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A New Geography for Information Technology Activity?

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Abstract. This paper utilizes data reported by the Bureau of Labor Statistics' Occupational Employment Survey (OES) to estimate relative cost-of-living (COL) indices for each state. Information Technology (IT) *activity* (as opposed to industry) is defined by employment in computer and math-related occupations (SOC 15). Occupational location quotients were calculated to identify the current distribution of IT. Money wages for these occupations were deflated by estimated state COL's to obtain real wages. Under the assumption that capital flows respond to relative money wages while labor responds to real salaries, future growth trajectories for currently specialized states as well as potentially specializing states are investigated. Results indicate a likely geographic dispersal of IT. Finally, policy recommendations are made.

1. Introduction

In this era of information-intensive development possibly no industry is as actively courted by officials concerned with regional development as the information technology, or IT, industry.[1] The proliferation of (hoped-for) high-technology industrial parks is truly amazing. States and localities all hope to be on the cutting edge of the continuing development of this industry. The above lead-in to an article titled "The New Geography of the IT Industry" will probably serve to further whet the appetite of those aspiring to be at the center of the next Silicon Valley. Unfortunately for those aspirants much of the geographic shift in location referred to by *The Economist* entails globalization and the development of fully operating international supply channels. Yet, as *The Economist* goes on to point out, an additional dimension of the change is occurring domestically as, for instance, a possible shift from Silicon Valley to locations such as Redmond, Washington, Austin, Texas and Armonk, New York. In addition there is the very real possibility that the Valley is in the process of re-inventing itself (The Economist, pp. 47-49).

2. Literature Review

In the academic sphere Malecki (1991), Saxenian (1994), Ellison and Glaser (2000) and Feser, Sweeney, and Renski (2005), among others, have provided insights into the location determinants of high-tech industries. The policy-related issues surrounding the location of such industries are emphasized in the publications of centers and institutes devoted to providing state and local policymakers with timely information on potential regional development initiatives. See, for instance, R.C. DeVol (1999), J. Cortright and H.Mayer (2001) and A. Markusen, et al (2001). This burgeoning, multi-faceted literature is concisely summarized in "HighTech Activities & Innovative Behaviors In & Between Regions", an annotated bibliography of books, articles and internet resources.

3. Methods and Data

This paper takes a very different approach to investigating the possible changing geography of information intensive technology. Instead of tracing the pattern of IT firms we concentrate on the location of IT workers. While there are obvious likely overlaps between location patterns for firms and workers it is likely that, as information technologies become more complex and differentiated, computer-related jobs will proliferate in even a wider variety of firms and institutions than today. Much like the automotive age, when the internal combustion engine became part of the technology employed by just about every industry, the information age is likely to be characterized by continued broadening of application and development of IT knowledge.

[1] A web search for high-tech industry location yields over 1 ½ million entries!

Labor supply, including quantity and quality dimensions, has always played a central role in any investigation of IT development. This study uses data contained in the Bureau of Labor Statistics' *2000 National Occupational and Wages Estimates* to study the geographic distribution of IT employment. These data are combined with BLS reported money wages and estimated real salaries to investigate likely changes in the location of IT jobs. The Bureau of Labor Statistics estimates that computer systems analysts, computer engineers and computer scientists will rank among the top twenty occupations in terms of new job creation at least until the year 2008 (pg. 109). Employment for computer programmers is also expected to grow faster than average and the requisite level of education and experience needed will increase as the complexity of programs expands (pg. 113).[2]

The theoretical foundations for the analysis are rather straight-forward. See, for instance, Roback (1982) and Tabuchi and Yoshida (2000). Assume firms, both within and outside the traditional IT industry but employing computer-intensive technologies, have a neoclassical production function with two inputs, labor and capital.[3] Further assume that both capital and labor are interregionally mobile. Capital will be attracted to those areas offering the lowest productivity-adjusted *money* wages for IT-related occupations. Labor on the other hand will respond, through entry and migration, to high *real* wages. Expansion of IT employment opportunities will thus be most rapid in those states offering firms low money wages and workers high real wages. Areas offering the opposite combination are most likely to be the losers in the competition for IT expansion.

Standard Occupational Classification (SOC) 15 in the BLS's OES survey contains an enumeration of 14 four-digit occupations in the computer and mathematical areas. These occupations are defined and grouped on the basis of similarity of job duties, skills, education, and experience. This level of detail is critical for our assumption that, for each four-digit SOC classification, labor productivity does not vary significantly between states. As seen below, this allows the estimation of real salaries for each occupation.

4. Data Analysis

Four four-digit occupations were selected to represent SOC 15 employment: computer programmers, computer engineers, computer support specialists, and computer system analysts. Together these classifications account for 64.5% of the 2.9 million workers in the SOC. For the entire SOC average 2000 annual salaries were $58,050, well above the overall national average salary of $32,935. The sampled occupations' salaries ranged from $39,680 for computer support workers to $70,300 for software applications engineers. Table 1 reports Relative money wages in 2000, by state, for each selected occupation are reported in Table 1.

The ten states, for each sampled occupation, reporting the highest relative money salaries in 2000 are summarized in Table 2. Eleven states make multiple appearances in this Table. For the most part they are those states most closely associated with so-called high -technology or information age technology. Four states, New Jersey, Connecticut, Massachusetts, and California appear on all four lists. New York and Colorado make three appearances and Arizona, Delaware, Washington, Texas, and North Carolina are all on two of the rankings. A similar table (not shown) for those ten states with the lowest average money wages also contains eleven states with multiple appearances: Wyoming and Arkansas (4 each), Mississippi, North and South Dakota, Vermont, Maine, West Virginia, and Montana (3 each), Oklahoma and Utah (2 each).

In order to predict likely labor flows, a major factor in likely changes in IT location patterns, it is necessary to "deflate" or correct money to real (or cost-of-living adjusted) salaries. It is assumed, as explained above, that entry into an occupation as well as migration of current practitioners of that endeavor is influenced by real rather than money income. Unfortunately the state-level cost of living (COL) statistics necessary to make this adjustment do not exist. This necessitated utilization of an approximation to actual interstate differentials in the true COL.

In order to accomplish this estimated differential in the COL it is assumed that each state has an occupational distribution (at the two-digit SOC level) identical to that of the U.S.[4] Given this distribution of workers a hypothetical overall average money wage based

[2] In 1998 58.7% of all programmers had a bachelors or graduate degree. (p. 115)

[3] Other inputs into the production function are either spatially ubiquitous or, in the case of (dis-) amenities and knowledge spillovers, immobile and therefore capitalized in the value land and buildings (and therefore differentials in the cost of living). See S.D. Gerking and W.N. Weirick (1982), M.S. Fogarty and G.A. Garofalo (1978), R.L. Moomaw (1983, 1986) and K. McCoy and R.L. Moomaw (1995).

[4] Differences in average money wages between specific states and the U.S. might be used to estimate COL differentials,. This would confound the results of true differences in the COL with differences in the occupational mix in each state. The assumption of an identical occupational mix in each state is therefore similar in effect to adjusting for the industrial mix effect in traditional shift/share analysis.

Table 1. Relative money salaries by state, 2000, SOC 15, computer/mathematical occupations (U.S. average = 1.000)

State	Computer Programmers	Computer Support Specialists	Computer Software Engineers, Applications	Computer Systems Analysts
Alabama	0.809	0.888	0.880	0.895
Alaska	0.919	1.008	0.969	0.936
Arizona	0.870	0.942	1.247	1.062
Arkansas	0.770	0.690	0.712	0.755
California	1.093	1.144	1.134	1.048
Colorado	1.071	1.025	1.035	1.061
Connecticut	1.039	1.108	1.015	1.066
Delaware	1.205	1.015	0.957	1.049
District of Columbia	0.874	0.961	0.848	1.094
Florida	0.906	0.788	0.871	0.901
Georgia	0.905	0.957	1.053	1.027
Hawaii	0.711	1.242	0.864	0.878
Idaho	0.996	0.923	0.934	0.866
Illinois	0.927	1.027	0.950	1.083
Indiana	0.843	0.891	0.794	0.891
Iowa	0.815	0.931	0.927	0.857
Kansas	0.927	1.039	0.777	0.933
Kentucky	0.831	0.802	0.820	0.926
Louisiana	0.764	0.962	0.823	0.825
Maine	0.830	0.773	0.782	0.803
Maryland	0.974	1.080	1.001	1.024
Massachusetts	1.151	1.181	1.115	1.064
Michigan	0.908	1.011	0.910	0.934
Minnesota	1.012	0.980	0.946	1.020
Mississippi	0.682	0.820	0.675	0.747
Missouri	0.971	0.969	0.927	0.907
Montana	0.761	0.825	0.717	0.794
Nebraska	0.823	0.890	0.820	0.869
Nevada	0.890	0.779	0.838	0.931
New Hampshire	0.817	0.914	1.021	1.036
New Jersey	1.148	1.158	1.040	1.182
New Mexico	0.894	1.045	0.924	0.874
New York	1.063	1.119	0.973	1.123
North Carolina	1.038	1.076	0.983	0.975
North Dakota	0.601	0.589	0.850	0.750
Ohio	0.925	1.015	0.881	0.945
Oklahoma	0.815	0.655	0.819	0.802
Oregon	0.923	0.784	1.006	0.941
Pennsylvania	0.925	0.988	0.896	0.947
Rhode Island	0.851	0.941	0.879	0.935
South Carolina	0.833	0.851	0.819	0.799
South Dakota	0.720	0.639	0.671	0.875
Tennessee	0.849	0.840	0.817	0.867
Texas	1.099	1.076	0.963	0.932
Utah	0.976	0.570	0.993	0.820
Vermont	0.790	0.918	0.728	0.779
Virginia	0.945	0.986	0.943	1.018
Washington	1.162	1.031	1.025	1.027
West Virginia	0.733	0.725	0.794	0.906
Wisconsin	0.858	0.999	0.861	0.884
Wyoming	0.624	0.642	0.735	0.718
U.S. Average	**$60,970**	**$39,680**	**$70,300**	**$61,210**

Table 2. Ten highest salary states, 2000; average money salary; computer-related occupations

Rank	Programmers	Engineers	Support Specialists	Systems Analysts
1	Delaware	Arizona	Hawaii	New Jersey
2	Washington	California	Massachusetts	New York
3	Massachusetts	Massachusetts	New Jersey	District of Col.
4	New Jersey	Georgia	California	Illinois
5	Texas	New Jersey	New York	Connecticut
6	California	Colorado	Connecticut	Massachusetts
7	Colorado	Washington	Maryland	Arizona
8	New York	New Hampshire	North Carolina	Colorado
9	Connecticut	Connecticut	Texas	Delaware
10	North Carolina	Oregon	New Mexico	California

on actual state money salaries is calculated for each state. This average money wage is then compared to that for the country as a whole to estimate the true COL differential.[5] In Massachusetts, for instance, the resulting average money wage, given the assumption of a national mix of occupations in the state, would be 11.1% higher than average.[6] This is assumed to be the mix adjusted COL differential. It is then used to adjust money salaries. Thus, to continue with our example, computer programmers in Massachusetts earn a money wage that is 15.1% higher than the national average (see Table 1). After adjusting for the estimated differential in the state's overall COL, however, real salaries were only 3.7% higher than average.

The results of deflating money salaries by the estimated cost-of-living differentials are presented in Tables 3 and 4. Table 3 reports estimated relative 2000 real salaries for each state and each of the four sampled occupational groups. Table 4, analogous to Table 2 above in construction, identifies the ten states, for each group, paying the highest real salaries. North Carolina, a state that appeared twice on the money salary rankings in Table 2, appears on all four lists for real salaries in Table 4. This state is followed by Idaho and New Mexico appearing on three of the four lists. Arizona, Colorado, Massachusetts and Texas are among the top paying states in terms of both money (Table 2) and real (Table 4) salaries. Several states synonymous with the term high-tech, such as California, New York and Washington, drop out of the rankings when moving from money to real wages. On the other hand states not usually identified as high-tech are enumerated in Table 4 as high real salary states for at least two of the four computer-related occupations. These states are New Hampshire, Georgia, Iowa, and Utah.

Several states also carry over from low money to low real salary lists. Wyoming again is on such a list for all four sampled occupations. Vermont (3), North (3) and South (2) Dakota, Utah (2), and Mississippi (2) are consistently low paying states no matter which measure is used. Utah, however, is somewhat of an anomaly. It is among the *highest* real salary states for computer programmers and software applications engineers, but among the bottom ten in real salaries for computer support specialists and systems analysts.

The entries contained in Tables 1 and 3 for each sampled occupation using the 2000 coefficient of variation (CV) are presented in Table 5. One anticipates that the CV will be lower for real wages than for money salaries as workers respond to geographic differences in the former by in-migrating or otherwise entering these occupations in high real wage states and exiting the market in low wage states. Clearly these expectations are fulfilled; the CV for real salaries is lower in all four occupations.

In order to investigate likely changes in the location of computer related employment Tables 1 and 3 were utilized to identify those states paying high real wages, thus likely to attract workers, and low money

[5] The two equations summarizing the technique used are:
(1) $_{us}EP_i(_rMW_i) = {}_rHMW_i$ (i = 1,…,22), (r= 1,…,51)
(2) Sum $_rHMW_i/_{us}MW = {}_rCOL$ where $_{us}EP_i$ = percent of U.S. total employment in occupation I, $_rMW_i$ = average money wage in occupation i in state r, $_rHMW_i$ = hypothetical relative money wage bill in occupation i in state r. $_rCOL$ = estimated relative cost-of-living in state r.

[6] Without adjusting for the difference in the occupational mix in Massachusetts the estimated COL adjustment would be 16.4% rather than 11.1% reflecting the state's relative concentration in high salaried occupations.

Table 3. Relative real salaries by state, 2000; SOC 15, computer/mathematical occupations (U.S. Average = 1.000)

State	Computer Programmers	Computer Support Specialists	Computer Software Engineers, Applications	Computer Systems Analysts
Alabama	0.927	1.017	1.008	1.025
Alaska	0.817	0.896	0.862	0.832
Arizona	0.926	1.003	1.328	1.131
Arkansas	0.941	0.842	0.869	0.922
California	1.000	1.046	1.037	0.958
Colorado	1.046	1.001	1.010	1.036
Connecticut	0.908	0.968	0.888	0.932
Delaware	1.163	0.980	0.924	1.013
District of Columbia	0.744	0.818	0.722	0.931
Florida	0.983	0.855	0.945	0.977
Georgia	0.946	1.001	1.101	1.073
Hawaii	0.695	1.213	0.844	0.858
Idaho	1.130	1.047	1.059	0.981
Illinois	0.917	1.016	0.940	1.072
Indiana	0.895	0.946	0.843	0.946
Iowa	0.924	1.056	1.051	0.972
Kansas	1.022	1.145	0.856	1.028
Kentucky	0.928	0.896	0.917	1.035
Louisiana	0.891	1.122	0.960	0.962
Maine	0.928	0.864	0.874	0.898
Maryland	0.957	1.062	0.983	1.006
Massachusetts	1.037	1.064	1.005	0.959
Michigan	0.835	0.930	0.837	0.859
Minnesota	0.973	0.943	0.910	0.982
Mississippi	0.852	1.025	0.842	0.933
Missouri	1.036	1.033	0.989	0.968
Montana	0.935	1.014	0.881	0.977
Nebraska	0.937	1.014	0.934	0.990
Nevada	0.902	0.789	0.849	0.944
New Hampshire	0.851	0.952	1.063	1.079
New Jersey	0.993	1.001	0.900	1.022
New Mexico	1.027	1.201	1.063	1.004
New York	0.922	0.971	0.844	0.975
North Carolina	1.121	1.161	1.061	1.052
North Dakota	0.733	0.718	1.036	0.914
Ohio	0.950	1.043	0.906	0.971
Oklahoma	0.964	0.775	0.969	0.949
Oregon	0.916	0.778	0.999	0.934
Pennsylvania	0.951	1.016	0.921	0.973
Rhode Island	0.836	0.925	0.864	0.919
South Carolina	0.952	0.973	0.937	0.914
South Dakota	0.875	0.777	0.815	1.064
Tennessee	0.949	0.939	0.913	0.969
Texas	1.174	1.149	1.028	0.996
Utah	1.077	0.628	1.096	0.904
Vermont	0.836	0.973	0.771	0.826
Virginia	0.962	1.004	0.960	1.037
Washington	1.050	0.932	0.927	0.929
West Virginia	0.888	0.878	0.961	1.097
Wisconsin	0.891	1.038	0.895	0.919
Wyoming	0.726	0.746	0.855	0.835

Table 4. Ten highest salary states, 2000; average real salary - computer-related occupations

Rank	Programmers	Engineers	Support Specialists	Systems Analysts
1	Texas	Arizona	Hawaii	Arizona
2	Delaware	Georgia	New Mexico	West Virginia
3	Idaho	Utah	North Carolina	New Hampshire
4	North Carolina	New Hampshire	Texas	Georgia
5	Utah	New Mexico	Kansas	Illinois
6	Washington	North Carolina	Louisiana	South Dakota
7	Colorado	Idaho	Massachusetts	North Carolina
8	Mass.	Iowa	Maryland	Virginia
9	Missouri	California	Iowa	Colorado
10	New Mexico	North Dakota	Idaho	Kentucky

Table 5. Coefficient of Variation; money and real salaries, 2000 (by sampled SOC 15 occupation)

Occupation	Money Salaries	Real Salaries
Computer Programmers	13.7%	10.3%
Computer Software Engineers	12.0	10.2
Computer Support Specialists	15.7	12.4
Computer Systems Analysts	10.9	6.8

wages, hence likely to attract capital.[7] The combination of salaries are listed in Table 6. No state appears on all four lists. Three states, Alabama, Idaho and New Mexico, appear on three of the four lists in Table 6. Kansas, Missouri, Utah, Iowa, and North Carolina appear twice in the rankings.

A similar comparison between money and real salaries was undertaken for eight states currently synonymous with information intensive high-tech development: California, Colorado, Massachusetts, Minnesota, New York, North Carolina, Texas, and Washington. For these states the typical pattern appears to be one of high money wages (78% of the cases for the four occupations) and high real wages (56%). While not conducive to long-term growth and development in terms of capital inflow (due to high money wages), the frequent occurrence of high real wages should, in several cases, aid in employment growth from a situation of excess capacity (for instance, a recession). However, two states, Minnesota and New York, tend to pay below U.S. average real wages in each occupation as well as high money salaries for several occupations. The prognosis with regard to continued growth, either long- or short-term, for these states cannot be considered favorable.

High-tech and information- or computer-intensive specialization need not, of course, be geographically congruent. The eight states identified above, on an *a priori* basis, as high-tech would probably be on anyone's list of computer-intensive locations, but it is probably better to allow the data to self-select current concentrations of computer-related work. Eleven states, listed in Table 7, have location quotients (LQ's) equal to or exceeding 1.20 in SOC 15 indicating an occupational specialization greater than 20% above national norms. In 32 of 44 possible cases (11 states x 4 sampled occupations) money salaries in these states,

[7] High (low) money and real salaries are defined relative to the U.S. average for each occupation.

Table 6. States paying relatively high real salaries and relatively low money salaries, 2000; computer-related occupations (Alphabetical Order)

Programmers	Engineers	Support Specialists	Systems Analysts
Idaho	Alabama	Alabama	Alabama
Kansas	Idaho	Arizona	Kansas
Missouri	Iowa	Georgia	Kentucky
New Mexico	New Mexico	Idaho	New Mexico
Utah	North Carolina	Iowa	North Carolina
	North Dakota	Louisiana	South Dakota
	Texas	Mississippi	West Virginia
	Utah	Missouri	
		Montana	
		Nebraska	
		Pennsylvania	
		Wisconsin	

Table 7. States specialized in SOC 15 occupations as measured by SOC 15 location quotients

State	Location Quotient	State	Location Quotient
Massachusetts	1.61	New Jersey	1.25
Minnesota	1.20	California	1.30
Maryland	1.44	Washington	1.55
Connecticut	1.20	Colorado	1.86
Delaware	1.22	Utah	1.41
Virginia	1.80		

possibly reflecting historical agglomerative forces, were above the U.S. average. In 23 cases states reported below average real salaries. Such states are unattractive labor markets for worker location. As a matter of fact in 19 cases the *combination* of high money- and low real wages likely dictates against further development either through labor or capital expansion. Such a combination of salaries is found for all four occupations in Connecticut, for three of the four in Washington and New Jersey and for two in Minnesota, Maryland, and California. Massachusetts, Delaware and Colorado exhibit this unfavorable combination for one four-digit occupation. Only Utah and Virginia completely escape this affliction. In such an environment one cannot be optimistic about future employment expansion in these currently specialized states. Possibly this is the downside of what *The Economist* calls the new geography of the IT industry in general and computer-related employment specifically.

Given the agglomerative nature of many of the employers of information technology specialists it seems unlikely that the next Silicon Valley or Route 128 is going to emerge in states with significant deficits in SOC 15 occupations.[8] Twenty-six states currently have deficits, measured with respect to national norms, of greater than 15% in SOC 15 employment. A list of these states by the size of their SOC 15 employment deficit is summarized in Table 8. The difficulty these states encounter in developing an information technology cluster is illustrated by the fact that 82% of all real salaries in our four sampled occupations are below U.S. average. On a more positive note, of the remaining nineteen cases where real salaries are above average, seventeen of them combine higher than average real salaries with lower than average money salaries. Eight of these seventeen cases are concentrated in three states: Idaho and Alabama (3 occupations each),

[8] Two-digit SOC employment location quotients were calculated for each state.

Table 8. States with significant deficits in SOC 15 employment (in comparison to national norms)

15-20% Deficit	20-30% Deficit	30-40% Deficit	40-50% Deficit	Over 50% Deficit
Florida	Idaho	Maine	Montana	West Virginia
Pennsylvania	South Dakota	Vermont	North Dakota	Wyoming
	Michigan	Oklahoma	Hawaii	Nevada
	Ohio	Alabama	Alaska	Louisiana
		Wisconsin	Kentucky	Mississippi
		Iowa	South Carolina	Arkansas
			Tennessee	
			Indiana	

Table 9. States reporting location quotients between 0.85 and 1.20 relative real salaries, 2000 (bold indicates that money salaries below national avg.)

State	Programmers	Support Specialists	Engineers	Systems Analysts
Arizona	0.926	**1.003**	1.328	1.131
District of Columbia	0.744	0.818	0.722	0.931
Georgia	0.946	**1.001**	1.101	1.073
Illinois	0.917	1.016	0.940	1.072
Kansas	**1.021**	1.145	0.856	**1.028**
Missouri	**1.036**	**1.033**	0.989	0.968
Nebraska	0.937	**1.014**	0.934	0.990
New Hampshire	0.851	0.952	1.063	1.079
New Mexico	**1.027**	1.201	**1.063**	**1.004**
New York	0.922	0.971	0.844	0.975
North Carolina	1.121	1.161	**1.061**	**1.052**
Oregon	0.916	0.779	0.999	0.934
Rhode Island	0.836	0.925	0.864	0.919
Texas	1.174	1.149	**1.028**	0.996

and Iowa (2). Clearly these states have development potential in information technology ***if*** they can overcome the problem of initial critical mass to realize agglomeration economies.

As the information technology industry moves beyond product innovation to execution the importance of agglomeration economies in determining location patterns is likely to diminish. This trend may help propel an expansion in computer/math related employment in states, identified above, as having significant deficits in these employment categories yet currently offering favorable combinations of money and real salaries. It is likely, however, that innovation in certain areas (for example, biotechnology) will continue to be a hallmark of an ever-widening range in the current information technology landscape. For that reason it is worthwhile to investigate relative real wages in the remaining fourteen states which report a 2000 LQ in SOC 15 somewhere between 0.85 and 1.20. These states have a presence in computer/math occupations approximating that of the country as a whole. They therefore have an IT base capable of future expansion capitalizing on the clustering tendency of innovative firms in these industries. The fourteen states falling in this category are listed in Table 9. For each state relative real salaries are given for each sampled occupation in the year 2000. Those states reporting both higher than average real salaries, thus attracting labor, and below average money salaries (not shown), therefore likely to attract capital, are printed in bold type. Thirteen entries in the table exhibit this favorable pattern. Three of these entries are for New Mexico and two each for Kansas, Missouri, and North Carolina. In the case of New Mexico, for instance, the state appears to be in a favorable position to attract both workers and capital for firms hiring computer programmers, computer software application engineers, and computer systems analysts. In the one remaining occupation sampled, computer support specialists, New Mexico paid real wages 20% above the U.S. average, but relative money wages were also 4.5% higher than average thus, *ceteris paribus,* discouraging capital inflows. It should also be noted that several of the states in Table 9, for instance Texas (Austin), North Carolina (The Research Triangle) and Arizona (Phoenix), have well-known local agglomerations which benefit from clustering economies of scale. All these states also have at least one favorable combination of money and real salaries.

5. Conclusions

In conclusion, what indications do we see from the above analysis of what *The Economist* calls the new geography in IT? Further, and more importantly, what are the policy implications of our results? Granted this analysis is limited to a domestic evaluation of this change in location patterns, but certain signs of likely dynamics are found.[9] Several of the eleven states (for example, Connecticut, New Jersey and Washington) currently specialized in computer/math related occupations exhibit an unfavorable pattern of high money- and low real-wages. Other things equal such a pattern is not conducive to further long-term growth. On the other hand certain states, such as New Mexico and North Carolina, that are closer to the U.S. average in terms of current computer/math specialization may be poised for further development in these areas. Even among the states with a significant deficit in current computer/math related occupations (what might be called "long-shot" states due to a lack of current agglomeration) Idaho and Alabama and even, possibly, Iowa exhibit characteristics favorable to long-term growth in these areas. Thus, while it is impossible to predict where the "creative juices" of innovation will flow, the basis of a new domestic geography for computer-related employment is present. The pattern of money and real salaries for SOC 15 occupations seems conducive to such a new geography.

From a policy perspective it is useful to view the results reported above in light of a quote from a study done by K.L. Bradbury, Y.K. Kodrzyski, and R. Tannenwald (1997, p. 11): "…some jurisdictions may be able to identify a cluster of primary industries whose growth could be stimulated with a few strategically placed public subsidies". First, replace the word industries with occupations, recognizing that "who we are" may be more important for long-run development than "what we are (currently) producing". Second, recognize that post-secondary education is a crucial prerequisite for entry into high-tech occupations. Finally, note that, in many states, the bulk of higher education is provided by public institutions and the loci for the necessary few strategically placed public subsidies becomes obvious.

The policy focus on people rather than bricks and mortar has other important implications. Surprisingly, the BLS's OES reports only 9.6% of the approximately 1.4 million jobs in the Computer and Electronic Product Manufacturing industry (NAICS 334000) in 2003, possibly the epitome of high-tech, are in computer and math related occupations. This percent is exceeded by industries as diverse as Non-internet Publishing (16.1%), Internet Publishing and Broadcasting (33.5%), Internet Services (33.9%), and Professional, Scientific & Technical Services (13.0%). In such an environment a policy of up-dated "smokestack chasing" or location incentives focused on narrowly defined high-tech industries will miss significant high-tech activity. The fact is that eighty-seven of the 88 three digit NAICS report employing workers in SOC 15!

It is clear from the existing literature that workers in high-tech activities such as the computer and math related occupations emphasized here, as well as those in the engineering professions encompassed by SOC 17, are attracted to areas with a high quality of life (QOL). A region's QOL reflects both natural and human-made amenities. Clearly a policy aimed at publicizing the former and improving the latter would be important in enticing in-migrants in these occupations

[9] Unfortunately, at the present time, the OES is available only for 2000-2004. This short period precludes any meaningful time series analysis of occupational entry patterns and migration. Other data sources tend to present employment by industry, not occupation. Census statistics on occupational migration between 1990 and 2000 might capture the dynamics of occupational change during the "dot.com" boom, but are unlikely to capture the 21st. century milieu. The best chance to validate the dynamics suggested by this research must await the temporal expansion of the OES.

thus supplementing policies to "grow your own" through educational initiatives.

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