustrated in the scatter-graph provided in Fig. 3. The two are related but clearly not the same. The correlation coefficient between the two of them is .727, while the correlation coefficient for super-creative occupations and education is slightly less, .665 (Table 2).

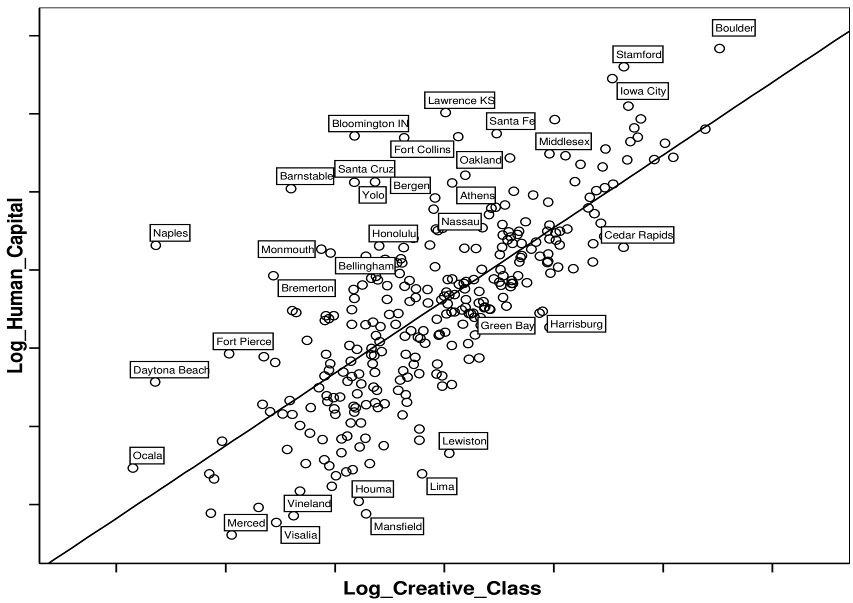



**Figure 3:** Scatter-graph between human capital and creative occupations

## Technology Variables

***Tech-Pole Index:*** We include a technology variable to account for the effects of technology on regional development. This technology variable is based on the Tech Pole Index from 2000 published by the Milken Institute. This index ranks metropolitan areas based on: (1) high-tech industrial output as a percentage of total US high-tech industrial output; and (2) the percentage of the region's own total economic output that comes from high-tech industries compared to the nationwide percentage. We also test for a more narrow definition of the high tech sector based on industries that use a more skilled labor force (Hecker, 1999).

## Tolerance and Related Variables

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:*** This variable is measured combines the concentration of gay and lesbian households and the concentration of individuals employed in the arts, design and related occupations. Here we follow Florida et al (2001, 2002a, b, c, 2005) and combine the Gay and Bohemian Indexes. The data are from the US Census for the year 2000. It is important to note that the bohemian measure here which is based on the household survey of the US Census thus differs considerably from the occupational measures used in the talent and creative class measures described above which are from the employer surveys of the Bureau of Labor Statistics.

***Universities:*** This variable measures number of university faculty per capita. It is based on 2000 data from IPEDS (Integrated Post-Secondary Data Set) from the US Department of Education.

***Consumer Service Amenities:*** We use the diversity of consumer service firms as our proxy for regional amenities, following Glaeser (1994) and Shapiro (2006). 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 2000 industry data from the Census.

## *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 modeling is used. Structural equation models (SEM) may be thought of as an extension of regression analysis and factor analysis, expressing the interrelationship between variables through a set of linear relationships, based upon their variances and covariances. In other words, structural equation replaces a (usually large) set of observable variables with a small set of unobservable factor constructs, thus minimizing the problem of multicollinearity (for further technical description see 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 (Fig.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 consumer services but rather treat them as correlations.

From the relationships depicted in the model (Fig.1, above), we estimate three equations:

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

$$\ln Technology = \beta_{21} \ln Tolerance + \beta_{23} \ln ConsumerServices + \beta_{24} \ln Talent + e_2 \quad (2)$$

$$\ln Wages = \beta_{31} \ln Tolerance + \beta_{34} \ln Talent + \beta_{35} \ln Technology + e_1 \quad (3a)$$

$$\ln Incomes = \beta_{31} \ln Tolerance + \beta_{34} \ln Talent + \beta_{35} \ln Technology + e_1 \quad (3b)$$

## *Findings*

We begin with the results of the bivariate analysis. We then turn to the results of the path analysis and structural equations models, looking at the roles played by human capital and the creative class on regional wages and incomes. The next section examines the roles played by specific occupations in regional development. After that we discuss the role of tolerance as well as consumer service amenities and universities in effecting the distribution of human capital and the creative class.

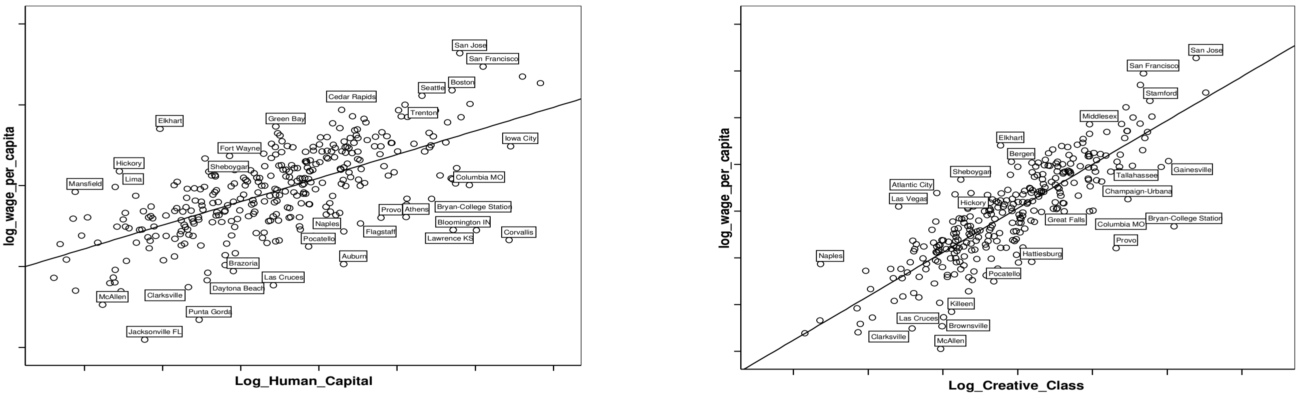
Table 2 provides a correlation matrix for the key variables. The correlation coefficient for human capital and income (.701) is higher than that for the creative class or (.474) or super-creative occupations (.399). But the opposite pattern appears for wages. The correlation between the creative class and wages (.840) is higher than that for human capital and wages (.653). This provides a first glimpse of the different channels through which human capital and the creative class effect regional development.

**Table 2:** Correlation matrix for key variables

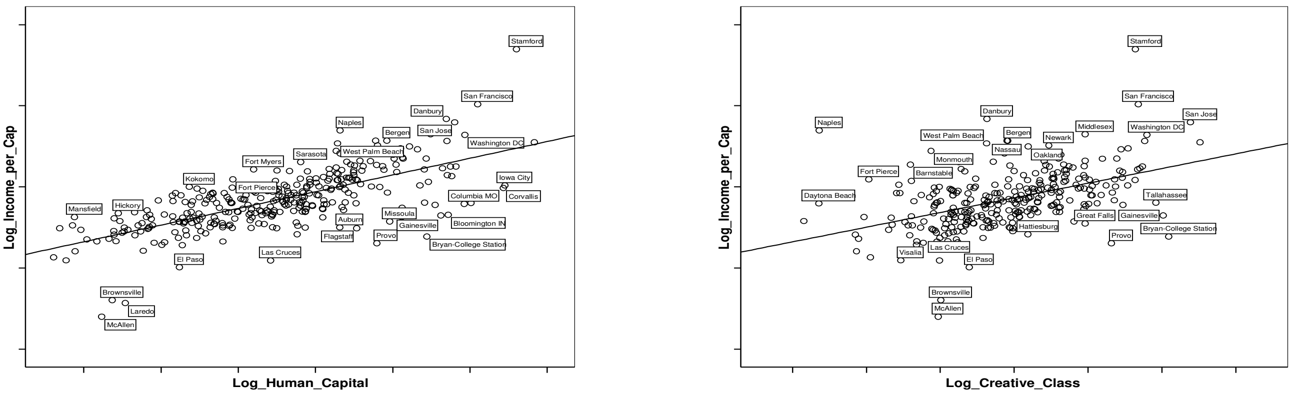
| | ***Human Capital*** | ***Creative Class*** | ***Super-creative*** | ***Wages*** | ***Income*** |
|---|---|---|---|---|---|
| ***Human Capital*** | 1 | | | | |
| ***Creative Class*** | 0.727** | 1 | | | |
| ***Super-creative*** | 0.665** | 0.868** | 1 | | |
| ***Wages*** | 0.653** | 0.840** | 0.695** | 1 | |
| ***Income*** | 0.701** | 0.474** | 0.399** | 0.723** | 1 |

** indicates significance at the 0.01 level

Figure 4 is a series of scatter-graphs which further illustrate the relationships between human capital and the creative class on wages and income. The slope for human capital and income is steeper than for the creative class and income. But the slope for the creative class and wages is much steeper than for human capital and wages. There are fewer outliers and the observations cluster tightly around the line. This reinforces the notion that human capital and the creative class act on different channels of regional development.




**Human capital, creative class, and *wages***




**Human capital, creative class,  and *income***

**Figure 4:** Scatter-graphs for human capital, creative class and income and wages

## *Inside the Black Box of Regional Development*

To further gauge the differential effects of human capital and the creative class on regional development, we turn to the key the findings from the structural equations models and path analysis.  We ran separate models for human capital and the creative class using both wages and income as measures of regional development. We analyzed models based on creative and super-creative occupations using Florida’s (2002a) definition as well as the revised, narrower definition introduced by

McGranahan and Wojan (2006), as well as for the major groupings of creative occupations. We also investigated excluding the arts, design, entertainment, media and sports occupations from the creative class occupations and super-creative core occupations to check for the possible collinearity between the tolerance measure and this group. We completed analysis for four regional size classes: regions over a million population; 500,000 to 1 million; 250,000 to 500,000; and less than 250,000. The results proved to be extremely robust to these different formulations of the basic model.

The models examine the effects of the different measures of human capital and the creative class on income and wages and also isolate the effects of three key factors – tolerance, consumer services and universities – on the level and geographic distribution of human capital and the creative class as well as their effects on income and wages. A path analysis is provided for each model based on the standardized β-coefficients. 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 by each variable. These coefficients can be used to analyze the relative importance of the explanatory variables in relation to the dependent variable. Also, the other structural equation results are reported for.

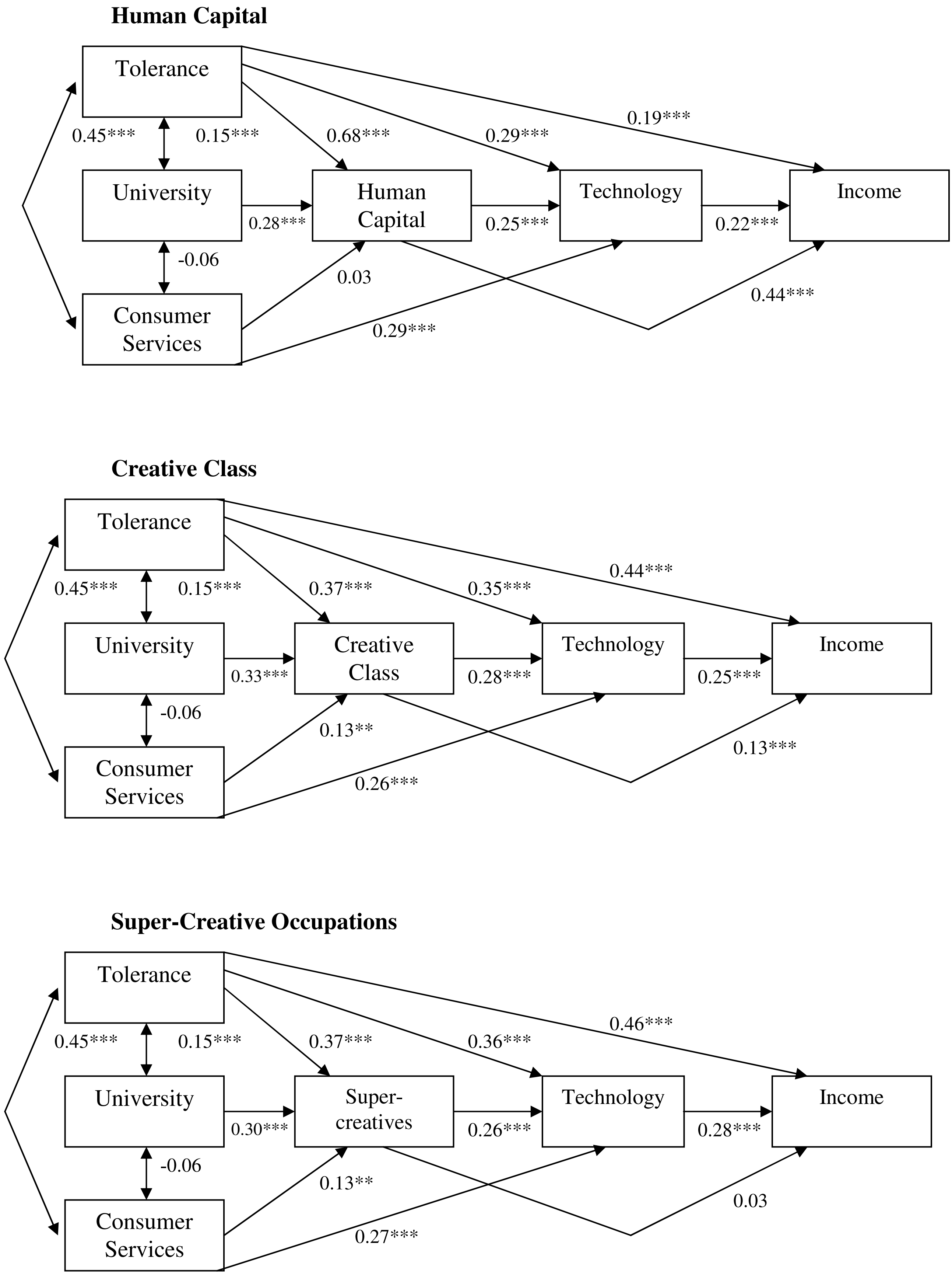



**Figure 5:** Path analysis for human capital, the creative class and income

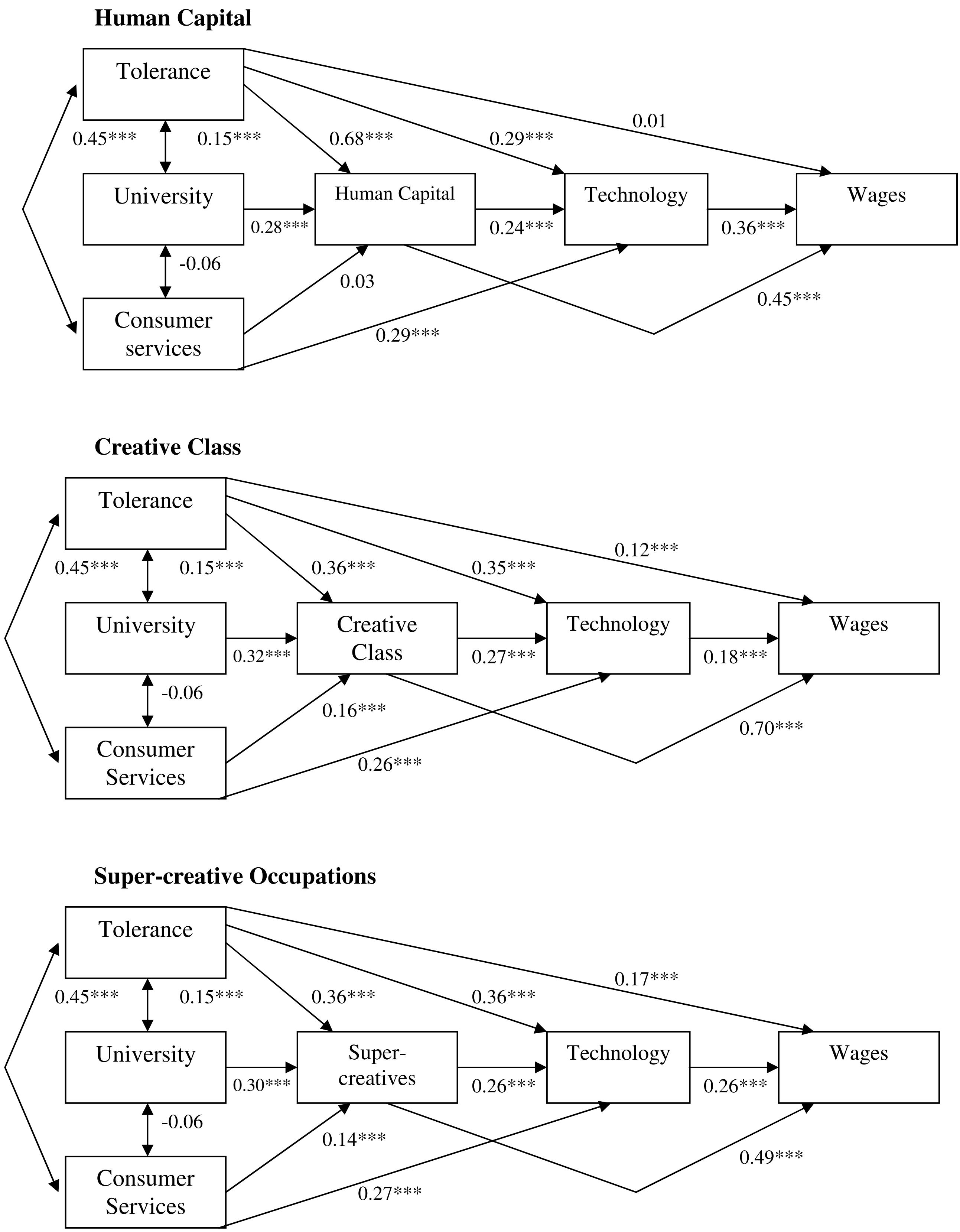



**Figure 6:** Path analysis for human capital, creative class, and wages

Fig. 5 summarizes the findings for the path analysis where income is the outcome variable, while Fig. 6 shows the findings for wages. Table 3 and 4 report the SEM results.

**Table 3:** SEM results for income

| **Income** | **Human Capital** | | | **Creative Class** | | | **Supercreative Core** | | |
|---|---|---|---|---|---|---|---|---|---|
| | ***Talent*** | ***Technology*** | ***Income*** | ***Talent*** | ***Technology*** | ***Income*** | ***Talent*** | ***Technology*** | ***Income*** |
| Variables | Eq 1 | Eq 2 | Eq 3 | Eq 1 | Eq 2 | Eq 3 | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.713*** | 2.576*** | 0.120*** | 0.362*** | 3.110*** | 0.270*** | 0.501*** | 3.230*** | 0.286*** |
| Consumer Services | 0.063 | 5.500*** | | 0.258** | 5.026*** | | 0.357** | 5.051*** | |
| University | 0.112*** | | | 0.121*** | | | 0.155*** | | |
| Talent | | 2.128*** | 0.257*** | | 2.607*** | 0.082*** | | 1.700*** | 0.012 |
| Technology | | | 0.015*** | | | 0.017*** | | | 0.019*** |
| Observations | 331 | 331 | 331 | 331 | 331 | 331 | 331 | 331 | 331 |
| R2 | 0.619 | 0.453 | 0.559 | 0.332 | 0.486 | 0.486 | 0.315 | 0.475 | 0.476 |

**Table 4:** SEM results for wages

| **Wages** | **Human Capital** | | | **Creative Class** | | | **Supercreative Core** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Talent** | **Technology** | **Wages** | **Talent** | **Technology** | **Wages** | **Talent** | **Technology** | **Wages** |
| Variables | Eq 1 | Eq 2 | Eq 3 | Eq 1 | Eq 2 | Eq 3 | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.713*** | 2.595*** | 0.013 | 0.355*** | 3.140*** | 0.111*** | 0.494*** | 3.192*** | 0.158*** |
| Consumer Services | 0.063 | 5.601*** | | 0.326*** | 4.995*** | | 0.414*** | 5.058*** | |
| University | 0.112*** | | | 0.121*** | | | 0.157*** | | |
| Talent | | 2.061*** | 0.400*** | | 2.476*** | 0.659*** | | 1.719*** | 0.338*** |
| Technology | | | 0.037*** | | | 0.018*** | | | 0.027*** |
| Observations | 331 | 331 | 331 | 331 | 331 | 331 | 331 | 331 | 331 |
| R2 | 0.619 | 0.451 | 0.518 | 0.332 | 0.482 | 0.769 | 0.316 | 0.477 | 0.602 |

Looking at the findings for the income models in Table 3, the $R^2$ for education on income (.559) is considerably higher than for creative (.486) or super-creative occupations (.476). Turning to the wage models in Table 4, the $R^2$ for creative occupations (.769) and super-creative occupations (.602) are both higher than for educational human capital (.518). The same models were run for the occupational definitions used by McGranahan and Wojan (2006) with only minor differences in the results (see Appendix). Nor did excluding arts, design, entertainment, sports and media occupations from the creative class and the group of super-creatives significantly change the results**.** (Results available from the authors on request.) Furthermore, the path coefficients between human capital (.44) and income are much stronger than those for the creative class (.13) and super-creative occupations which is insignificant. Conversely, the path coefficients between wages and the creative class (.70) and super-creative occupations (.49) are stronger than for human capital (.45).

Our models include a technology variable so we can parse its effects alongside the two major talent variables as well as tolerance on regional development. The findings indicate that while technology plays a role in regional development, the effect of talent – whether measured as human capital or the creative class - is stronger. When included alongside human capital, the coefficient between technology and wages is .36. This is smaller than the coefficient of .45 between human capital and wages. The coefficient for technology and income is .22, about half the size of the coefficient of .44 between human capital and income. When the creative class is used, the coefficient for technology and wages (.18) is significantly smaller than the coefficient of .70 between the creative class and wages. Technology performs better in the models with creative class and income. The coefficient between technology and income is .25, about twice as much as that for the creative class and income (.13). When super-creative occupations are used, the coefficient between technology and income is .28 while the coefficient for super-creative occupations and income is insignificant. Since some industries within the high-technology sector will have progressed further along the life cycle and become more standardized in their production (and thereby less dependent on skill and knowledge), we ran the model with another, narrower definition of high-technology industry based on highly skilled labor intensity (Hecker, 1999). In these versions of the model, technology is slightly stronger in explaining wages and incomes, but there are no major changes in the significance, direction or path of the results.

It is important to note that both human capital and creative class act on technology directly and as such also act indirectly through technology to have an additional effect regional development. The path coefficient between human capital and technology is .24 in the wage model and .25 in the wage model. The coefficient between the creative class is .27 in the wage model and .28 in the income model. The coefficient between super-creative occupation and technology is .26 in the wage mode and .26 in the income model.

***Region Size Effects***

We also completed this analysis based on four groupings based on regional population. The key findings hold regardless of region size**.** (Results available.) Human capital remains more closely associated with income, while the creative class is more closely associated with regional wages or productivity. The path coefficients for human capital and income range from .86 in the largest regions to .31 in the smallest. When wages are used, the path coefficients for human capital and wages range from .81 in the largest regions to .44 in the smallest. For the creative class, the path coefficients between it and wages range from .81 in the largest regions to .79 in the smallest; and for income the path coefficients range from .27 in the largest regions to .16 in the smallest. The difference between the creative class and human capital is most pronounced among the 144 regions with less than 250,000 people. Here the creative class has a much stronger positive relationship with wages.

The overall findings from both the SEMs and the path analyses are clear. Human capital and the creative class are not substitutes. Rather, they act on regional development through different channels. Human capital or education operates through the channel of income, raising overall regional wealth. The creative class acts on through wages and is much more closely associated with regional labor productivity. This is a non-trivial difference. Wages indicate a region's ability to generate labor productivity and wealth, while income can be, and frequently is, based on the ability of a region to attract wealth generated elsewhere. Wages reflect a Silicon Valley style of regional development where the wage-to-income ration in Silicon Valley is .924, while income can and frequently does reflect a South Florida style of regional development - the wage-to-income ratio in Naples, Florida is .333. The creative class is much more likely to be associated with regional labor productivity, while the human capital level reflects some regional labor productivity but also wealth accumulated over time and (potentially) in other locations. In our view, high human capital regions may be wealthier, but this can and frequently is due their attractiveness to individuals and households who have accumulated wealth elsewhere. The creative class is much more closely associated with current regional labor productivity – the basic mechanism through which wealth is generated in the first place.

## *How and Why Occupations Matter to Regional Development*

Most studies treat human capital as monolithic, but clearly it is not. There is good reason to believe that some occupations and specific types of skill play a relatively larger role in regional development. There is a long tradition in industrial organization economics of identifying particular industries which contribute to overall growth. For example Gordon (2003) found that computers and related industries accounted for a large share of US productivity growth in the 1990s. But far fewer studies have probed the effects of occupations on economic development.

Table 5 provides the correlations for the major occupational groupings, between both wages and income with the share of the regional workforce in that occupation. Several things are evident. First, the correlation coefficients are consistently higher for wages than for income, reinforcing the finding that occupations act on regional development through the channel of regional labor productivity. Second, while the correlations are all positive and significant, there is a wide range in the value and strength of the coefficients. Certain occupations appear to contribute relatively more to regional labor productivity.

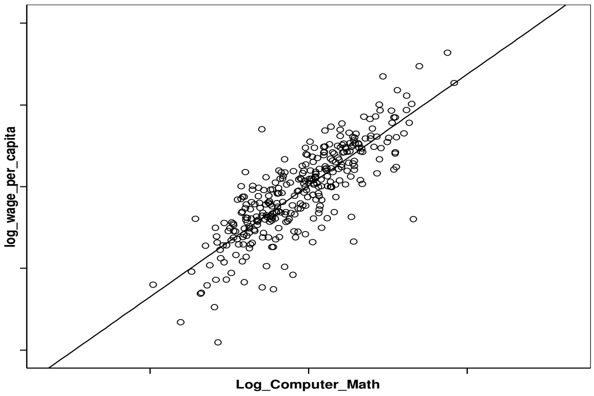
**Table 5:** Correlation Matrix for Occupations, Wages and Income

| Occupation | Wages | Income |
|---|---|---|
| Business and financial operations | 0.830** | 0.549** |
| Computer and mathematical occupations | 0.822** | 0.659** |
| High-end sales and sales management | 0.774** | 0.480** |
| Arts, design, entertainment, sports and media | 0.736** | 0.511** |
| Management | 0.668** | 0.358** |
| Architecture and engineering | 0.649** | 0.472** |
| Legal | 0.593** | 0.390** |
| Life, physical and social sciences | 0.540** | 0.393** |
| Healthcare | 0.364** | 0.052 |
| Education and training | 0.232** | 0.055 |

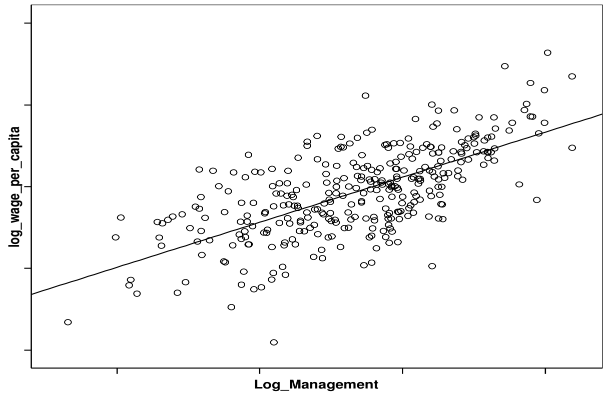
** significant at the 0.01 level

Business and financial operations (.830) and computer and mathematical (.822) top the list. High-end sales (.774) and arts, design and media (.736) form a second cluster. A third cluster is composed of management (.668) and architecture and engineering (.649). Legal (.593) and scientific occupations (.540) form a fourth cluster. The effects of healthcare (.364) and education occupations (.232) are much weaker, and insignificant in terms of regional income.

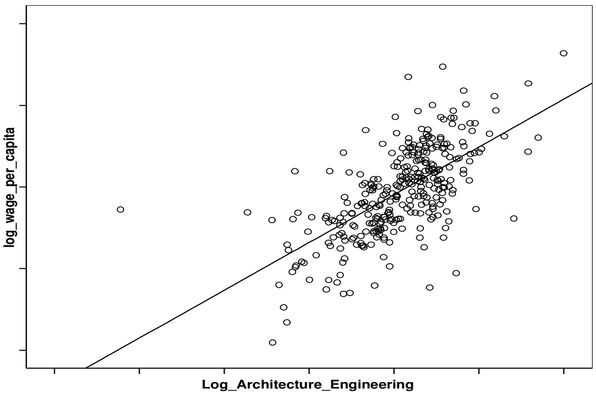
Fig. 7 supplements this with scatter-graphs for the major occupations and wages. The scatter-graphs show the steepness of the slopes for computer and mathematics occupations; business and financial operations; and architecture and engineering. Art and entertainment occupations and high-end sales occupations also have steep slope and cluster neatly around the line. Education and healthcare evidence a much weaker relation to wages which stays at approximately at the same level no matter what the regional wage levels are, with only a few exceptions.



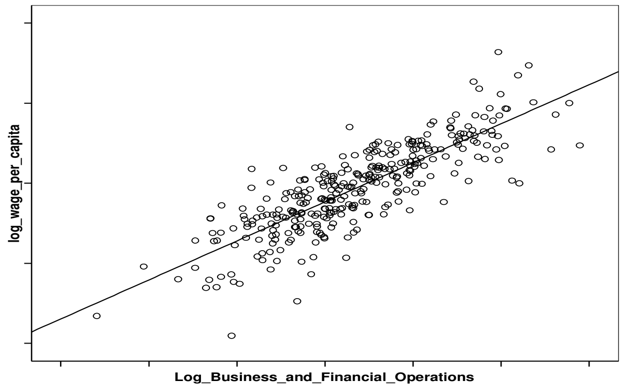

**Computer and Math**



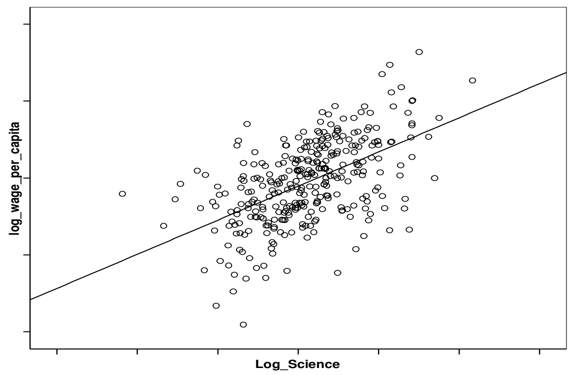

**Management**



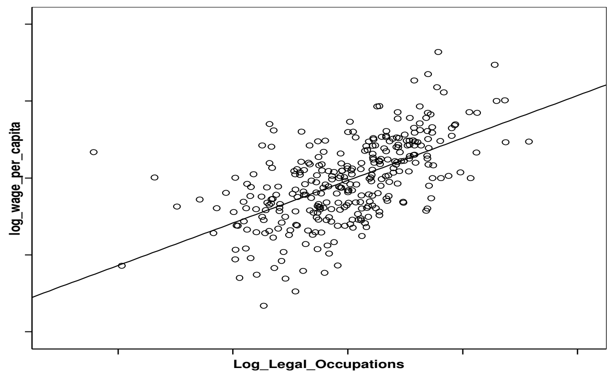

**Architecture and Engineering**




**Business and Financial Operations**




**Life, Physical, and Social Sciences**




**Legal Occupations**

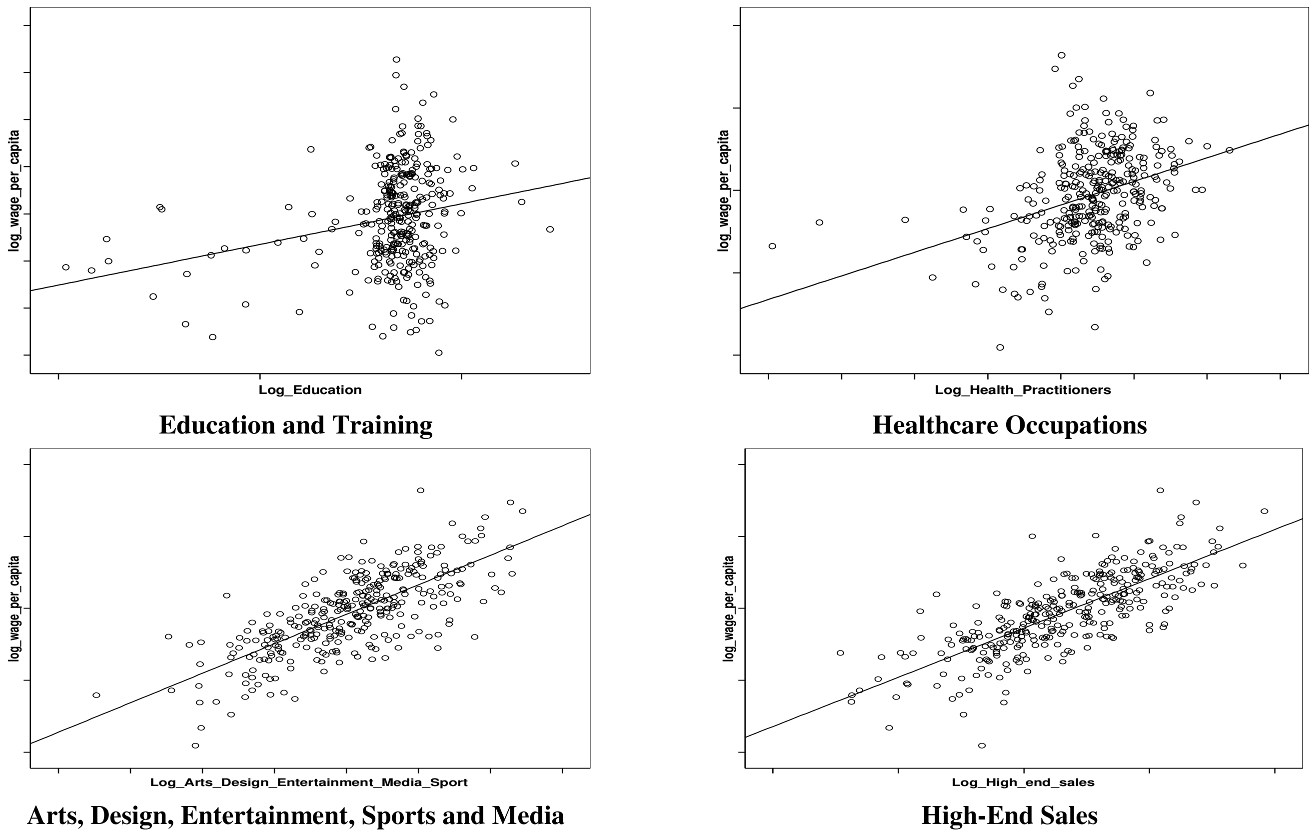



**Figure 7:** Scatter-graphs for occupations and regional wages

Fig. 8 plots education and healthcare occupations as a share of the creative class against regional wages. The slope is distinctly negative. The larger the share of these two - the lower regional wages will be. There are several possible explanations for this. It is likely that the demand for these occupations does not increase with incomes or wages but rather with population. It may also reflect demographic characteristics. Regions for example with a larger share of students will have a greater demand for education and a smaller share of population to engage in other productive activities. Regions with larger populations of elderly households will have a greater demand for healthcare, more heath-care occupations, and smaller share of the workforce employed in other productive activities. Needless to say, education and healthcare do not appear to add significantly to regional labor productivity and wealth. These occupations might be understood as a regional floor or constant. All regions will need some floor or threshold of these occupations, but the ones that experience productivity improvement and growth are those which have relatively higher concentrations of other occupations such as computer and math, science and engineering, business and management, or arts and entertainment.

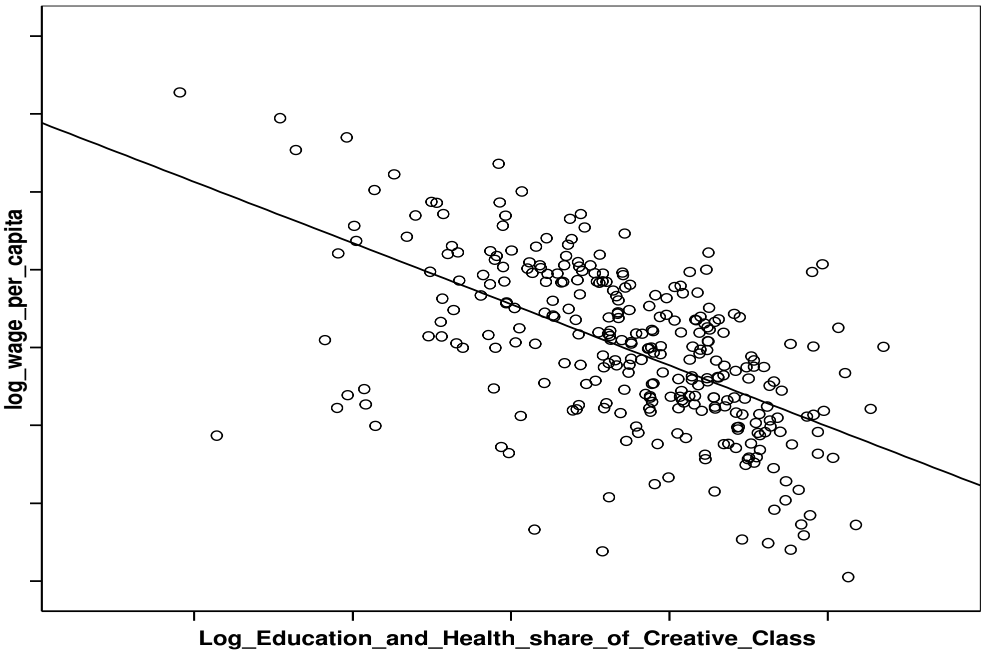



**Figure 8:** Education and healthcare occupations and wages

**SEM and Path Analysis Findings for Major Occupations**

We completed structural equation modeling and path analyses for each of the major occupational groups, technology and wages. The key results of the SEM models are summarized in Table 6, while Fig. 9 presents the findings for the path analysis.

**Table 6: SEM Results for Major Occupations**

| ***Business and financial operations*** | | | |
|---|---|---|---|
| | ***Talent*** | ***Technology*** | ***Wages per Capita*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Gay Index | 0.613*** | 3.168*** | 0.107*** |
| Consumer services | 0.683*** | 4.586*** | |
| University | 0.088*** | | |
| Talent | | 1.553*** | 0.399*** |
| Technology | | | 0.018*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.293 | 0.479 | 0.735 |
| ***High-end sales and sales management*** | | | |
| | ***Talent*** | ***Technology*** | ***Wages per Capita*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.279*** | 3.644*** | 0.177*** |
| Consumer services | 0.558*** | 4.589*** | |
| University | 0. 050** | | |
| Talent | | 1.811*** | 0.528*** |
| Technology | | | 0.023*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.212 | 0.461 | 0.703 |

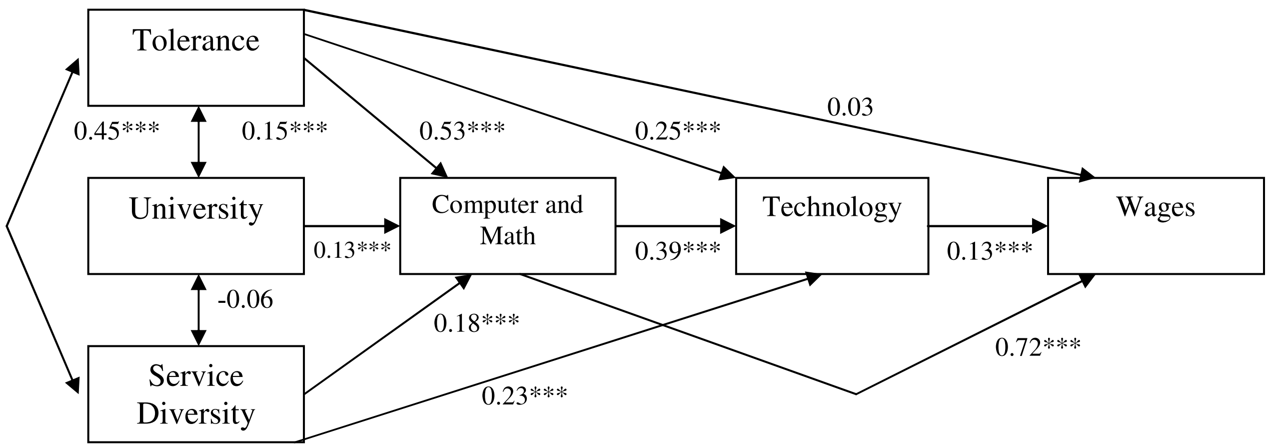
| *Computer and Math Occupations* | | | |
|---|---|---|---|
| | ***Talent*** | ***Technology*** | ***Wages per Capita*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 1.488*** | 2.282*** | 0.025 |
| Consumer services | 1.054*** | 4.336*** | |
| University | 0.142*** | | |
| Talent | | 1.232*** | 0.239*** |
| Technology | | | 0.014*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.427 | 0.513 | 0.689 |
| ***Arts, Design, Media and Entertainment*** | | | |
| | ***Talent*** | ***Technology*** | ***Wages per Capita*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Gay Index | 0.250*** | 2.060*** | -0.005 |
| Consumer services | 0.965*** | 6.240*** | |
| University | 0.235*** | | |
| Talent | | 1.368*** | 0.323*** |
| Technology | | | 0.038*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.269 | 0.394 | 0.646 |
| ***Management*** | | | |
| | ***Talent*** | ***Technology*** | ***Wages per Capita*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.302*** | 3.620*** | 0.215*** |
| Consumer services | 0.136 | 5.440*** | |
| University | 0.083*** | | |
| Talent | | 1.637*** | 0.400*** |
| Technology | | | 0.030*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.138 | 0.463 | 0.628 |
| ***Architecture and Engineering*** | | | |
| | ***Talent*** | ***Technology*** | ***Wages per Capita*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.635*** | 3.333*** | 0.227*** |
| Consumer services | 0.661*** | 4.773*** | |
| University | 0.082** | | |
| Talent | | 1.268*** | 0.193*** |
| Technology | | | 0.026*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.177 | 0.496 | 0.564 |
| ***Legal Occupations*** | | | |
| | ***Talent*** | ***Technology*** | ***Wages per Capita*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.692*** | 3.558*** | 0.188*** |
| Consumer services | 0.626*** | 5.075*** | |
| University | 0.094** | | |
| Talent | | 0.852*** | 0.173*** |
| Technology | | | 0.034*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.217 | 0.453 | 0.533 |

| ***Healthcare*** | | | |
|---|---|---|---|
| | ***Talent*** | ***Technology*** | ***Wages per Capita*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | -0.039 | 4.160*** | 0.284*** |
| Consumer services | 0.196 | 5.517*** | |
| University | 0.160*** | | |
| Talent | | 0.539* | 0.239*** |
| Technology | | | 0.041*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.124 | 0.429 | 0.522 |
| ***Life, Physical and Social Sciences*** | | | |
| | ***Talent*** | ***Technology*** | ***Wages per Capita*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.814*** | 3.601*** | 0.196*** |
| Consumer services | 0.484* | 5.318*** | |
| University | 0.184*** | | |
| Talent | | 0.651*** | 0.123*** |
| Technology | | | 0.038*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.236 | 0.447 | 0.500 |
| ***Education*** | | | |
| | ***Talent*** | ***Technology*** | ***Wages per Capita*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.098 | 4.103*** | 0.273*** |
| Consumer services | 0.250 | 5.527*** | |
| University | 0.256*** | | |
| Talent | | 0.375* | 0.070*** |
| Technology | | | 0.043*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.129 | 0.431 | 0.451 |

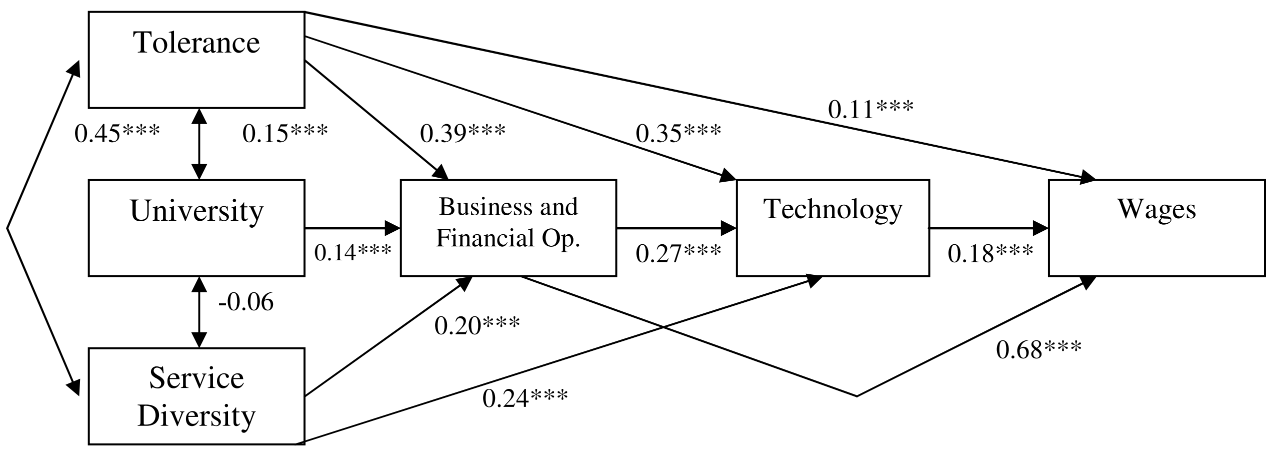
Computer and math occupations have the largest effect on wages with a path coefficient of .72. It is followed by two occupations with path coefficients greater than .6: business and financial operations (.68) and high-end sales (.60). Arts, design, entertainment and media occupations are close behind with a path coefficient of .58. This may be considered surprising since both the conventional wisdom and academic research views these groups as consumers as opposed to producers of resources. We should point out however that the models for the arts and entertainment occupations are slightly different than the others, including just the gay measure of tolerance in this model due to potential collinearity between some of these occupations and the bohemian measure. Overall, the gay measure is slightly weaker than the combined tolerance measure, which may work to strengthen the relative importance of these arts-related occupations. However, the model proved robust when the overall tolerance index returned results approximately the same (.56). Next in line are a cluster of occupations with path coefficients greater than 0.4: management (.48), architecture and engineering (.43).

Computer and math occupations also have the highest path coefficient for technology (.39). It is followed by: architecture and engineering (.29); business and financial operations (.27); and arts, design, entertainment and media (.26). Of these three occupations, the SEM which includes arts and entertainment generates the highest overall $R^2$ in explaining wages together with tolerance and technology. The path coefficients for management (0.21); high-end sales (0.21); legal (0.19) and scientific occupations (0.16) are smaller. The coefficients for education (0.08) and healthcare (0.07) are weakest and significant only at the 0.1 level.

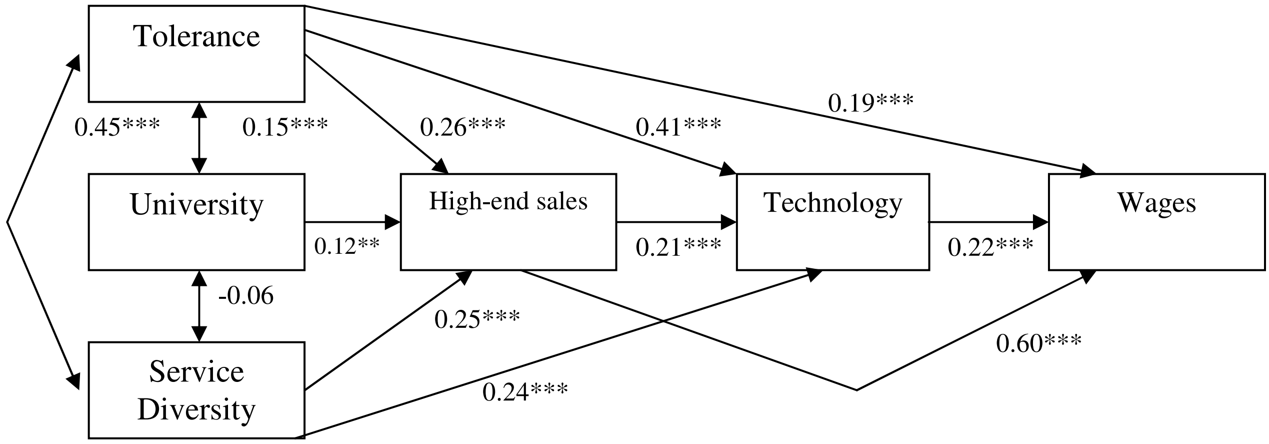
***Computer and math***



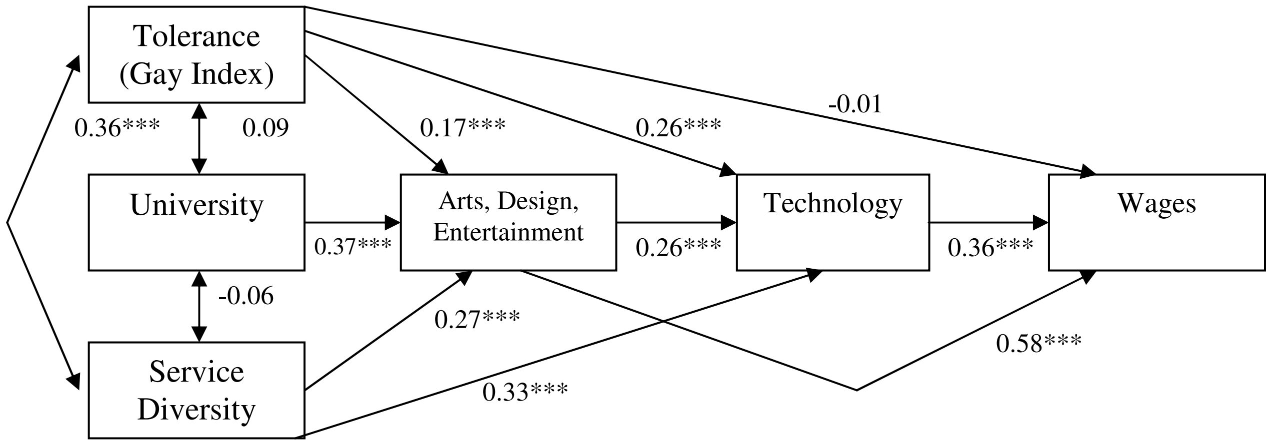

***Business and financial operations***



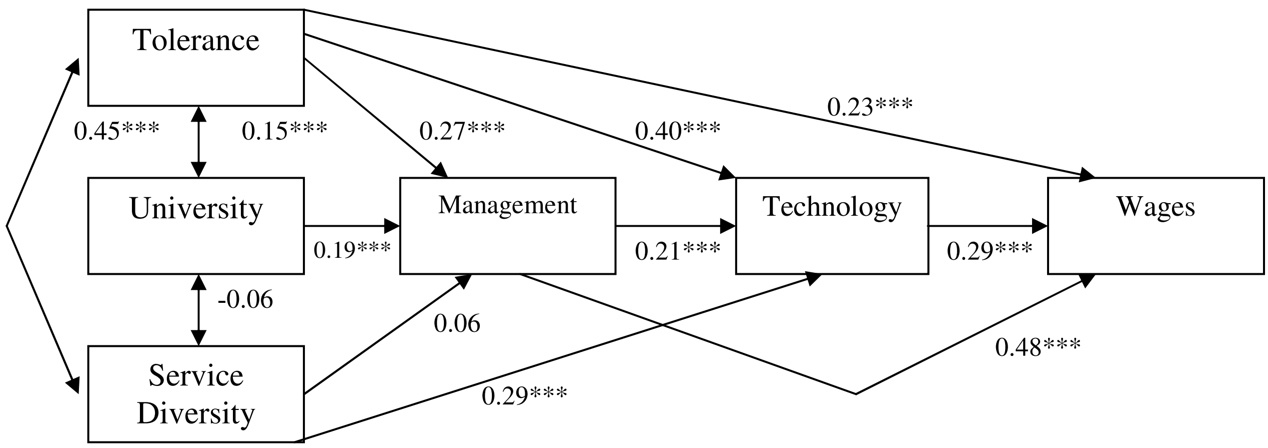
***High-end sales***



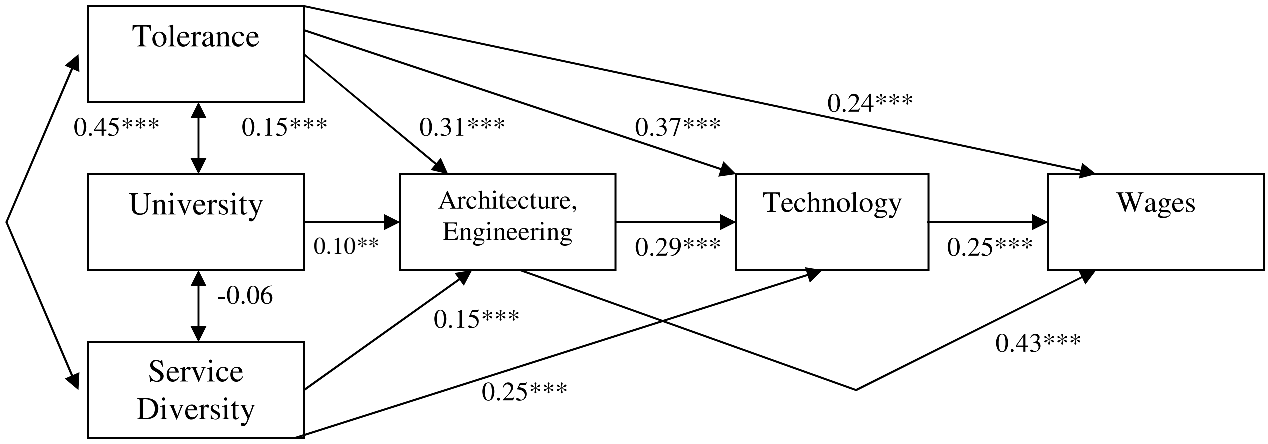

***Arts, design, entertainment, and media***



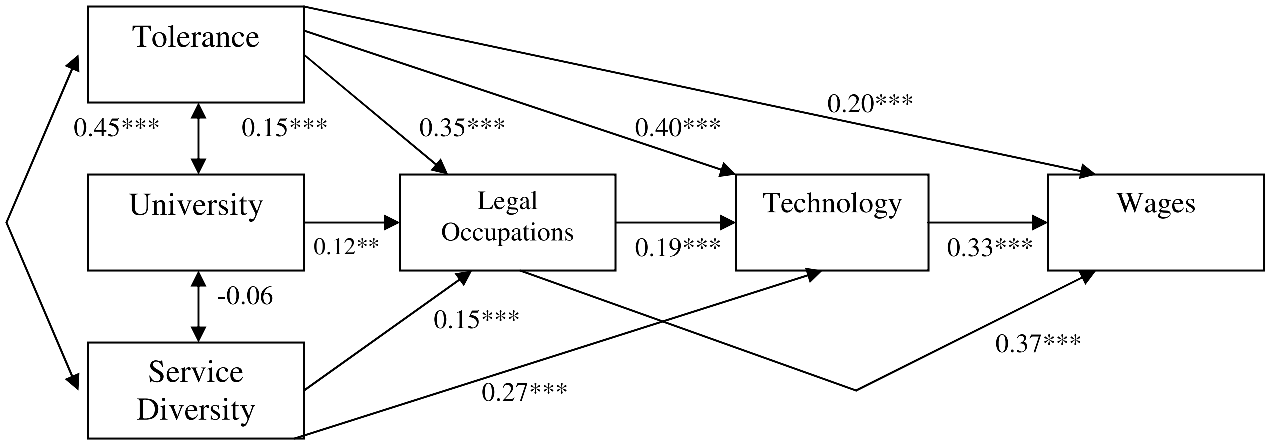

***Management***



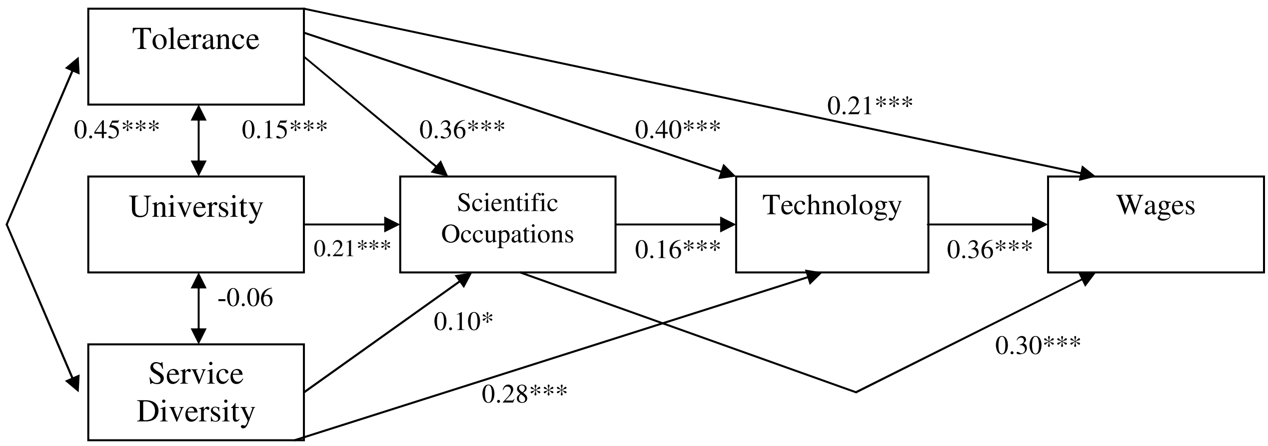
***Architecture and Engineering***



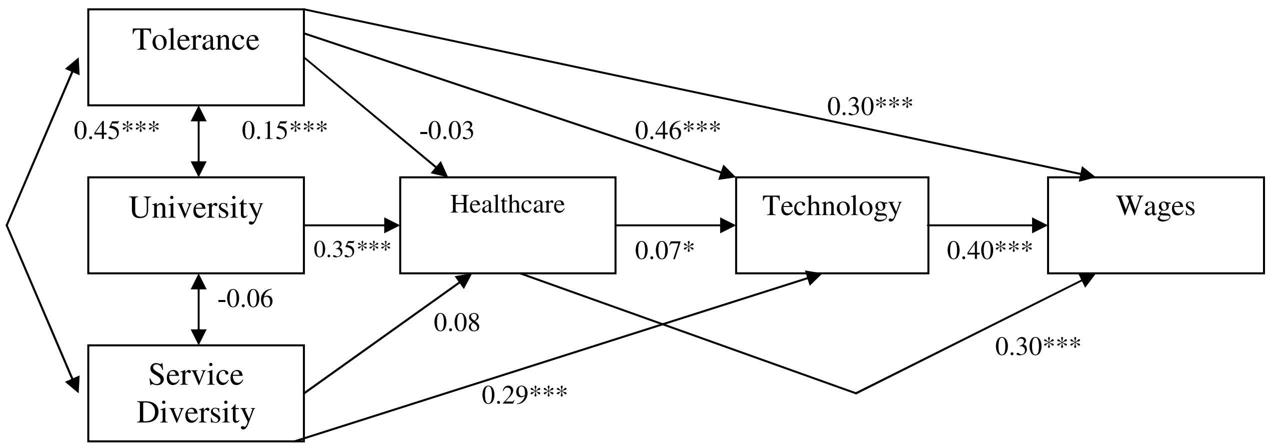

***Legal***




***Scientific occupations***



***Healthcare***




***Education occupations***

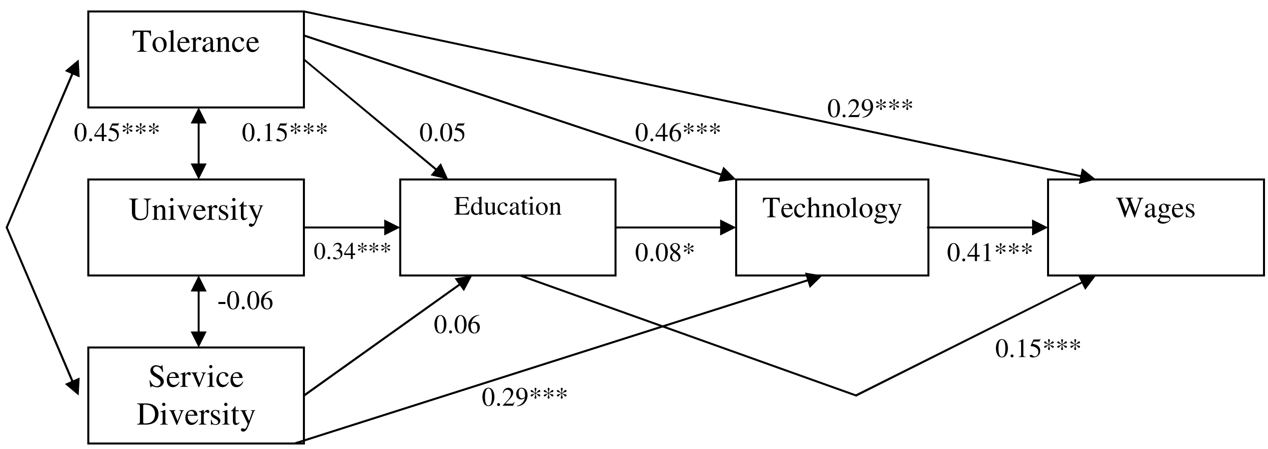



**Figure 9**: Path Analysis for key occupational groups

We have examined the role of particular occupational groups in regional labor productivity. We find that the effects of these occupational groups on wages vary widely. Occupations such as computer and mathematics, business and financial operations, engineering and architecture, and somewhat surprisingly arts and entertainment are very closely associated with regional labor productivity and wages. However, occupations like education and healthcare are much less so. From a public policy standpoint, it seems that regions would want to foster a healthy mix of the former and they would be wise to avoid becoming too heavily specialized in education and healthcare if they want to improve their labor productivity and develop their economies.

## *Explaining the Uneven Distribution of Human Capital*

Our research is concerned with a second key question: How to explain the uneven distribution of human capital or the creative class in the first place. Our models examine the roles played by three factors: tolerance, consumer amenities measured by the diversity of service firms, and universities. We now present the key findings for this aspect of our research.

### *University*

The findings indicate that universities are consistently associated with both human capital and the creative class. The coefficient between the university and human capital is (.28) in both the wage and income models (see Fig 2). The coefficient between it and the creative class is (.32) in the wage model and (.33) in the income model. The coefficient between the university variable and super-creative occupations is (.30) in both models. In terms of individual occupations, the university variable is strongly related to science occupations as might be expected, since these occupations are closely related to university science and universities are major employers of scientists. It is strongly associated with education and healthcare, where again universities and university-affiliated hospitals are major employers. The university is closely associated with arts, design and entertainment occupations, but again recall that the tolerance measure includes only the gay index in this version of the model, potentially damping down its effect. The university is less closely related to other, more business-oriented occupations, including engineering and architecture.

### *Consumer Service Amenities*

The variable for consumer service amenities has mixed effects. It is associated with the creative class but not with human capital. The path coefficient between it and the creative class is .16 in the wage model and .13 in the income model. The results are similar for super-creative occupations. The path coefficient between consumer services and super-creative occupations is .14 in the wage model and .13 in the income model. Furthermore, the variable for consumer services plays a role in all of the major occupational categories, with the path coefficients ranging from .10 to .29 for arts and entertainment, although the coefficient for arts and entertainment may be affected by the fact that it includes only the gay index as noted earlier. The path coefficients between consumer services and human capital are insignificant in both models. Consumer services appear to play an additional role on technology, being closely associated with it in both the wage and income models with path coefficients ranging from .26 to .29. The variable for consumer services is more closely oriented with business-oriented occupations like management, sales and business and financial operations, than with scientific or artistic and cultural occupations.

***Tolerance***

Our findings indicate that tolerance plays an important set of roles in regional development. The coefficients between tolerance and human capital and it and the creative class are consistently high and significant. The coefficient between tolerance and human capital is .68 in both the wage and income models. It ranges from .37 to .38 for the creative class and super-creative occupations in both models. The path coefficients also show sizeable effects of tolerance on all the major occupational categories, especially computer and math where the coefficient is .53. The variables for tolerance also have a sizeable and consistent effect on technology. The path coefficients range from .29 in the models with human capital to .35 in the models with the creative class, and 0.36 in the models with super-creative occupations.

Furthermore, the variable for tolerance has a direct effect on wages and income in many permutations of the model. The path coefficient is .44 in the model for the creative class and income, and .46 in the model for super-creative occupations and income. In these two models, tolerance has the largest magnitude effect on income. Interestingly, in models with the creative class, tolerance actually has the single biggest effect on income, which may be a reflection of the role of tolerance in attracting higher income individuals and retirees. The coefficient between tolerance and income is .19 in the model with human capital. Overall, tolerance adds considerable additional explanatory power to the model of human capital and income.

These findings suggest that tolerance plays a key role in regional development. It is strongly associated with both human capital and the creative class. And it is closely associated with technology, wages and incomes as well. In other words, tolerance affects the other two Ts – talent and technology – as well as regional development outcomes. In a very fundamental sense, this 3rd T, tolerance, plays a key role in the overall system of regional development.

It is important to note that while our theory and model posit a strong set of underlying mechanisms for the effects of tolerance on regional development, our empirical models and evidence do not specify the precise nature and direction of causality. One concern may be that empirical results for tolerance reflect the fact that gay and artistic populations are themselves a function of higher wage, higher income locations. But the nature of our models which isolate the independent effects of human capital, the creative class, and technology as well as the university and consumer amenities on each other as well as regional wages and income gives us confidence in the role played by tolerance in the system of regional development. We initially expected the tolerance variable would exert its influence on regional development only by directly acting on the human capital and creative class variables. In addition to that, we have found that tolerance has a positive and direct relationship on wages and income as well.

It is also important to recall that our theory of the effects of tolerance on regional development does not posit a mechanistic relationship between regional tolerance (measured as concentrations of artists and or gays) and regional development. Rather, we argue that tolerance or openness to diversity makes local resources more productive and efficient acting through four key mechanisms. First, locations of bohemian and gay 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. Second, larger bohemian and gay populations signal underlying mechanisms that increase the efficiency of knowledge spillovers and human capital, as artistic networks act as conduits for the spread of new ideas and knowledge transfer across firms and industries. Third, artistic and gay populations reflect regional values that are open-minded, meritocratic, tolerant of risk, and oriented to self-expression which are in turn associated with higher levels of creativity, innovation and entrepreneurial behavior. Fourth, locations with larger artistic and gay populations signal underlying mechanisms which increase the productivity of entrepreneurial activity. These four factors, when taken together, improve the efficiency and productivity of regional human capital, innovation and entrepreneurship.

### *Region Size Effects*

We also looked at the effects of tolerance, universities and consumer services by region size. In particular, we wanted to test whether the results are being driven by large regions with bigger markets, more options and more cosmopolitan attitudes. The findings indicate that the overall pattern of results hold across region sizes for tolerance and the university, but not for consumer services. Tolerance remains significant on both human capital and the creative class, except for the creative class in the smallest regions. It is also significantly related to wages and income in most permutations of the model across region sizes. The role of the university increases in medium and small regions. The variable for consumer services plays its most important role in smaller regions.

## *Conclusions*

Our research has examined the role of human capital, the creative class, and tolerance in regional development. We distinguished between two channels of regional development, regional labor productivity and regional wealth and included measures of both of wages and income in as outcome variables in our models. We tested for the direct and indirect effects of human capital, the creative class, and individual occupations on regional wages and income, using path analysis and structural equations models. We advanced a stage-based model for regional development to separately and jointly examine the effects of talent, technology, and tolerance on regional development. In the first stage, factors such as tolerance, universities and consumer service amenities act on the location of talent (measured as human capital and the creative class). In the second stage, the concentration of talent in turn affects technology. And in the third stage technology, talent, and tolerance combine to effect regional wages and income. This stage-based model structure enabled us to isolate the direct and indirect effects of these factors in the overall system of regional development. We used 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 believe this modeling approach is an improvement over previous studies, because it enables us to examine the roles of technology, talent, tolerance and other factors on each other as well as on regional development in a system context.

Our results inform three overall findings. First, we find that human capital and the creative class play different but complimentary roles in regional development. The creative class – or occupational skill – operates through the channel of wages and exerts its effect on regional labor productivity. Human capital – or education – operates by increasing regional income and wealth. Our findings here reinforce Marlets and Van Woerken's [2004] claim that the creative class sets a "new standard" for measuring human capital especially when considering regional labor productivity.

Second, we find that certain occupations effect regional development to a much greater degree than others. Education and healthcare have little effect on regional development, while occupations like computer science, engineering, management and business and financial operations have a relatively large effect. A particularly interesting finding is that artistic and entertainment occupations exert considerable direct influence on regional development. Our findings indicate that these occupations are not just consumers of regional resources; they are producers of them as well. Based on this, we suggest that future studies of regional and cross-national development make use of occupational measures which provide important information not captured by standard educational or industry variables.

Third, we find that tolerance is significantly associated with human capital and the creative class. Universities and consumer services also affect the regional distribution of educated and skilled populations, but less so than tolerance. Tolerance thus plays a key role in the regional development system being associated with regional income and wages as well as the other two Ts - talent and technology. These findings substantiate and deepen Florida's [2002a,b, 2005] theory of the 3 Ts of economic development. More research is needed on how these and other factors shape the increasingly uneven distribution of human capital, especially in light of the increasing divergence of human capital levels across regions. It is important to future research to zero in more precisely on the factors that affect not just the current stock but the flow of human capital or the creative class at the margins.

Generally speaking, our findings suggest that the structure of relationships between technology, talent and tolerance in regional development is complex and that regional development cannot be understood as a series of either-or phenomena. Human capital is important but so is the creative class. Education captures one element of regional capability, but occupational skill is critical. The creative class acts to improve regional labor productivity directly, while human capital is more closely associated with increased regional wealth.

Our findings also indicate that the effects of tolerance on regional development must be taken seriously. Our models, which are much more appropriate methodologically for understanding the broad system of regional development, show the consistently significant role of tolerance on technology, on talent, and on regional wages and income directly. We do not argue here that gays and artists are the direct producers of regional economic growth. Rather, our combined measure of artists and gays is a proxy for the much broader impacts of tolerance and openness generally on regional development. As we have argued and shown, tolerance acts on regional development by making other inputs, such as education and occupational skill, more efficient. In our view, tolerance increases the efficiency of key regional resources by lowering barriers to entry for highly skilled and educated people across ethnic, racial, sexual orientation lines; by creating a regional culture that is more oriented to new ideas and tolerates higher levels of risk; by helping to foster a broad environment which facilitates networking, accelerates spillovers, and generates new combinations of talent and resources; and by encouraging the entrepreneurial mobilization of resource in new and more productive firms and organizations.

We hope our research helps clarify some key issues in the ongoing debate over the role of technology, talent and tolerance in regional development. And we also hope it draws more attention and interest in this debate and motivates others to engage in research on how these factors effect regional productivity, income, and living standards across the globe.

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## *Appendix*

**Table 1:** SEM Results for McGranahan-Wojan Revised Creative Class

| Wages | Florida Creative Class | | | McGranahan and Wojan Creative Class | | |
|---|---|---|---|---|---|---|
| | ***Talent*** | ***Technology*** | ***Wages*** | ***Talent*** | ***Technology*** | ***Wages*** |
| Variables | Eq 1 | Eq 2 | Eq 3 | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.355*** | 3.140*** | 0.111*** | 0.471*** | 3.149*** | 0.085*** |
| Consumer services | 0.326*** | 4.995*** | | 0.227 | 5.329*** | |
| University | 0.121*** | | | 0.127*** | | |
| Talent | | 2.476*** | 0.659*** | | 1.908*** | 0.541*** |
| Technology | | | 0.018*** | | | 0.024*** |
| Observations | 331 | 331 | 331 | 331 | 331 | 331 |
| R2 | 0.332 | 0.482 | 0.769 | 0.325 | 0.472 | 0.742 |
| **Income** | **Florida Creative Class** | | | **McGranahan and Wojan Creative Class** | | |
| | ***Talent*** | ***Technology*** | ***Income*** | ***Talent*** | ***Technology*** | ***Income*** |
| Variables | Eq 1 | Eq 2 | Eq 3 | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.362*** | 3.110*** | 0.270*** | 0.479*** | 3.125*** | 0.255*** |
| Consumer services | 0.258** | 5.026*** | | 0.149 | 5.351*** | |
| University | 0.121*** | | | 0.125*** | | |
| Talent | | 2.607*** | 0.082*** | | 2.007*** | 0.099*** |
| Technology | | | 0.017*** | | | 0.016*** |
| Observations | 331 | 331 | 331 | 331 | 331 | 331 |
| R2 | 0.332 | 0.486 | 0.486 | 0.324 | 0.473 | 0.498 |

**Table 2: SEM results for redefined creative class**
(without education and health-care)

| ***Narrow creative occupations (without healthcare and education)*** | | | |
|---|---|---|---|
| | ***Talent*** | ***Technology*** | ***Wages*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.551*** | 2.750*** | 0.071** |
| Consumer services | 0.456*** | 4.626*** | |
| University | 0.090*** | | |
| Talent | | 2.400*** | 0.579*** |
| Technology | | | 0.010*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.333 | 0.506 | 0.807 |
| ***Narrow super-creative occupations (without education)*** | | | |
| | ***Talent*** | ***Technology*** | ***Wages*** |
| Variables | Eq 1 | Eq 2 | Eq 3 |
| Tolerance | 0.424*** | 3.034*** | 0.099*** |
| Consumer services | 0.372*** | 4.860*** | |
| University | 0.103*** | | |
| Talent | | 2.396*** | 0.635*** |
| Technology | | | 0.014*** |
| Observations | 331 | 331 | 331 |
| R2 | 0.306 | 0.491 | 0.811 |