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Estimating County-Level Demand For Educational Attainment

by

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Abstract

A procedure is developed based on "step-down" methods familiar from input-output studies to estimate county-level demands for educational attainment. An empirical example is presented. Potential extensions and applications are numerous, including dynamic shift-share analyses, rural labor market studies, and long-range regional economic development planning.

Key words: Step-down, Input-output, Educational demand

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Introduction

Human resource economics has traditionally emphasized the importance of formal education in affecting an individual's lifetime income-earning ability (Mincer; Zimmer; Nechyba; Psacharopoulos; see Diamond, Simon and Warner for a recent empirical analysis). Formal education beyond high school enables individuals to obtain higher-paying jobs. However, these higher-paying jobs are not necessarily available in rural areas, forcing individuals with a college education to migrate to urban areas. In a recent paper, Debertin *et al.* note that a key deterrent to economic development in many rural areas is the lack of job opportunities for residents who have more than a high school diploma. This results in a "brain drain" from rural areas.

At the same time, there is evidence that off-farm employment is becoming increasingly important as a source of income for U.S. farmers (e.g., Findeis). Farm operators working off-the-farm tend to have a higher level of formal education than those who are full-time farmers (e.g., Huffman; Goetz). If the transition from farming to non-farming is indeed facilitated by the signalling property of formal education, an important issue of providing farmers and their offspring with equitable educational opportunities arises for policy makers. For the purposes of this paper, a more immediate issue is whether farm operators qualify for rural jobs in the same or in adjacent counties so that they may continue to operate their farms on a part-time basis.

In view of these concerns, this paper develops a procedure for estimating the demand for public education in individual counties of a state by sector and occupation, using readily available employment data. The approach is analogous to the "step-down" method traditionally used to estimate input-output (I-O) models for states and counties from non-survey data. Non-survey I-O models apply ratios to the national input/output table (Leontief; Miernyk; Mattas, Pagoulatos and Debertin; U.S. Department of Commerce). In this paper, ratios are applied to state sector, occupation and education data in order to estimate county-level "demands" for education by sector and occupation.

The procedure is important for a number of reasons. First, because of confidentiality rules it is difficult to obtain sector by occupation by education data for individual counties; at best, it is possible to obtain data for *groups* of counties. If confidentiality is not a concern (because the county is well-populated), the Bureau of Census is unlikely to provide individual data for more than one county because of the data processing costs involved. A second reason is that Census-based data rapidly become obsolete. By merging Census data with annual employment security data (collected by the Bureau of Economic Analysis), inaccuracies caused by out-of-date estimates are reduced. Third, Census data reflect the county of residence rather then employment, whereas the BEA data reflect employment demand by firms within a county. Hence, the method reduces inaccuracies resulting from commuting across county lines. The importance of this phenomenon is illustrated in an empirical example below. Finally, the method presented here could be used to generate estimated annual historical data series on the structure of occupation and industry by educational requirement.

We apply the procedure using data from Kentucky, a state with diverse economic sectors, and a state with wide variations among residents with respect to years of schooling completed. The basic assumption, as in step-down non-survey I-O models, is that educational levels or requirements within a specific sector and occupational group that apply to the state also apply at the county level. That is, if the percentage of employees in a specific occupational category within a specific sector of the economy is known for the entire state, then these same percentages can be applied to county-level data by sector and occupation. By applying these percentages, county-level "demands" for education by sector and occupational category can be estimated. The assumption is analogous to the "constant technology" assumption frequently made in nonsurvey I-O modeling, where the technologies employed in the production of each good at the national level are assumed to apply at the state and county level.

The Procedure

The starting point for our analysis is the state employment matrix by occupational category and sector for Kentucky (Table 1), which is maintained by the U.S. Department of Commerce, Bureau of Census. The state is divided into nine sectors comprising the columns of the table and nine occupation categories comprising the rows. The sectors are (1) Agriculture (including Fisheries and Forestry); (2) Mining (energy); (3) Contract Construction; (4) Manufacturing of durables and non-durables; (5) Transportation, Communications and Public Utilities; (6) Wholesale trade; (7) Retail trade; (8) Finance, Insurance and Real Estate (FIRE); and (9) Services. For this analysis, public sector employment is omitted. The occupational categories are (1) Professional, Technical, etc.; (2) Managers, Officials and Proprietors; (3) Sales Occupations; (4) Clerical Workers; (5) Craft and Related Workers; (6) Operatives; (7) Service Workers; (8) Laborers (except farm); (9) Farmers and Farm Workers.

Table 2, also maintained by the Bureau of Census, links education to occupational type for Kentucky. Forty percent of those classified as "farmers" have an eighth grade education or less, a far greater percentage than for laborers, service workers and operatives. College graduates dominate the professional and management categories, but sales, clerical and crafts workers tend to hold high school diplomas. Educational attainment categories include (1) 8th-grade education or less; (2) 1-3 years of high school; (4) high school graduate; (3) some but less than 4 years of college; and (4) 4 years of college or more. Lastly, we use Table 3, which shows the county-level employment by sector. This table is updated annually by the Bureau of Economic Analysis.

From Tables 1 and 2 we construct a matrix measuring the percent of jobs in each sector in each educational category for the state (Table 4). The state-level data are reproduced in Figure 1 (and reported for selected sectors later on in Table 6 to facilitate comparisons). Note from Figure 1 that 37.5 percent of those employed in the agricultural sector in Kentucky have an 8th-grade education or less, compared with only 20 percent in the mining and construction sectors, and slightly over 6 percent in the finance sector. Employment by college graduates is similarly skewed, with college graduates representing over 25 percent of the services sector employment, and over 15 percent of the finance sector employment. Unlike the other sectors, the agricultural sector exhibits a bimodal distribution, with peaks at 0-8 years and 12 years of education.

Now suppose that $P'_{u \times s}$ is defined as a matrix of dimension u counties (of a state) by s economic sectors, with element $[p_{us}]$ measuring the number of jobs in county u and sector s (see Table 3). Suppose further that $M_{c \times s}$ has dimension c occupation categories by s economic sectors as in P', with element $[m_{cs}]$ measuring employment by occupation and sector. Also, define $N_{c \times e}$ as having dimension c occupation categories (as in M) by e educational attainment levels, with element $[n_{ce}]$ showing employment by occupation and education. Then the total quantity of labor demanded, $D_l = \Sigma_s \Sigma_c \Sigma_e \, d_{sce}$, is the quantity demanded in sector s, occupation c and with educational attainment level e.

In equilibrium, D_l equals the quantity and quality of labor supplied in each sector and occupational category.

The first step is to calculate average state educational needs by sector, which is accomplished by transposing N and normalizing each element by its column sum ($\Sigma_e n_{ec}$) so that $n_{ec} \in N$ is the proportion of jobs of occupation c which require educational attainment e, and $\Sigma_e n_{ec} = 1$. Next calculate $Q_{e \times s} = N'M$, to obtain the state-level educational needs by sector matrix. Normalize each element of Q by its column sum so that $\Sigma_e q_{es} = 1$ and $q_{es} \in Q_{es}$ shows the proportion of jobs by sector requiring education level e (see Table 4). The matrix $\Omega_{e \times u} = Q_{e \times s} P_{s \times u}$ then yields the estimated educational demand of each county: row vector λ_s of matrix **P**, which measures the share of sector s in total employment of county u, is the weighting factor used to arrive at the educational requirement.

The final step is to estimate educational needs for each county by economic sector and occupation level. To do this, form the Kronecker product,[1] $M \otimes \mathbf{i}$, where **i** is the unit vector with dimension $1 \times e$. Partition the resulting matrix into s submatrices M_{1s}, each with dimension $c \times e$. For each submatrix, form the Hadamard product,[2] $B_s = N' * M_{1s}$ to estimate the number of jobs in each occupational and educational attainment category of sector s. The $\mathbf{B}_s$ matrices for each of the nine sectors of Kentucky are presented in Table 5. Similarly, educational requirements by occupation can be estimated for individual sectors of a county.

Results and Discussion

Educational attainment demands are presented for three different counties and the dominating sector of each county: the manufacturing sector of Hancock county; the agricultural sector of Bath county; and the services sector of Fayette county. Hancock county is located on the Ohio river, approximately 40 miles from Evansville, Indiana. County population (in 1987) was 8,100; the total number of jobs in the county is 5,136, of which 4,733 are in the private sector.[3] The major industry is an aluminum plant located in Hawesville, which attracts comparatively well-educated workers from surrounding counties. The county has several small towns, the largest of which has a population of approximately 1,800. Bath county, located in northeastern Kentucky and at some distance from any major cities, has approximately 950 farms consisting on average of 130 acres. The county's agricultural sector is diversified: products include corn and tobacco, and beef, dairy and hogs. Cash receipts from agriculture recently placed it 53rd among the 120 Kentucky counties. Its population is 10,200. Fayette County, with a population of 221,500, is a metropolitan county in which Lexington (the urban county government) and the main campus of the University of Kentucky are located.

The results are presented in Table 6. The first column pertains to Hancock county and shows, respectively, the estimated absolute number and proportion of jobs by occupation and educational attainment category for the county as a whole, as well as the estimated proportion of jobs in the same categories for the dominant sector (manufacturing), which are assumed to be the same as those at the state level. It should be stressed that the results for Hancock are probably more representative of the actual situation than would be the case if one were to examine Census micro-data. This is because many skilled workers commute into the county. Similarly, Census data would overestimate the educational demands of the counties surrounding Hancock to the extent that residents filling out the long form of the questionnaire did not work there. Results are also presented for Bath and Fayette counties in Table 6.

In Hancock county most jobs are held by operatives with 12 years of education (14.8%), followed by operatives with 8 years or less (8.0%). In the agricultural county (Bath), the preponderance of jobs is in farming with workers who have 8 years or less of high school (17.6%), followed by workers with a high school diploma (13.2%). In Fayette county, clerical workers with 4 years of high school make up the largest share of the job pool (9.4%), followed by professional workers with a college degree (8.6%).

Of particular interest for this paper are the educational requirement vectors reported at the bottom of the sub-tables. About one-quarter of the employment in Bath county as a whole is in the lowest educational attainment category. The proportion is 37.5% when only the agricultural sector is examined. In contrast, 6.7% of the jobs in the agricultural sector required a college degree.[4] Similarly, 15.1% of the jobs in Fayette county are in the highest educational attainment category, but that proportion rises to one-quarter of the jobs in the service sector. Not surprisingly, only 10.2% of the jobs in the service sector were filled by workers with less than an 8th-grade education.

An important finding is the fact the agricultural sector is an "employer of last resort" for those with minimal formal education. On the one hand this is beneficial to the extent that the uneducated workers, working mostly in the tobacco sector, might otherwise have been unemployable. On the other hand, the high proportion of uneducated workers in that sector suggests it is not highly progressive and innovative.

As indicated in the introduction, one concern of public policy in agriculture is how farmers obtain access to jobs in the non-farm sector. In order to maintain viable part-time farming operations, especially those including livestock, farmers must be able to commute to the place of employment. One immediate application of the procedure developed here is to estimate the educational demands of counties surrounding major farming areas. For a farmer with a specific educational level, this would indicate the feasibility of obtaining off-farm employment within easy commuting distance.

Conclusion and Further Applications

This paper presents a simple algorithm allowing analysts to estimate educational attainment demands at the level of individual counties and/or counties within a region. Obviously, the procedure could be taken one step(-down) further by disaggregating employment demands within sectors according to the local mix of industries. For example, data for manufacturing counties can be steppeddown further using knowledge of employment numbers and the educational demand of different manufacturing industries.

The data also have implications for the delivery of extension programs for farmers. For example, Kentucky farm-level data reveal that dairy and beef farmers are on average more educated than tobacco farmers. Technical information may have to be delivered in a different fashion depending on whether the intended audience holds a college degree or has less than eight years of formal education.

This information can assist in rural policy analyses that are concerned with the transition of farm families from the farm to the non-farm sector. To the extent that off-farm employment requires more than an eighth-grade education, more highly educated farmers will have the greatest opportunities for part-time or full-time off-farm employment. Also, to the extent that livestock farmers are better-educated, rural economic activity may be greater in livestock-farming areas than in major crop-producing areas, *cet. par.*

The procedure developed here can be applied at the state or regional level (such as Appalachia) to identify counties or sub-regions with especially low demands for educational attainment. These could then be listed as priority areas in long-term economic development programs. Similarly, low demand may reflect inadequate supplies of educational attainment, so that this information can be used to identify inadequate public school systems, which could receive particular attention in educational reform efforts. Low educational supply may also reflect low rates of return to educational attainment. As suggested in the introduction, individuals from rural areas who obtain college degrees often have difficulty finding employment in their rural areas, which may in turn retard local development initiatives.

Information on local educational supply and demand conditions that is generated using this method has immediate utility for firms attempting to decide whether or not to locate in a given rural county or region. More refined information could be generated through surveys once potential areas have been identified. On the other side, with knowledge of local educational supplies and the education-intensity demands of employers in different industries, local community leaders are in a better position of deciding which types of firms to attract to their particular areas, and which firms should therefore be offered different levels of incentives.

Historical series of educational attainment demands in different regions can be constructed using this procedure. Time series data could be useful in complementing traditional and dynamic shift-share analyses by revealing changes in educational demand that result from, or contribute to, major shifts in the spatial location of economic activity. Similarly, the data will allow dynamic analyses of rural labor markets to be refined in that information on the demand for educational qualifications of workers can be introduced into the analysis.

In addition to providing a historical perspective, the method presented here will be useful in forecasting. In particular, future educational needs of individual counties and regions within a state can be forecast based on knowledge about existing trends in different economic sectors. This will constitute an important input into long-range local economic development planning.

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Endnotes

1. If A is of dimension mxn and C is of dimension rxt, then the *Kronecker product* is defined as:

$$A \otimes C = \begin{bmatrix} a_{11}C & a_{12}C & \dots & a_{1n}C \\ a_{21}C & a_{22}C & \dots & a_{2n}C \\ \vdots & \vdots & & \vdots \\ a_{m1}C & a_{m2}C & \dots & a_{mn}C \end{bmatrix}$$

The resulting dimension of $A \otimes C$ is $mr \times nt$.

2. If $Z = \{z_{ij}\}$ and $Y = \{y_{ij}\}$ are two matrices of the same size, then the *Hadamard product* is defined as $Z*Y = \{z_{ij}y_{ij}\}$.

3. The relatively high proportion of jobs to county residents is due to commuting, as explained below.

4. Given the diversity of Kentucky agriculture, it would be desirable to present an educational requirements matrix for the agricultural sector which reflects the different levels of education of beef, grain and tobacco farmers (for example), as determined from farm-level surveys. That is beyond the scope of the present paper, however.

Table 1: Distribution of Employment by Occupation and Sector, Kentucky (1980)

Occupation	Agri-culture	Mining	Construc-tion	Manu-facturing	Sector Trans-portation	Wholesale Trade	Retail Trade	Finance	Service	Total Employment
Professional	1,563	1,963	2,829	22,182	7,649	2,467	7,238	5,583	151,629	203,103
Managers, etc.	344	1,806	4,118	14,556	6,604	5,764	19,643	8,053	29,809	90,697
Sales Occupations	201	149	766	7,523	2,310	13,459	84,573	15,120	6,483	130,584
Clerical Workers	905	2,975	4,103	31,595	25,421	11,032	21,350	30,625	80,573	208,579
Craft & Related	360	28,462	49,758	49,936	20,717	6,564	18,020	792	22,503	197,112
Operatives	485	16,455	11,196	154,884	30,525	10,329	8,274	466	17,429	250,043
Service Workers	524	1,145	594	8,819	2,528	935	45,741	2,836	112,613	175,735
Laborers	220	3,679	11,247	20,550	6,149	4,611	19,394	314	4,394	70,558
Farmers & Workers	56,364	40	96	1,977	121	98	235	442	2,262	61,635
Sector Employment	60,966	56,674	84,707	312,022	102,024	55,259	224,468	64,231	427,695	1,388,046

Source: Hackbart et al. (1987, p.162). Based on Census of the Population (Kentucky), U.S. Department of Commerce, Bureau of Census, 1980.

Table 2: Distribution of Employment by Occupation and Educational Attainment, Kentucky (1980)[a]

Occupation	Educational Attainment: 0-8 years of school		1-3 years of high school		4 years of high school		1-3 years of college		4 or more yrs of college		Column Total
Professional	4,372	2.1%	6,408	2.8%	35,603	6.5%	42,153	20.5%	117,609	59.4%	206,145
Managers, etc.	5,447	2.6%	7,307	3.2%	28,490	5.2%	19,086	9.3%	27,325	13.8%	87,655
Sales Occupations	11,023	5.3%	22,133	9.6%	56,066	10.3%	25,077	12.2%	16,285	8.2%	130,584
Clerical Workers	7,171	3.4%	18,225	7.9%	117,293	21.5%	49,243	24.0%	16,647	8.4%	208,580
Craft & Related	41,723	20.1%	38,632	16.7%	88,049	16.2%	21,573	10.5%	7,135	3.6%	197,113
Operatives	59,759	28.7%	58,648	25.3%	110,406	20.3%	17,689	8.6%	3,541	1.8%	250,044
Service Workers	37,784	18.2%	48,742	21.0%	63,161	11.6%	20,882	10.2%	5,166	2.6%	175,736
Laborers	16,336	7.9%	20,330	8.8%	27,479	5.0%	5,419	2.6%	944	0.5%	70,508
Farmers & Workers	24,466	11.8%	11,222	4.8%	18,351	3.4%	4,359	2.1%	3,237	1.6%	61,635
Empl. by Educ. Level	208,081		231,647		544,898		205,481		197,939		1,388,046

Source: Hackbart et al. (1987, p.72 and 168). Based on Census of the Population (Kentucky), U.S. Department of Commerce, Bureau of Census, 1980.
Note. a. Columns for each sector should sum to 100%. Errors are due to rounding.

Table 3: Kentucky County by Sectoral Employment Matrix ('000 Jobs); 1987 Data†

COUNTY	Agri-culture 1	Mines 2	Contract Constr. 3	Manu-factur. 4	Sector Trans-port 5	Whole-sale 6	Retail 7	Finance 8	Services 9	Total Priv. Jobs	Private & Publ. Jobs
1 ADAIR	2.080	0.080	0.384	1.155	0.184	0.103	0.856	0.130	1.369	6.341	7.154
2 ALLEN	1.518	0.038	0.192	1.548	0.159	0.069	1.177	0.251	0.510	5.462	6.127
3 ANDERSON	1.117	0.015	0.277	0.961	0.140	0.188	0.703	0.204	0.855	4.46	5.025
6 BATH	1.335	0.000	0.251	0.137	0.122	0.044	0.326	0.111	0.469	2.795	3.262
34 FAYETTE	5.451	0.821	10.187	17.657	6.682	6.589	29.178	12.360	42.939	131.86	159.574
46 HANCOCK	0.665	0.015	0.204	2.939	0.200	0.018	0.236	0.091	0.365	4.733	5.136
118 WHITLEY	0.529	0.837	0.573	1.350	0.827	0.563	2.704	0.499	3.635	11.517	13.236
119 WOLFE	0.597	0.084	0.060	0.339	0.121	0.030	0.247	0.022	0.192	1.692	2.073
120 WOODFORD	2.627	0.027	0.632	2.849	0.168	0.232	1.355	0.541	1.861	10.292	11.111

Source: Kentucky Economic Information Service, Data Base (CBER, University of Kentucky).
†. To conserve space, data are presented for only 9 of Kentucky's 120 counties.

Table 4: Estimated Educational Requirements by Sector (Matrix $Q_{x,}'$), Kentucky

Sector	0-8 yrs	1-3 yrs	4 yrs	coll	coll 4+	ROW TOTAL
	EDUCATION					
Agriculture	37.46%	17.78%	30.20%	7.86%	6.72%	100.00%
Mining	20.00%	19.98%	43.22%	10.98%	5.80%	100.00%
Construction	19.48%	19.74%	42.80%	11.54%	6.44%	100.00%
Manufacturing	18.62%	19.48%	42.32%	11.48%	8.10%	100.00%
Transportation	15.04%	16.78%	43.94%	14.36%	9.88%	100.00%
Wholesale	12.84%	16.50%	43.32%	16.06%	11.30%	100.00%
Retail	13.12%	18.64%	40.86%	16.24%	11.08%	100.00%
Finance	6.36%	11.38%	45.34%	21.08%	15.84%	100.00%
Services	10.16%	13.26%	33.80%	17.62%	25.16%	100.00%

Source: Calculated from Tables 1 and 2.

Table 5: Estimated Educational Requirement Matrices (B_s) by Sector and Occupation, Kentucky

Agric. Sector Requirements	0-8 yrs	1-3 yrs	4 yrs	coll	coll 4+
	EDUCATION				
Professional	0.06%	0.08%	0.44%	0.52%	1.46%
Managers, etc.	0.04%	0.04%	0.18%	0.12%	0.18%
Sales Occupations	0.02%	0.06%	0.14%	0.06%	0.04%
Clerical Workers	0.06%	0.12%	0.84%	0.36%	0.12%
Craft & Related	0.12%	0.12%	0.26%	0.06%	0.02%
Operatives	0.20%	0.18%	0.36%	0.06%	0.02%
Service Workers	0.18%	0.24%	0.30%	0.10%	0.02%
Laborers	0.08%	0.10%	0.14%	0.02%	0.00%
Farmers & Workers	36.70%	16.84%	30.20%	6.54%	4.86%
COLUMN TOTAL	37.46%	17.78%	30.20%	7.86%	6.72%

Service Sector Requirements	0-8 yrs	1-3 yrs	4 yrs	coll	coll 4+
	EDUCATION				
Professional	0.76%	1.10%	6.12%	7.24%	20.22%
Managers, etc.	0.44%	0.58%	2.26%	1.52%	2.18%
Sales Occupations	0.12%	0.26%	0.66%	0.30%	0.18%
Clerical Workers	0.64%	1.64%	10.60%	4.44%	1.50%
Craft & Related	1.12%	1.04%	2.36%	0.58%	0.20%
Operatives	0.98%	0.96%	1.80%	0.28%	0.06%
Service Workers	5.66%	7.30%	9.46%	3.12%	0.78%
Laborers	0.24%	0.30%	0.40%	0.08%	0.02%
Farmers & Workers	0.20%	0.10%	0.16%	0.04%	0.02%
COLUMN TOTAL	10.16%	13.26%	33.80%	17.62%	25.16%

Source: Calculated from Tables 1 and 2.
Note: To conserve space, data are reported only for the agricultural and services sectors (similar matrices have been constructed for the 7 other sectors).

Table 6: Estimates of County-Level Demands for Education; Hancock, Bath and Fayette Counties

	Hancock County					Bath County					Fayette County				
	Educational Attainment					Educational Attainment					Educational Attainment				
Occupation	0-8 yrs	1-3 yrs	4 yrs	coll	coll 4+	0-8 yrs	1-3 yrs	4 yrs	coll	coll 4+	0-8 yrs	1-3 yrs	4 yrs	coll	coll 4
	--------Proportions (all sectors)--------					--------Proportions (all sectors)--------					--------Proportions (all sectors)--------				
Professional	0.2%	0.3%	1.4%	1.7%	4.7%	0.2%	0.3%	1.5%	1.8%	5.1%	0.3%	0.5%	2.6%	3.1%	8.6%
Managers, etc.	0.3%	0.4%	1.5%	1.0%	1.5%	0.3%	0.3%	1.3%	0.9%	1.3%	0.5%	0.6%	2.4%	1.6%	2.3%
Sales Occupations	0.4%	0.7%	1.8%	0.8%	0.5%	0.5%	1.1%	2.8%	1.2%	0.8%	1.1%	2.2%	5.5%	2.5%	1.6%
Clerical Workers	0.4%	0.9%	6.0%	2.5%	0.9%	0.3%	0.8%	5.2%	2.2%	0.7%	0.6%	1.5%	9.4%	4.0%	1.3%
Craft & Related	3.1%	2.8%	6.5%	1.6%	0.5%	2.0%	1.8%	4.1%	1.0%	0.3%	2.6%	2.4%	5.5%	1.3%	0.4%
Operatives	8.0%	7.8%	14.8%	2.4%	0.5%	1.6%	1.6%	3.0%	0.5%	0.1%	3.0%	2.9%	5.5%	0.9%	0.2%
Service Workers	1.1%	1.4%	1.9%	0.6%	0.2%	1.7%	2.1%	2.8%	0.9%	0.2%	3.1%	3.9%	5.1%	1.7%	0.4%
Laborers	1.3%	1.6%	2.2%	0.4%	0.1%	0.8%	0.9%	1.3%	0.3%	0.0%	1.2%	1.4%	1.9%	0.4%	0.1%
Farmers & Workers	5.3%	2.4%	4.0%	1.0%	0.7%	17.6%	8.1%	13.2%	3.1%	2.3%	1.7%	0.8%	1.2%	0.3%	0.2%
Educational Requirements vector	20.0%	18.5%	40.0%	12.0%	9.5%	24.9%	17.1%	35.2%	11.9%	10.9%	13.9%	16.2%	39.2%	15.7%	15.1%
	-----Proportions (manufacturing only)----					-----Proportions (agriculture only)------					-------Proportions (services only)-------				
Professional	0.2%	0.2%	1.2%	1.5%	4.1%	0.1%	0.1%	0.4%	0.5%	1.5%	0.8%	1.1%	6.1%	7.2%	20.2%
Managers, etc.	0.3%	0.4%	1.5%	1.0%	1.5%	0.0%	0.0%	0.2%	0.1%	0.2%	0.4%	0.6%	2.3%	1.5%	2.2%
Sales Occupations	0.2%	0.4%	1.0%	0.5%	0.3%	0.0%	0.1%	0.1%	0.1%	0.0%	0.1%	0.3%	0.7%	0.3%	0.2%
Clerical Workers	0.3%	0.9%	5.7%	2.4%	0.8%	0.1%	0.1%	0.8%	0.4%	0.1%	0.6%	1.6%	10.6%	4.4%	1.5%
Craft & Related	3.4%	3.1%	7.1%	1.8%	0.6%	0.1%	0.1%	0.3%	0.1%	0.0%	1.1%	1.0%	2.4%	0.6%	0.2%
Operatives	11.9%	11.6%	21.9%	3.5%	0.7%	0.2%	0.2%	0.4%	0.1%	0.0%	1.0%	1.0%	1.8%	0.3%	0.1%
Service Workers	0.6%	0.8%	1.0%	0.3%	0.1%	0.2%	0.2%	0.3%	0.1%	0.0%	5.7%	7.3%	9.5%	3.1%	0.8%
Laborers	1.5%	1.9%	2.6%	0.5%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.2%	0.3%	0.4%	0.1%	0.0%
Farmers & Workers	0.3%	0.1%	0.2%	0.0%	0.0%	36.7%	16.8%	27.5%	6.5%	4.9%	0.2%	0.1%	0.2%	0.0%	0.0%
Educational Requirements vector	18.6%	19.5%	42.3%	11.5%	8.1%	37.5%	17.8%	30.2%	7.9%	6.7%	10.2%	13.3%	33.8%	17.6%	25.2%

Source: Calculated from Tables 1, 2 and 3 (see explanation in text).

Figure 1. Comparative Educational Requirements by Sector, Kentucky.