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IMPACTS OF SOCIOECONOMIC CHARACTERISTICS OF A REGION ON THE AVAILABILITY OF RESOURCES FOR PUBLIC EDUCATION*

David L. Debertin and John M. Huie

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Abstract

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This study examines the impacts of socioeconomic characteristics of a region on the availability of resources for public elementary and secondary education. A public school administrator is assumed to be confronted with a management problem analogous to that confronted by any other firm manager. An administrator allocates available tax dollars among alternative uses within the school system. For example, an administrator makes choices as to whether funds should be allocated to reduce pupil/teacher ratios, increase average salaries of teachers, or increase the number of available course offerings. It is argued that the socioeconomic characteristics of people in the region (district) surrounding the school have not only an impact on the total dollars available to fund local schools, but also influence the internal allocation of funds within the school.

An empirical analysis of data for 269 Indiana school districts is conducted. The analysis reveals that family income levels of residents in the region is a primary factor influencing the level of teachers salaries. Property values are primarily related to pupil/teacher ratios. Communities in regions where a high proportion of the residents have graduated from college tend to have schools in which a high proportion of the teachers hold Masters, rather than Bachelor's degrees. Experienced teachers tend to be found in regions where a large proportion of the population is over 65. Elasticities of demand for school resources are calculated. Implications of the findings are discussed in relation to recent court cases dealing with the constitutionality of funding public schools with a local property tax.

David L. Debertin is Assistant Professor, Department of Agricultural Economics, University of Kentucky. John M. Huie is Associate Professor, Department of Agricultural Economics, Purdue University.

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This study examines the impacts of socioeconomic characteristics of a region on the availability of resources for public elementary and secondary education. Recent court cases dealing with the constitutionality of funding schools with a local property tax have focused public attention on factors influencing the availability of resources or inputs to elementary and secondary education.[1] The analysis presented in this paper examines the extent to which the value of property (assessed valuation) and other social and economic characteristics of the residents in a region (school district) are related to measures of school inputs. School inputs are characteristics of a public school often believed by the public to be related to the educational opportunities provided within the school. The analysis reveals that the value of property per pupil within the district is not the sole determinant of the availability of school inputs. Rather, the availability of inputs used within the educational process occurring in a public school is to a large extent influenced also by socioeconomic variables other than assessed valuation.

A Theoretical Model

A public school administrator is assumed to be confronted with a management problem analogous to that confronted by the management of any other firm. During a school year, an administrator has available to him a fixed amount of tax dollars from federal, state and local sources. Given a fixed amount of tax dollars an administrator has a degree of control on the allocation of these funds. Hence, school inputs can also be thought of as administrative policy variables over which the school administrator exerts control by choosing the amount of money to be spent on each input.

A large number of studies have been conducted relating levels of school inputs to alternative outputs of the educational process.[2] Outputs most often used in these studies have consisted of scores on standardized tests of achievement. "Traditional" educational production functions used in these analyses have been similar to the following:

$$(1) \quad Q_j = Q_j(x_1, \ldots x_k, x_{k+1}, \ldots x_p; y_1, \ldots y_m; z_1, \ldots z_n)$$

Where:

Q_j = measurement on the jth output dimension of educated students. For example, scores on a standardized test of achievement

$(x_1, \ldots x_k, x_{k+1}, \ldots x_p)$ = a vector of school inputs. Variables $x_1, \ldots x_k$ consist of policy variables that are *under the control of the school administrator*. Variables $x_{k+1}, \ldots$

x_p consist of variables outside the control of the administrator such as peer group influences.

$(y_1, \ldots y_m)$ = a vector of socioeconomic and (perhaps) other variables believed to affect a students motivation and interest in doing school work. These variables are assumed to affect the output dimension, but are normally *outside the control of the local school administrator.*

$(z_1, \ldots z_n)$ = one or more measurements on the innate genetic ability of the student

The total differential (1) yields the following equation:

$$(2) \quad dQ_j = \sum_{i=1}^{p} \frac{\partial Q_j}{\partial x_i} \cdot dx_i + \sum_{i=1}^{m} \frac{\partial Q_j}{\partial y_i} \cdot dy_i + \sum_{i=1}^{n} \frac{\partial Q_j}{\partial z_i} \cdot dz_i$$

where:

dQ_j = the total change in output

$\sum_{i=1}^{p} \frac{\partial Q_j}{\partial x_i} \cdot dx_i$ = the influence of school inputs on the jth output measure

$\sum_{i=1}^{m} \frac{\partial Q_j}{\partial y_i} \cdot dy_i$ = the influence of socioeconomic variables on the jth output measure

$\sum_{i=1}^{n} \frac{\partial Q_j}{\partial z_i} \cdot dz_i$ = the influence of innate genetic ability on the jth output measure

The underlying assumption of these studies-that the school administrator allocates tax dollars in order to maximize achievement on standardized tests-is quite generous. First, there is no widespread agreement that administrators do attempt to maximize achievement scores on standardized tests. Further, even if a school administrator did decide to attempt to maximize achievement on a standardized test(s), the administrator is usually unaware of the appropriate allocation of tax dollars among alternative school inputs required to maximize a test score.

If the school administrator is not allocating tax dollars based on the maximization of a(n) output(s) such as a score on a standardized test of achievement, it might be argued that the administrator has no basis for making the allocative decisons. However, the administration of a local public school does not operate in a vacuum, and forces do exist which act to influence the allocative decisions made by the local school administrator. Administrators of public schools are, of course, hired by the school board. Whether elected or appointed, school board members undoubtedly reflect the needs and wishes of residents in the community. The school administrator who does not allocate funds within the local public school in keeping with the wishes of the school board will not long retain his position.

Consequently, from the model of school administrator behavior, two assumptions are incorporated into the analysis that follows:

1. The allocation of funds among alternative inputs within the local school is based not on the maximization of quantifiable outputs, but rather on the desires of residents in the community, and

2. Socioeconomic characteristics of the community measure community preferences in the allocation of funds within the local school.

Since it has been argued that the school administrator allocates inputs based on the desires of residents in the community as measured by the socioeconomic characteristics of the community:

$$(3) \quad x_i = x_i(y_1, \ldots y_m)$$

$$i = 1, \ldots k$$

The total differential of (3) yields:

$$dx_i = \sum_{j=1}^{m} \frac{\partial x_i}{\partial y_j} \cdot dy_j$$

$$i = 1, \ldots k$$

Estimates of the $\frac{\partial x_i}{\partial y_j}$ were derived from OLS estimates of the parameters of (3). Finite changes in the y_j (Δy_j) were assumed in order to estimate the resultant impacts of socioeconomic variables within the local public school.

The School Inputs

Eight measures of school inputs under the control of school administrators were considered in the subsequent analysis. Data on the various school inputs were provided from records of the Indiana Department of Public Instruction for Indiana school districts during 1970-71. The measures are as follows:

Pupil/Teacher Ratios. The pupil/teacher ratio represents a key school input over which the school administrator exerts direct control. Reductions in the pupil/teacher ratio are extremely costly. The pupil/teacher ratio is closely linked to the level of per pupil expenditure within a public school. Assuming non-salary instructional expenditures within a school district to be zero the following equations hold true by identity:

$$(1) \quad PPE = S * P/T$$

where:

PPE = per pupil expenditures for instruction

S = average salary of teachers in the school

P = number of pupils in the school

T = number of teachers in the school

Equation (1) holds because:

$$(2) \quad PPE \cdot P = S \cdot T$$

Differentiating (1) with respect to P/T yields

$$(3) \quad \frac{\partial PPE}{\partial P/T} = \frac{-S}{(P/T)^2}$$

PPE varies inversely as the square of P/T. Hence, substantial reductions in per pupil expenditures for instruction can be achieved by slightly increasing the pupil/teacher ratio if the school district is initially operating at a very low pupil/teacher ratio. However, only modest reductions in per pupil expenditures for instruction can be achieved if the school district is initially operating at a relatively large pupil/teacher ratio.

Course Offerings. Educators have argued that a "quality" education meets the needs of the individual student. One way for the school system to meet the needs of the student is to provide for a wide variety of courses at the secondary level. For high schools with large enrollments, the cost of adding a course may be minimal. Sections of existing courses need merely be combined and teachers reassigned to new course without operating at an extremely low (and therefore costly) pupil/teacher ratio. A "course offering" as used in the analysis was defined by the Indiana Department of Public Instruction. Different sections of the course are treated as the same course.

Proportion of Teachers with a Graduate Degree. State departments of public instruction have established minimum training requirements for public school teachers. Laws in most states provide that no person may receive a permanent teaching license without having at least completed a bachelors degree. A state law passed in the mid 1960's requires that all new public school teachers licensed in the state of Indiana receive a masters degree within five years. In spite of this law, substantial variation exists among Indiana school districts in the proportion of teachers holding graduate degrees. Administrators of public schools no doubt vary in their willingness to hire replacement teachers that hold advanced degrees. This willingness is presumed to be conditioned by the socioeconomic characteristics of the community.

Salary Differentials for Advanced Degrees. The local school administrator can seek to increase the proportion of teachers holding masters

degrees in the school district by raising salary increments or differentials that the school district is willing to pay for a graduate degree. The extent to which a school administrator can raise increments for advanced degrees is again presumed to be largely determined by the socio-economic characteristics of the community.

Mean Experience Level of Teachers. It is widely believed that, *ceteris paribus*, experienced teachers are better teachers than inexperienced teachers. Administrators of public schools who wish to increase the mean experience level of teachers in the district can attempt to hire experienced rather than inexperienced teachers as replacements. Further, the administrator can reduce teacher turnover rates, so that few new teachers need to be hired each year.

Salary Differentials for Experience. One way in which the school administrator can seek to reduce teacher turnover rates is by increasing the increment or salary differential that the school district is willing to pay for each additional year of experience.

Base Salary Levels. School administrators who wish to hire the best qualified beginning teachers may need to offer higher base, on starting salaries than do school administrators who are less selective.

Mean Salary Levels. Base salaries, salary differentials for training and experience, average training and experience levels are linked through a school district's salary schedule. Local residents are no

doubt concerned that average salaries of teachers not be out of line in relation to incomes of other comparatively trained and experienced people in the community. It is widely believed that high average salaries attract the competent teachers.

Socioeconomic Variables

Socioeconomic characteristics of residents in the school district act as measurements of the desires of the residents in the allocation of tax dollars within the local public school. Data on socioeconomic variables consist of information for individual school districts, not city or county averages. Township data from the 1970 census were aggregated for school districts.[3] Data on per pupil assessed valuation and enrollment levels were obtained from the Indiana Department of Public Instruction for 1970-71.

Assessed Valuation. In Indiana and in most other states, the bulk of the tax revenue for local schools continues to be raised from the local property tax. The basic limitation in tax dollars imposed on the local school administration can be represented by the amount of assessed valuation backing each pupil in the district.

Family Income. It is anticipated that schools in high income areas would tend to (a) operate at low pupil/teacher ratios, (b) offer a wide variety of courses, (c) have teachers that are highly trained and experienced, (d) pay large base salaries and salary differentials for training

and experience, and (e) have relatively large average salary levels. High incomes allow residents to pay high taxes associated with large expenditures for public education.

Percent of Persons Over 25 that Graduated from College. Anticipated results are the same as for family income. Parents who are college graduates may be particularly concerned that their children are taught by teachers who hold graduate degrees.

Percent of Persons Over 65. Schools in communities where a high proportion of the population is over 65 might be expected to (a) operate at relatively high pupil/teacher ratios, (b) have few teachers holding graduate degrees, and (c) have relatively low salaries. Persons over 65 are expected to be disinterested in the kind of education offered by the local public school and interested in keeping tax rates low.

Enrollment. The enrollment of the school district is usually not thought of as a socioeconomic characteristic of a community. However, enrollment is expected to be a major determinant of pupil/teacher ratios and the availability of course offerings.

Empirical Results

Each of the school inputs was viewed as a function of assessed valuation, enrollment and other socioeconomic characteristics. All Indiana districts were included for which data were complete. There are 315 districts in Indiana. Equations for estimating pupil/teacher ratios

and course offerings used enrollment data for individual plants (buildings). Remaining equations used enrollment for the entire district. Each equation was estimated using OLS procedures. Simple linear firms were estimated, there being no overriding theoretical reason to choose another form.

Results are presented in Table 1, while Table 2 gives the estimated impact of a standard deviation increase in each socioeconomic variable. R^2 values for all equations range from low to moderate. High R^2 values would not be anticipated, given the large sample sizes and the cross sectional data.

Assessed Valuation

School districts with high assessed valuation operate at low pupil/teacher ratios. Average per pupil assessed valuation in Indiana is approximately 10,000 dollars. Evidence indicated that an increase in assessed valuation of one standard deviation ($4,426) results, *ceteris paribus*, in a reduction in pupil/teacher ratios of .71 students at the elementary level and .62 students at the secondary level.

Average salaries in schools with high assessed valuations tend to be higher than in schools with low assessed valuations. One standard deviation increase in assessed valuation, *ceteris paribus*, results in a 183 dollar increase in average salaries. Other evidence indicates that the primary reason why schools with high assessed valuations have higher mean salary levels than do other schools is because schools with high assessed valuation pay large salary differentials for experience - one standard deviation increase in assessed valuation results in a $9.34

Table 1. Factors influencing the Availability of School Inputs, Indiana, 1970-71 School Year[a]

	Dependent Variables	Assessed Valuation Per Pupil in District	Mean Family Income	Percent of Persons Over 25 That Graduated From College	Percent of Total Population Over 65	Enrollment[b]	Intercept	R^2	F	N
		Independent Variables								
1.	Pupil/Teacher Ratio, Elementary Level	-.00016*** (3.20)	-.00037*** (2.85)	-.02266 (1.17)	.13370*** (2.02)	.00740*** (10.57)	27.12	.16	27.09	967
2.	Pupil/Teacher Ratio, Secondary Level	-.00014*** (3.50)	-.00050*** (2.96)	-.01196 (0.48)	-.07620 (1.04)	.00183*** (6.78)	27.03	.12	12.56	325
3.	No. of Courses Offered in the High School	.00017* (1.31)	.00195*** (3.36)	-.03789 (0.43)	-.45920** (1.78)	.01605*** (16.89)	30.21	.64	111.39	325
4.	Proportion of Classroom Teachers With a Graduate Degree	.00030** (1.74)	.00180*** (2.41)	.5487*** (3.71)	1.0439*** (3.10)	.00036*** (2.23)	3.85	.21	13.88	269
5.	Mean Experience Level of Classroom Teachers	.00002 (0.98)	-.00042*** (3.82)	.03363** (1.71)	.24598*** (3.01)	.00004*** (2.75)	11.20	.32	24.24	269
6.	Mean Salary of Classroom Teachers	.04143*** (5.85)	.12008*** (3.93)	8.9458* (1.48)	21.039* (1.52)	.03422*** (8.09)	6808.26	.41	36.15	269
7.	Base Salary from Salary Schedule	.01206* (1.34)	.06389*** (2.16)	-10.47* (1.37)	20.309 (1.16)	.00987** (1.84)	5820.06	.04	2.39	269
8.	Salary Differential For Experience (From Salary Schedule)	.00211*** (3.05)	.01701*** (5.68)	.0691 (0.12)	-1.94* (1.37)	.00085*** (2.07)	18.02	.34	27.37	269
9.	Salary Differential for an Advanced Degree (From Salary Schedule)	.00175 (0.63)	-.00765 (0.64)	7.8459*** (3.34)	-10.468** (1.95)	.00531*** (3.24)	638.81	.13	8.19	269

[a] Student's t ratios in parenthesis
***Statistically significant at the .05 level, two tailed test
**Statistically significant at the .10 level, two tailed test
*Statistically significant at the .20 level, two tailed test

[b] Enrollment figures for equations 1, 2, and 3 were for the individual school plant. Enrollment in the remaining equations was the district total.

Table 2. Impact of a One Standard Deviation Increase in Socioeconomic Variables on School Inputs, Indiana Public Schools, 1970-71

y_i / x_i	Pupil/Teacher Ratio, Elementary Level	Pupil/Teacher Ratio, Secondary Level	No. of Courses Offered in the High School	Proportion of Classroom Teachers With A Graduate Degree	Mean Experience Level of Classroom Teachers	Mean Salary of Classroom Teachers	Base Salary (From Salary Schedule)	Salary Differential For Experience, (From Salary Schedule)	Salary Differential For An Advanced (From Salary Schedule)
Assessed Valuation Per Pupil in the District	-0.71 pupils	-0.62 pupils	0.75 courses	1.33 percent	0.09 yr.[a]	$183.37	$ 53.37	$ 9.34	$ 7.75[a]
Mean Family Income	-0.60 pupils	-0.81 pupils	3.16 courses	2.91 percent	-0.68 yr.	$194.33	$136.90	$27.55	$12.39[a]
Percent of Persons Over 25 That Graduated from College	-0.14[a] pupils	-0.07[a] pupils	-0.23[a] courses	3.46 percent	0.23 yr.	$ 56.35	$-65.93	$ 0.43[a]	$49.50
Percent of Population Over 65	0.41 pupils	-0.23[a] pupils	-1.41 courses	3.22 percent	0.75 yr.	$ 64.60	$ 62.55[a]	$ 5.67	$-32.24
Enrollment	1.62 pupils	1.23 pupils	10.80 courses	2.74 percent	0.30 yr.	$257.91	$ 74.39	$ 6.41	$40.02

[a]Calculated from a regression coefficient nonsignificant at the .20 level.

increase in the size of the increment for experience. Even though this was the case, evidence was not sufficient to support the belief that experienced teachers tend to be found in high assessed valuation districts.

There was weak evidence to support the belief that schools with high assessed valuations offer more courses, pay higher starting salaries and have slightly greater proportion of teachers with graduate degrees than do other schools. Estimated changes occurring as a result of one standard deviation increase in assessed valuation would result in the offering of .75 additional courses in the high school, a $53.37 increase in base salaries, and a 1.3 percent increase in the proportion of teachers with advanced degrees. Relationships are not strong, and need to be interpreted with caution. The coefficient on assessed valuation in the degree equation (Equation 4) was particularly sensitive to slight changes in the specification.

Family Income

Relationships found between school inputs and family income were largely consistent with *a priori* expectations. The simple correlation coefficient between family income and assessed valuation was estimated at .02 for the 269 school districts. Thus, evidence for Indiana does not support the contention by plaintiffs in Rodriguez that the funding of public schools with a local property tax discriminates against the poor. From a statistical standpoint, the low degree of correlation between family income and assessed valuation means that variation in school input levels explained by family income could not also be attributed to assessed valuation.

Available evidence indicates that one standard deviation increase in average family income ($1,620) results in a decrease in the pupil/teacher ratio of .6 pupils at the elementary level and .8 pupils at the secondary level. *Ceteris paribus*, the same standard deviation increase in family income will result in 3.2 additional courses offered in the high school. One standard deviation increase in family income will result in a 2.9 percent increase in the proportion of teachers holding graduate degrees. Base salary levels would be increased by $136. Mean salaries will be increased by $194.

A major finding is that experienced teachers tend to be found in low not high income communities. One standard deviation increase in family income would result in a decrease in the average experience level of .68 years for teachers within the local public school. This may be due to out-migration in low income areas.[4] Other findings (Equation 8) reveal that schools in high income areas pay higher salary differentials for experience than do other schools. A one standard deviation increase in family income would increase the increment for experience by $27.55.

Persons Graduating from College

Findings largely supported the hypothesis that teachers holding graduate degrees tend to be found in communities where a high proportion of the population had graduated from college. One standard deviation increase in the percent of persons in the community that graduated from college (6.31 percent) results in an increase in the percentage of teachers holding graduate degrees of 3.46 percent. The same standard

deviation increase results in an increase in salary differentials paid for an advanced degree of $49.50. Teachers in communities where a high proportion of the population graduated from college also tend to be more experienced than those in other schools. There is weak evidence to support the belief that mean salary levels are higher in communities with a high proportion of college graduates than in other communities. The sign on the coefficient in the base salary equation (Equation 7) suggests that administrators of schools in communities where a high proportion of the population has graduated from college have large "pools" of available teachers, and need not pay high starting salaries in order to attract teachers from other areas. Remaining coefficients were nonsignificant.

Population Over 65

The key finding is the relationship between the percent of population over 65 and the experience of teachers. Experienced teachers tend to be found in communities where a high proportion of the population is over 65. Net out-migration may be the underlying cause.

Indiana law requiring that all teachers obtain a masters degree may be the reason why teachers in communities where a high proportion of the population is over 65 also tend to hold advanced degrees (Equation 4). The law forces experienced teachers found in these communities to obtain a graduate degree. Salary differentials for both experience and an advanced degree are lower for schools in communities in which a high proportion of persons are over 65. Yet, these are the schools that, *ceteris paribus*, have the best trained and experienced teachers. Mean salaries are higher in these communities than in other areas because

teachers are, on the average, relatively high on the salary schedule. Pupil/teacher ratios tend to be high, and fewer courses tend to be offered in schools located in communities where a large percentage of the population is over 65 than in other communities.

Enrollment

Relationships between enrollment and the school inputs were largely as hypothesized. Each 100 students added to an elementary plant results in an increase in the pupil/teacher ratio of .74 units. At the secondary level, a similar increase in enrollment will result in an increase in the pupil/teacher ratio of .18 units. Enrollment is the major determiant of the availability of courses at the secondary level. One hundred additional students allows a high school to offer 1.6 additional courses. Teachers in school districts with large enrollments (a) hold more graduate degrees, (b) tend to be more experienced, (c) receive larger salary increments for an additonal year of experience and an advanced degree, (d) are paid higher starting and average salaries. Undoubtedly these relationships reflect almost entirely rural - urban differences in Indian public schools.

Estimates of Elasticities

Elasticities calculated about the mean for school inputs are presented in Table 3. All of the elasticities are somewhat less than 1. Income elasticities tended to be largest in absolute value. A one percent increase in family income levels in the school district would result

Table 3. School Input Elasticities, Indiana Public Schools, 1970-71[a]

x_i	y_i	Pupil/Teacher Ratio, Elementary Level	Pupil/Teacher Ratio, Secondary Level	No. of Courses Offered in the High School	Proportion of Classroom Teachers With A Graduate Degree	Mean Experience Level of Classroom Teachers	Mean Salary of Classroom Teachers	Base Salary (from Salary Schedule)	Salary Differential for Experience (from Salary Schedule)	Salary Differential for an Advanced Degree (from Salary Schedule)
Assessed Per Pupil Valuation in the District		-.062	-.068	.011	.088	.024[b]	.047	.017	.104	.030
Mean Family Income		-.158	-.243	.324	.529	-.421	.142	.124	.879	-.140[b]
Percent of Persons Over 25 that Graduated from College		-.010[b]	-.056[b]	-.046[b]	.146	.034	.010	-.014	.003[b]	.129
Percent of Total Population Over 65		.060	-.037[b]	-.075	.307	.249	.025	.030[b]	-.095	-.191
Enrollment		.116	.083	.246	.062	.016	.016	.006	.017	.038

[a]Values in the table are the $\frac{\partial y_i}{\partial x_i} \cdot \frac{x_i}{y_i}$ calculated at the mean.

[b]Regression coefficient from which the elasticity was computed was nonsignificant at the .20 level, 2 tailed test.

in only a .142 percent increase in mean salary levels, but a .879 percent increase in salary differentials for experience. School input elasticities with respect to assessed valuation and enrollment tended to be extremely small.

Concluding Comments

The analysis revealed that socioeconomic variables other than the value of property have more to do with the availability of inputs within local schools than do property values. If the desired objective of policy makers is to equalize the availability of school inputs among districts, it is clear that the abandonment of the local property tax as a source of revenue will not necessarily achieve the policy objective. Clearly, forces exist which act to determine the availability of school inputs that are totally outside the control of the policy maker. Of particular interest was the high degree of relationship found to exist between school inputs and family income levels.

Complete equality in the availability of school inputs among districts will probably never be achieved, nor is complete equality even desirable. Given the present state of our knowledge of the relationships between school inputs and measurable outputs, it is appropriate that substantial diversity in the allocation of tax dollars among school inputs continues to exist. It is only through this diversity that we can hope to identify allocations of tax dollars that do lead to increased student performance.

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Footnotes

*David L. Debertin is Assistant Professor of Agricultural Economics at the University of Kentucky. John M. Ihnie is Associate Professor of Agricultural Economics at Purdue University.

[1]See, for example [8, 11, 14, 16, 19].

[2]See, for example [1, 2, 3, 4, 5, 6, 9, 10, 12, 13, 15, 17, 18, 20, 22, 23].

[3]Data were taken from [21].

[4]These findings are summarized in [7, pg. 23].