# Who Should Teach in Pennsylvania's Public Schools?

## Modeling Teacher Supply and Demand, Curricula, & High School Seniors' Post-secondary Educational Plans

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## Preface

This is the third in a series of monographs on public education in Pennsylvania which I have developed at the Center for Public Financial Management. The earlier studies [1] dealt first with measuring the differential access to advanced science and mathematics courses among secondary schools in Western Pennsylvania, and then developing alternative strategies which might improve access to such courses for poorer, smaller and more remote school districts.

This monograph, much more ambitious in scope and purpose, examines the adequacy of Pennsylvania's teachers across all grade levels, the ability of the State's various teacher certification programs to meet evolving teacher needs in the remainder of the decade, and the determinants of students' post-secondary educational plans. It does so within the context of Pennsylvania's *system* of public education.

The project could not have been accomplished without the interest and support of many institutions and individuals throughout Pennsylvania.

The Pew Charitable Trust provided a generous grant during 1990-3 which supported the research, and which built on an earlier seed grant from the Pennsylvania Department of Education. Robert Schwartz and Ellen Wert of the Pew Charitable Trust were not only very patient program officers, they also provided continuing interest, encouragement, and sympathy for the study's ambitious goals.

Dr. Robert Feir, former Executive Director of the Pennsylvania Board of Education, was instrumental in inaugurating this project under the auspices of the State in 1988. The late Walter Geisey, Governor Robert Casey's executive policy assistant, encouraged me in conjunction with the Pennsylvania Department of Education to examine in depth these important policy problems, both to determine their nature, and suggest ways in which the Commonwealth might address them in the remainder of the decade.

Within the Pennsylvania Department of Education, a number of individuals assured the project's steady progress. Dr. Peter Garland, Director of the Bureau of Post-Secondary Services, organized support for this project, and ensured that the Department's vast, machine-readable archives were made available. Rodger Hummel, Chief of the Division of Data Services, and Denny Shomper, Chief of the Division of Systems Development, helped me to understand over the years of this project the transmitted data.

Special thanks go to Mr. John Senier, Research Associate at the Office of Post-Secondary Services, for his patience in helping me to understand Pennsylvania's public education system, and his extensive knowledge of the various data, its problems, and pitfalls, which are analyzed in this study. I hope that this statistical excavation of the Department's archives provides some new insight into the evolution of Pennsylvania's system of public education over the last decade, as well as provide recommendations which can inform public policy.

The project also benefited from extensive conversations with many local school officials across the State. Discussions with the personnel directors of the Philadelphia and Pittsburgh School Districts, Mrs. Connie McCalla and Mrs. Lee Nicklos, respectively, helped me to understand the

[1] See **The Mon-Valley Education Consortium: Improving Access to Science and Math**, (Pittsburgh, Pennsylvania: Center for Public Financial Management, School of Urban and Public Affairs, May 1989), and **Establishing High School Advanced Science and Math Centers: A Feasibility Study for Allegheny Intermediate Unit 3**, (Pittsburgh, Pennsylvania: Center for Public Financial Management, School of Urban and Public Affairs, June 1990).

challenges which the two largest urban school districts face in recruiting and retaining teachers. I also benefited from extensive conversations with Dr. Dorothy Walsh, Deputy Superintendent of Baldwin-Whitehall, and Mr. J. Paul Mueller, Assistant Superintendent of Elizabeth-Forward, about the practicalities of finding and reassigning certificated teachers in a changing fiscal and economic environment.

Mr. James Perry, Executive Director of the School Employees' Retirement System, and Yvonne C. Wineholt, Assistant Director of the Bureau of Fiscal Control, also assisted the project by making available data on retirees both inside and outside of Pennsylvania.

At Carnegie-Mellon University, Dr. Harry Faulk, Associate Dean for Executive Education and former superintendent of several Western Pennsylvania school districts for better than 25 years, has been most generous over the years in explaining the theory and practice of Pennsylvania public education.

Professor William Cooley of the Learning Research and Development Center of the University of Pittsburgh also provided stimulating comments on this project as it progressed over the past several years.

Professor Peter Schmidt of Michigan State University was most helpful in discussing the econometric issues which arose in the estimation of the retirement and quit decisions, and the projection of retirements and quits in chapters seven and eight.

This project was completed while on sabbatical at the University of Rochester in 1992/3. The Departments of Economics, Political Science, the Program in Public Policy, and the H. Alan Wallis Institute of Political Economy provided a hospitable and intellectually fertile climate in which to pursue and complete this research. Eric Hanushek, chairman of the Department of Economics and director of the Wallis Institute, was especially helpful in providing encouragement, discussing a wide variety of educational research issues with me, and improving the focus and relevance of the analysis reported below.

Finally, this project could not have been accomplished without the continuing computational support of the Center for Public Financial Management. Stuart Hiser, Systems and Facilities Manager of the computing center, cheerfully imported and interpreted the numerous data tapes provided by the Department of Education. Not only did he develop the simulation models of the project, but he maintained a calm through several fearful periods when we lost our hard disks on the Center's Vaxes. During the project, he and I wrote and ran over 3,600 separate computer programs to analyze the teacher, student, and district data. Finally, Jennifer Heid, and Kathy Nee, at Carnegie-Mellon, and Anita Hattiangadi, Shelley Staples and Nicole Oleske at Rochester, provided expert research assistance over the life of this project, and cheerfully helped produce this complex document with its nearly 100 tables and graphs.

While many have provided their assistance to this study, as is customary, I must take final responsibility for its views, findings, and any errors.

Robert P. Strauss
August, 1993
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# Chapter 1

# Introduction

## 1.1 The Issue of Teacher Supply and Demand

National data on public school enrollments indicate that they reached their minimum in the fall of 1984 at 39,208,000, and are projected to grow to 46,539,000 by the fall of 2000.[1]; this growth represents a peak-to-trough ratio of 1.18. Pennsylvania public school enrollments reached their minimum in 1989 when enrollment was 1,621,000, and are predicted to grow to 1,778,766 by the fall of 2000.[2]; this represents a peak-to-trough ratio of 1.10. Not only has total public school enrollment begun growing both nationally and in Pennsylvania, but the *age* composition of enrolled students is rapidly changing; there will be relatively more secondary school students by the close of the century than there are today.

Such changes in student demographics are mirrored by changes in teacher demographics. Both nationally and in Pennsylvania, the average age and experience of classroom teachers has been rising steadily, and questions have been raised about whether there is now, or is going to be a shortage or oversupply of public school teachers in the balance of the decade. States with rapidly growing populations are facing rather different problems than states with a stable but aging population, and as a result, the issue of possible surplus or shortage depends heavily on the geographic area in question. This is as true within each state as it is among states. In Pennsylvania, more counties lost population between 1980 and 1990 than gained population. East of Harrisburg, population generally increased, while west of Harrisburg, population generally decreased between 1980 and 1990.

Both the shifting composition and level of student enrollment have implications for staffing needs in Pennsylvania's public schools. The projected relative movement of primary school students to secondary school suggests that districts will be increasingly looking for more specialized secondary school teachers. As current teachers become older, retirement will become more likely which in turn will accelerate districts' search for various teaching skills.

For districts, regions, and the Commonwealth as a whole, the way in which these complex demographic pressures interact may lead to possible shortages and surpluses of particular teaching skills across time. The implications of a shortage of classroom teachers to parents, children and school districts are increasing class size, fewer elective offerings, and possibly rising salaries and

[1] Table 3, National Center for Educational Statistics, **Digest of Education Statistics: 1991**

[2] See Chapter 5 for a further discussion of historical student and teacher demographics at the state and regional levels.

budgetary outlays as school districts bid against each other in order to hire classroom teachers; the effects of an excess supply of teachers could readily be the reverse: smaller class sizes, more elective offerings, and stable teacher salaries. Ultimately, student performance will be affected by the educational choices made by districts.

Of course, many factors will determine either the presence or the absence of a shortage beyond student and teacher demographics: the financial condition of individual districts which reflects both the economic position of the district's residents and the economic position of the state, choices by individuals over time to either enter, remain in, or not enter the teaching profession, and the limitations imposed on the hiring process by state law and local collective bargaining agreements all affect the nature of Pennsylvania's teachers.

In the fall of 1987, I began a series of discussions with state officials to explore the possibility of examining these questions at Carnegie-Mellon through the demographic and economic analysis of the State's machine-readable archives on teachers, enrollment, curricula, and students' post-secondary educational plans. At the time, there was significant concern that many of Pennsylvania's school districts were having difficulty hiring sufficient numbers of physics, chemistry, and computer science teachers, and concern that the ability to offer these and other courses might affect educational outcomes. This monograph reflects the result of several years of intensive examination of a wide variety of data to answer these fundamental questions, and to inform state public policy in these areas.

## 1.2 Focus and Goals of this Study

The research reported below is a statistical policy essay which seeks to document the implications of changing student and teacher demographics on the educational process, the effects of economic incentives on the decisions to either become a teacher, retire or quit teaching, and the effects of curricula and other factors on students' post-secondary educational plans.

These general objectives are achieved through the development of a series of empirical models based on the administrative records of the Commonwealth. More specifically, the study seeks:

1. to develop a model of the classroom hiring decision which can be applied at the district, region, and state levels of aggregation and which takes into account:
    - likely changes in student demography at the district level;
    - the nature of classroom teachers' retirement, and voluntary quit decisions;
    - current curricula, and both teacher certification and graduation requirements;
2. to analyze the nature of teacher supply in terms of:
    - the number of newly trained teachers from Pennsylvania's certificate granting institutions and their certification areas;
    - the effects of economic incentives on the decision to become a teacher in Pennsylvania;
    - the effects of economic incentives on the decision to remain a teacher in Pennsylvania;
    - the potential availability of retired classroom teachers;
    - the size and composition of the pool of certificated teachers;

3. to predict at the district level the number of hires by type of teacher through school year 2000 and to ascertain if the current inventory plus historical supply of teachers available to Pennsylvania's public schools will be adequate;

4. to identify at the district level the employment problems each district must solve by area of certification and assignment to continue current patterns of curricula, and compare these needed hiring patterns to those evident during the 1980's.

5. the effects of differential curricula on educational outcomes, and relationships between school level resources and the post-secondary educational plans of graduating high school seniors;

## 1.3 The Nature and Sources of Data

The research reported below makes extensive use of a wide variety of data about teachers, students, curricula, and finances of Pennsylvania's school districts. Data about current and historical teachers come from the machine readable administrative records of the Pennsylvania Department of Education. Data about retired teachers come from the machine readable administrative records of the Pennsylvania School Employees' Retirement System. The acquisition and utilization of these administrative records was governed by a series of signed, non-disclosure agreements between the author and the respective State agency.

### 1.3.1 The Nature and Sources of Teacher Data

The Division of Data Services of the Pennsylvania Department of Education routinely collects data for a number of databases dealing with the inventory of currently certificated professional personnel. In the mid-1960's, the Department of Education began to put information about the inventory of teaching certificates granted by the Department into machine readable form. By 1967, the project was complete, and the Department has continued to add to what is generally called the "Certification File." This database contains the name, social security number, date of birth, race, sex, up to 15 certifications and dates, and the college/university code of most recent certification. As of 1992, the file contained 434,512 individuals, many of whom are not currently teaching or employed by Pennsylvania public school districts.

The second major teacher database, maintained by the Division of Data Services of the Pennsylvania Department of Education, is the annual Pennsylvania Professional Personnel File. Each fall, every Pennsylvania school district is required to provide to the Department of Education, in either magnetic or paper form, the complete inventory of professional personnel employed during the previous year in the district. In doing so, the district indicates any withdrawals, by cause, from the prior year's inventory of teachers.[3] This database contains the name, social security number, date of birth, race, sex, educational attainment, salary, employment status, total years of service in any school system, total years of service in the district currently employing the person, the school district of current employment, administrative position code, and three areas of certificated teaching assignment, ordered in terms of time commitment of each teacher. In 1991, the reporting system was changed, and somewhat more limited, although more accurate data are now obtained by the Department of Education.

[3]The data are annually reported by each district on *Professional Personnel Record Form PDE 5018.*

These data have been merged together with the relevant withdrawal information from the Professional Personnel file to form a series of annual snapshots of the professional personnel working in Pennsylvania's various public school districts for school years 1981/2 through 1990/1.

Data on 98,844 retired, certificated teachers was obtained from the Pennsylvania School Employees' Retirement System and included date of birth, race, sex, retirement date, municipality and zip code of residence.

### 1.3.2 The Nature and Sources of Student, Fiscal and other Data

District level data was obtained from a variety of sources within the Pennsylvania Department of Education. Each year, the Division of Child Accounting of the Bureau of Basic Education and Fiscal Administration in the Department of Education prepares demographic forecasts of student enrollment for each school district by grade level. These forecasts take into account live births, deaths, and migration, and are used by local districts in the development of their capital budgeting proposals. These data, which are publicly available, are annually updated to account for historical experience in the fall of each school year. It should be noted that this enrollment data differs from average daily attendance data which are used to administrate various formula-based payments of state aid to local school districts. The weighted average daily attendance data reflect the differential costs of educating primary vs. secondary school students, and school dropouts.

The Division of Data Services annually collects from each school district detailed secondary subject enrollment data by gender and course, and also collects annual data on the post-secondary educational plans of graduating high school seniors.

The Office of the Comptroller of the Pennsylvania Department of Education supervises the collection and audit of a variety of fiscal information related to the administration of state grants to local school districts. Such data include information on average daily membership and weighted average weighted daily membership, as well as the fraction of the student population from families with aid to dependent children (AFDC).

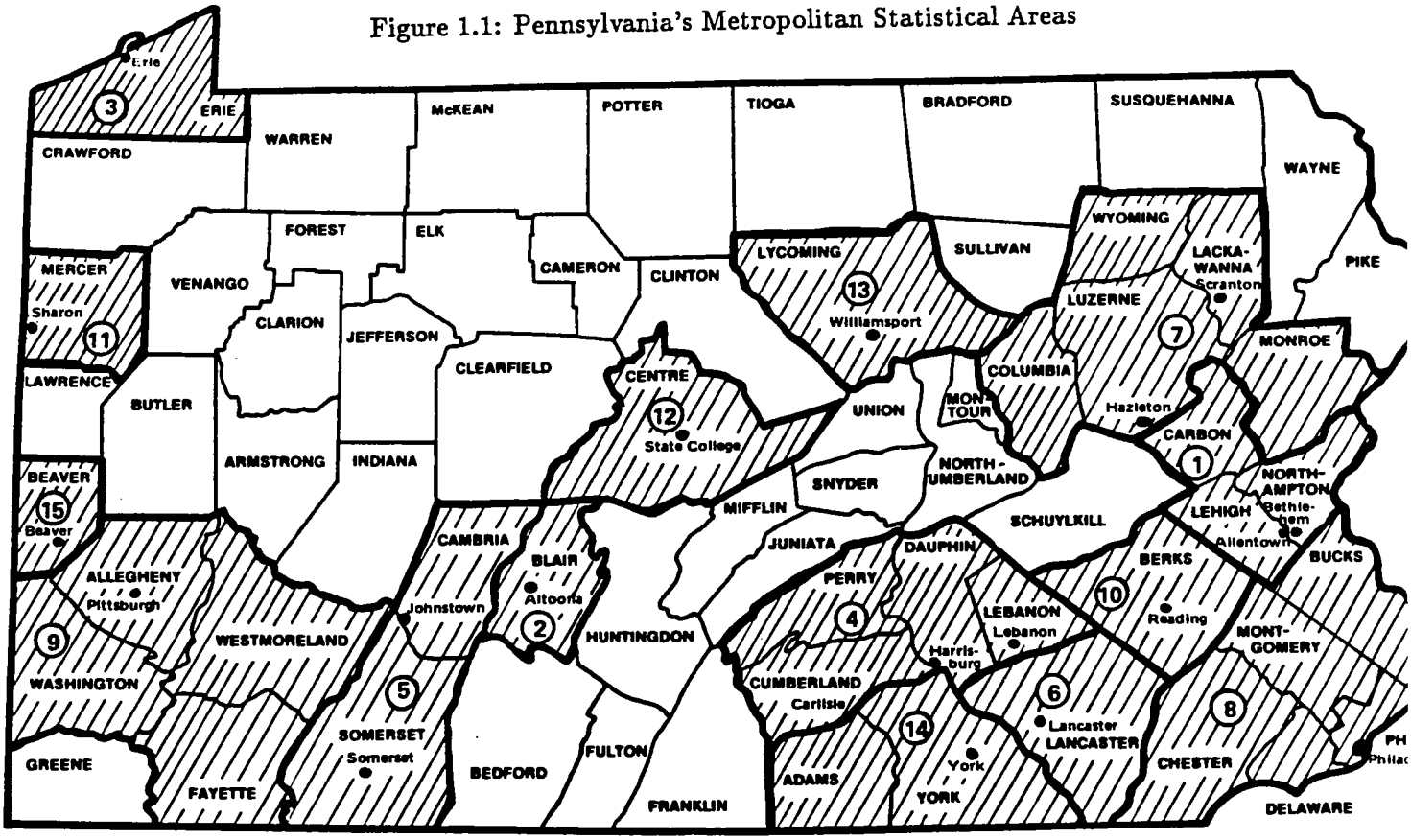
Data on the total money income of residents in each school district are collected by the Pennsylvania Department of Revenue in conjunction with the administration of the state personal income tax.

1990 Census of Population enumeration counts by school district were created by processing 1990 population counts at the Minor Civil Division (MCD) level and aggregating the MCD's to known school district boundaries; per capita income was formed by dividing 1990 total money income, reported by the Pennsylvania Department of Revenue by School District to the Department of Education, by the 1990 Census of Population data.

## 1.4 Pennsylvania's Metropolitan Statistical Areas

Pennsylvania's regions will be characterized below by examining its Metropolitan Statistical Areas (MSAs). Figure 1.4 displays these 15 MSAs by county, and indicates a few key characteristics of these MSAs. The MSA was chosen as a classification tool primarily because the market for teacher services was thought to extend beyond each school districts boundaries. Only a handful of Pennsylvania school districts currently have residency requirements, and many public school teachers reside in areas other than where they teach. These metropolitan areas, which are often multi-county in Pennsylvania, are typically used for labor market analysis, and provide a convenient intermediate level of detail between state aggregates, and county level aggregates.

Figure 1.1: Pennsylvania's Metropolitan Statistical Areas




| MSA | 1990 Population | Per Capita Income | Total | Enrollment Ratio |
|---|---|---|---|---|
| Allentown | 596,054 | $11,891 | 81,472 | 13.7% |
| Altoona | 134,811 | $8,232 | 21,043 | 15.6% |
| Erie | 281,987 | $9,500 | 41,726 | 14.8% |
| Harrisbur | 613,795 | $11,751 | 91,187 | 14.9% |
| Johnstown | 238,978 | $7,758 | 35,816 | 15.0% |
| Lancaster | 419,065 | $12,213 | 58,907 | 14.1% |
| Scranton | 747,381 | $9,379 | 97,080 | 13.0% |
| Philadelp | 3,709,469 | $11,846 | 450,691 | 12.1% |
| Pittsburg | 2,055,914 | $10,717 | 265,966 | 12.9% |
| Reading | 357,727 | $12,143 | 51,125 | 14.3% |
| Sharon | 121,093 | $8,388 | 18,844 | 15.6% |
| State Col | 113,912 | $9,341 | 12,576 | 11.0% |
| Williamsp | 119,904 | $9,346 | 19,622 | 16.4% |
| York | 395,011 | $12,149 | 59,333 | 15.0% |
| Beaver | 183,127 | $8,445 | 27,955 | 15.3% |
| NonMSA | 1,789,013 | $8,613 | 287,928 | 16.1% |
| Total | 11,877,241 | $10,772 | 1,621,271 | 13.6% |

## 1.5 Limitations of the Study

While this study makes concrete forecasts about hiring needs at the district level by assignment and certification area, statistically explores the individual teacher's decision to retire or quit, and explores the effects of various factors on the postsecondary educational plans of graduating seniors, there are a number of things which it does not do. First, it focuses solely on traditional school districts; it does not analyze the rapidly changing situation of special education and its relationship to Pennsylvania's Intermediate Units.

Second, the study does not directly address the Output Based Education (OBE) reforms adopted by the State Board of Education; however, the district-specific projections of hiring needs under current and best-practice curricula are informative and may encourage those attracted to eliminating state-imposed requirements to revisit the curriculum issue. This may be especially important in view of the study's findings about the paucity of elective coursework in the majority of the State's secondary schools, and the effects of curricula access on the post-secondary educational plans of graduating high school seniors. Third, the issue of salary schedules, budgetary costs, and the State's role in the support of public education, given different supply and demand scenarios, are not addressed; they remain topics for future research.

## 1.6 Outline of Study

This monograph is organized as follows: Chapter 2 discusses the evolution of Pennsylvania's public school in terms of its history, recent legislative and regulatory environment, and major empirical indicators of change with respect to the student population, teacher hiring and quit decisions, and their implications for subsequent modeling. Chapter 3 reviews other demographic and behavioral studies of teacher supply and demand, and collects techniques and hypotheses to be explored by this study. Chapter 4 develops the demographic model of teacher hiring needs to be empirically implemented, and Chapter 5 reviews empirically the experience of the 1980's, a period of significant decline in student enrollment, to ascertain if this has implications for the modeling process. Chapter 6 reports the application of the hiring models, and compares the predictions with the historical patterns of teacher production from Pennsylvania's various teacher certification programs. Chapter 7 develops aggregate behavioral models of the decision to pursue a teaching degree from a Pennsylvania certificating institution, and the decision to retire or quit a teaching job in a school district. Predictions from these behavioral models are contrasted to those from the demographic models. Chapter 8 explores further issues of differential access to secondary curricula, and Chapter 9 summarizes the findings of the study and makes a number of public policy recommendations aimed at improving the teacher market's functions.

Given the keen interest in the issues of teacher supply and demand, curricula, and their effects on educational outcomes among legislators, state education administrators, union officials, local school officials, academics and the public, this monograph has been written for multiple audiences. It has been my goal in this study to devise modeling processes which are both intuitively plausible and empirically robust, and to explain them in a clear, not overly technical manner. General findings, based on technical analysis, are summarized at the end of each chapter, to improve the overall readability of the study.

# Chapter 2

# An Overview of Pennsylvania's System of Public Education

In order to understand the market for teaching services, it is useful to first step back and view the public education system as a set of rules, inter-related decisions, resource flows, and finally, yet most importantly, educational services. It is convenient to view the various state agencies responsible for providing and regulating public education as the institutional actors affecting the **demand** for public school teachers, and those agencies responsible for certifying and training teachers as institutional actors affecting the **supply** of public school teachers.

## 2.1 The Constitutional and Statutory Basis for Public Education in Pennsylvania: Agencies Effecting the Demand for Public School Teachers

The Pennsylvania Constitution, like many other state constitutions, requires the General Assembly to provide for a "...thorough and efficient education...", (Article III, Section 14). In order to accomplish this, the General Assembly has met this obligation through the statutory delegation of operational responsibilities to a variety of state and local educational agencies:

- **school districts** of various **classes** [1] were established as political subdivisions of the state whose residents' school age children have been required to attend either the schools in the district, pursuant to the Compulsory School Attendance Law, or other certified (e.g. non-public) schools.

- **school boards** were established as local legislative bodies with the authority to impose various taxes and fees, and expend those and both federal and state funds to provide educational services to public school students; its members are unpaid state officials charged to carry out the General Assembly's educational policies.

- the **State Board of Education** was established to promulgate rules, regulations, and standards for the educational programs of the state, review the rules and regulations of the

[1] There are 501 school districts composed of: Philadelphia, a First Class School District; Pittsburgh, A First Class A school District; 80 Second Class, 394 Third Class School Districts, and 25 Fourth Class School districts. The classifications are based on population size.

State Department of Education, review and approve budgets for the various state education agencies (Departments of Education, State Universities and State-Related Universities) and both investigate and hear appeals on school district annexation issues. The State Board has adopted regulations dealing with curriculum, attendance, quality assessment, and teacher certification. In each instance, these regulations are subject to the approval of the General Assembly.

- **the State Department of Education,** formerly the Department of Public Instruction, was established to supervise and partially fund local school districts. Also, it requires attendance of school age children in approved educational systems (both public and private) under Section 1327 of the 1949 Public School Law. The Department of Education stipulates by regulation the subjects which must be covered in the primary grades (e.g.1-7), and also stipulates graduation requirements.

## 2.2 Agencies Affecting the Supply of Public School Teachers

The 1949 Public School Code provides a formal definition of a public school teacher which includes classroom teachers, demonstration teachers etc., and establishes under Section 1109 that a qualified teacher must be of 'good moral character, at least 18 years old, a U.S. citizen, and certified in appropriate areas'.

Appropriate certification is obtained by a prospective teacher through the satisfactory completion of an approved course of study in a school of education. The State Board of Education has established a process of program approval which is administered by the Department of Education. As a practical matter, the Department of Education maintains a list of approved certification programs at various Pennsylvania colleges and universities each year. Individual students and/or the institutions submit a list each year to the Department of Education of students who have satisfactorily completed the approved program of study. Then, the Department issues certificates to each newly approved teacher, and receives college transcripts as final validation of having completed the approved course of study.

Teachers certificated in institutions outside of Pennsylvania may present their credentials to the Department of Education to become certified to teach in Pennsylvania, and since 1988 must take and pass state determined examinations. Currently, the Department of Education requires applicants to take and pass various portions of Educational Testing Service's National Teacher Examination (NTE).

Act 195 of 1970, the Public Employee Relations Act, eliminated the 1947 prohibition against public employee strikes, and eliminated the prohibition against collective bargaining by public school teachers and their employers. Act 195 allowed teachers to bargain collectively through representatives, provided for compulsory mediation and fact-finding, allowed for arbitration in the event of bargaining impasses, defined the scope of bargaining, and set criteria for the determination of unfair labor practices. Act 88 of 1992 amended the School Code, and provided for a mandatory timeline for bargaining, a minimum complement of state mediators, enabled either bargaining party (school board or union) to initiate fact-finding, prohibited selective strikes, a 48 hour advance notice of a legally authorized strike, provision of voluntary, *nonbinding* arbitration as a new impasse procedure, and injunctive power for the Secretary of Education should a strike endanger completion of the minimum 180 day school year.[2]

[2]See Pennsylvania School Boards Association, *Public School Negotiations: A Complete Guide to Collective Bargaining Pennsylvania Public Education*, 1993.

As a practical matter, upon employment any teacher, temporary, probationary, or permanent, must become a member of either the chapter of the American Federation of Teachers (AFT) or the local chapter of the Pennsylvania State Employee Association (PSEA), and subsequent matters relating to assignment, salary, and terms of employment are governed by the collective bargaining agreement approved by the local school board and the union. Every district in Pennsylvania is covered by a union contract.

## 2.3 General Scale of Pennsylvania's System of Public Education

As noted earlier, Pennsylvania's 501 school districts are classified by population size. There are approximately 128,000 professional personnel associated with local public education in Pennsylvania. As of 1990/1, approximately 98,000 were classroom teachers in traditional school districts. The majority, 63%, are women, and the vast majority, 92.9% are white. A little over half, 53.3% hold bachelors degrees, 45.7% hold masters degrees, and .7% hold Ph.Ds. In 1990/1, the median (9 month) salary for classroom teachers was $35,425; the median teacher was 45 years old, had 17 years of experience in his/her district, and 19 years of total experience.

The General Assembly has obligated itself to defray 50% of the cost of public education, although there is significant disagreement over whether this has been accomplished in recent years. The State currently transfers $2.9 billion in state monies to local school districts through the basic education subsidiary, and is budgeted this fiscal year to provide $5.8 billion in total support of local public education. This larger figure reflects additional funds for transportation, area vocational schools, intermediate units, and retirement contributions. Parents pay state income, sales, and indirect business taxes to fund these state transfers, and at the local level pay local property, wage, and indirect business property and miscellaneous taxes in support of the state and local costs of public education. The federal government transfers $750 million/year to the state for various educational purposes.

There are currently about 1.9 million, school age children in Pennsylvania, and about 1.6 million go to public schools ([4] in Figure 2.1). The balance go to a mixture of parochial and private schools.

These 1.6 million students attend school in one of Pennsylvania's 501 public school districts; in 1991/2, 915,000 were in grades k-7, and 727,000 were in grades 8-12. Of these students, about 112,000 graduate from Pennsylvania's public schools each year. Also, the districts employed approximately 98,000 classroom teachers in 1990/1.

Each year, some 6,000 to 7,500 teachers withdraw or leave these 501 public school districts for a variety of reasons:

1. 4,000-4,500 voluntarily leave or quit,([9] in Figure 2.1);
2. 1,800-2,300 per year retire after 10 or more years of service, ([10] in Figure 2.1); and,
3. 200-700 are furloughed or laid off, ([11] in Figure 2.1).

These voluntary and involuntary departures of classroom teachers can be viewed as entering a reserve pool of some 434,000 Pennsylvania certified teachers. An unknown number may be outside of the state, and some of the withdrawals leave the state as well.

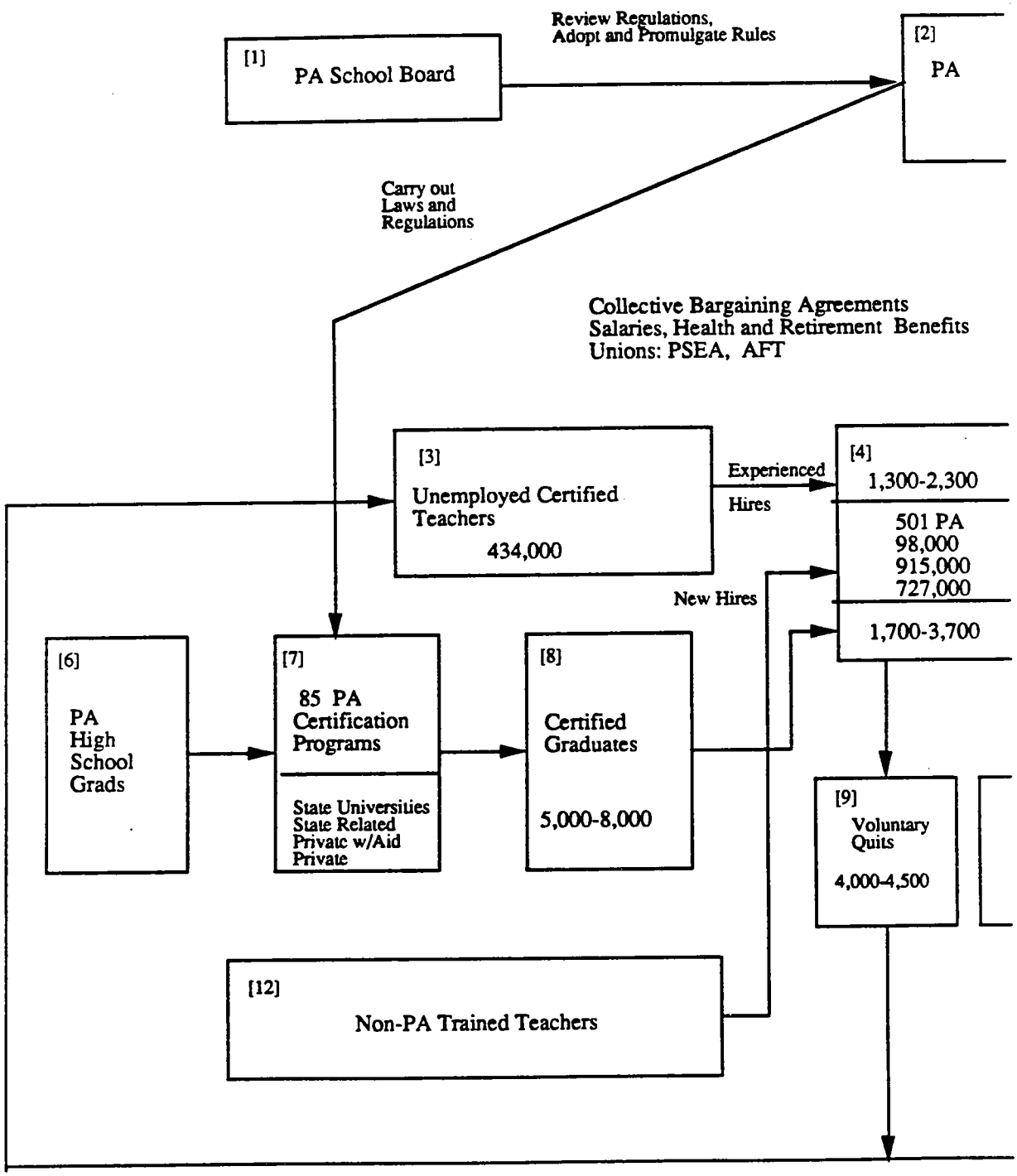
Each year, Pennsylvania's public school districts hire some 1,300 to 2,300 experienced teachers from the aforementioned pool, ([3] in Figure 2.1). Also, Pennsylvania's 85 institutions which are approved to award teaching certificates graduate 5,000 to 8,000 newly trained teachers each year who then seek teaching jobs ([7] in Figure 2.1). Each year, Pennsylvania's public school districts

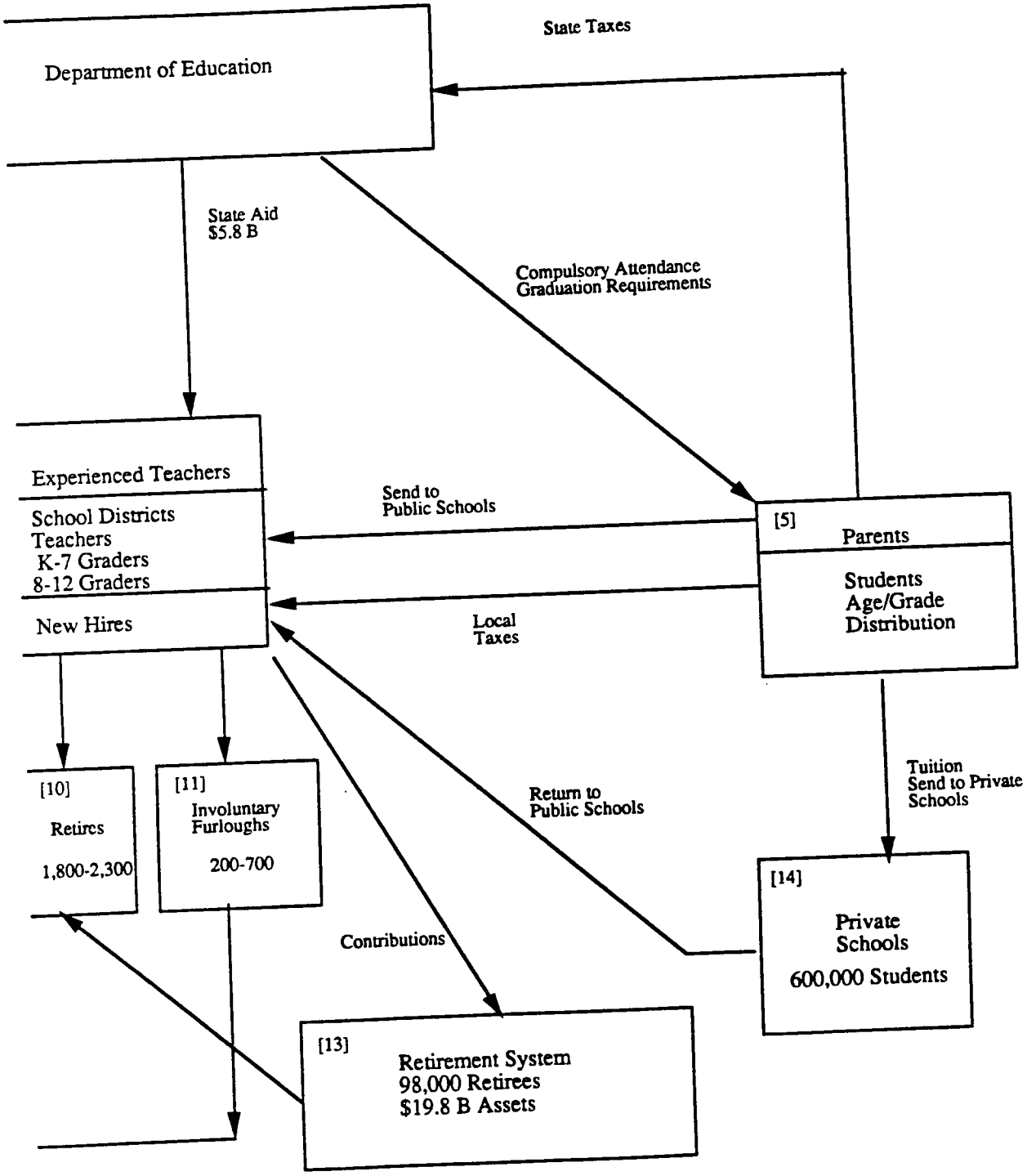
hire 1,700 to 3,700 newly trained teachers both from Pennsylvania's certificate granting institutions ([8] in Figure 2.1) and from those outside the State which have approved certification programs ([12] in Figure 2.1).

Finally, it should be noted that the State, local districts, and teachers make retirement contributions into the Pennsylvania Public School Employees' Retirement System ([13] in Figure 2.1) which currently has some $19 billion in assets, and currently pays benefits to some 98,800 beneficiaries, 87% of whom continue to live in Pennsylvania. About 10,000 of these retirees are under age 60 and continue to reside in the state.

In the chapters below, we shall examine these flows with particular reference to *classroom teachers* to ascertain, given changing demographics of students and teachers, and retirement and quit decisions, what the likely hiring needs will be at the district, regional and state level.

Figure 2.1: Pennsylvania's System of Public Education




Department of Education
State Taxes
State Aid
$5.8 B
Compulsory Attendance
Graduation Requirements
Experienced Teachers
School Districts
Teachers
K-7 Graders
8-12 Graders
New Hires
Send to
Public Schools
[5]
Parents
Students
Age/Grade
Distribution
Local
Taxes
[10]
Retires
1,800-2,300
[11]
Involuntary
Furloughs
200-700
Return to
Public Schools
Tuition
Send to Private
Schools
[14]
Private
Schools
600,000 Students
Contributions
[13]
Retirement System
98,000 Retirees
$19.8 B Assets

# Chapter 3

# Other Studies of Teacher Supply and Demand

## 3.1 Introduction

The study of teacher preparation has occupied educational researchers and labor economists for many years. Virtually all recognize the importance of current and expected student demographics in affecting the decision to become a teacher, and in affecting schools' decisions to hire teachers. Most also recognize, either implicitly or explicitly, that the decision to become a school teacher is made by students when weighing alternatives, in terms of both the pecuniary and non-pecuniary aspects of competing career opportunities.

To the extent that one can generalize, most educational researchers have tended to enquire if there will be sufficient numbers of primary and secondary school teachers under various assumptions; several have raised issues of the quality of the current and prospective teacher force. Others have examined such behavioral issues as the effects of relative and absolute salaries on the decision to become a teacher vis a vis other professions requiring a BA degree, and the effect incentives have on the retention of the teaching force. A few have wondered about the effects of differing quality in classroom teachers on the educational outcomes of students.

Our purpose in this review is to accumulate models, methodologies, hypotheses, and empirical findings so that we can develop several Pennsylvania teacher supply and demand models, and provide a set of issues to be addressed with these models. Below, we review studies of teacher recruitment and supply, studies of teacher retention, studies of student demography and teacher demand, and state-specific studies.

## 3.2 Teacher Recruitment and Supply

Much of the initial post WWII research on teachers was suggested by Kershaw and McKean (1962) who examined national teacher recruitment issues. They examined how a standardized salary policy developed in the teaching profession, and contrasted this with salary differentials for different specialties in other professions. They concluded that fixed starting salaries in teaching might cause a shortage of teachers in certain specialties as alternative, higher paying opportunities outside of teaching attracted college students at the margin. They suggested differential starting salaries for different teaching subjects as an economic remedy to these projected shortages.

In a similar study, Zambala (1979) examined English data with an econometric model of occupational choice and found that starting salary was the most important variable affecting occupational choice.

Schlechty and Vance (1983) summarized a series of papers on teacher recruitment and selection. Their own work, e.g. (Vance and Schlechty (1982), Schlechty and Vance(1981, 1982)), and Pavalko(1970), Sharp and Hirshfield(1975), are cited to support the view that lower quality students choose public school teaching as a career, and that the teacher retention rates are worst for the most academically gifted. They also expressed concern that major research universities are phasing out teacher training programs and, as a result, the majority of teachers were "...produced with the lowest academic standards." (p.486, 1983). They recommended that professors at high-prestige campuses "...turn their interest away from teacher education and toward the development of healthy management systems in schools."(p. 486). Remarkably, they also argued that "..weaker institutions of higher education should acknowledge that they served an important function that is no longer required."(p.486).

Weaver (1983) constructed a national simulation model of teacher supply and demand based on his own as well as other researchers parameterizations. Of particular concern was the relatively low SAT scores of those choosing to teach. He tests four different reform alternatives using a system dynamics model which he developed earlier. He proposed that providing job alternatives to education graduates in order to attract college-bound students to teacher certification programs even when there is a chronic oversupply of teachers due to falling enrollments.

Cagampang, Garms, Greenspan, and Guthrie(1985) examined various sources of teacher supply in California's school districts, and the implications of California's rapidly expanding student enrollment. Between 1985 and 1995, California's school districts are expected to experience a 26.5% increase in student enrollment; primary school enrollment is expected to grow during that period 32%, and secondary school enrollment is expected to grow 14.4%.

They developed the demand for teachers based on state projections of enrollment at the county level. They then noted that student-teacher ratios vary widely across the state, as does enrollment growth. Two different scenarios for attrition were examined: the first used *average* historical attrition and retirement rates from the California State Teachers' Retirement System (7.67% per year), the second used a time trend of attrition rates (falling from 7.07% in 1984/5 to 5.56% in 1994/5). They found, paradoxically, that while enrollment had increased in California's certification programs, the number of certificates issued fell.

They attributed the decline in certificates issued to changes in the regulatory climate. In the early 1980's, about 4,700 teachers graduated per year; about 50% of them entered teaching. The implementation in early 1983 of the California Basic Educational Skills Test, a teacher skills test, reduced teacher supply both from California certificating institutions and from out of state. They estimated that there were 167,000 teachers with valid credentials not currently teaching, but that no more than 30% were likely to re-enter teaching.

Overall, they predicted that unless state policy changed drastically, maintenance of current student-teacher ratios and the projected supply of new teachers and their attrition would yield a predicted teacher shortfall of 4,000 to 7,000/year through 1990.

Manski (1987) examined 22,652 high school seniors surveyed by the 1972 National Longitudinal Survey to model the relationship between academic ability, earnings, and the decision to become a teacher. He concluded that among bachelor degree holders, there was an inverse relationship between academic ability and the frequency of choice of teaching; conditional on sex and academic ability, the earnings of teachers are lower than those of college graduates. Academic ability (class rank or SAT scores) explained only a small portion of earnings. Furthermore, given academic

ability, there were very few gender differences among teacher salaries.

Manski conjectured that increases in salary would increase the size of the teaching force, but might not improve the overall quality of teachers as both high and low ability students would be attracted into teaching. Manski reported aggregate wage elasticities of the teacher supply from +2.4 to +3.2, depending on the size of salary change. If teacher salaries were not increased, institution of a minimum ability standard could improve the average ability of the teaching force but reduce its overall size. Hence, Manski suggested that a higher minimum ability standard for teachers be combined with salary increases to improve both the quality and quantity of the teaching force.

Hanushek and Pace(1993) examined entry into the teaching profession as a sequence of decisions. Using longitudinal data from High School and Beyond, they trace the development of career goals, the choice of college major, and the characteristics of those who ultimately teach. They found that white females are more likely to become teachers than males or ethnic minorities; lower ability students are more likely than higher ability students to enter teaching. Interestingly, they found that state certification tests lower the rate of teacher preparation as do increased course requirements. Also they did not find that teacher salaries or relative salaries had substantial or statistically significant effects on students' decisions to enter teaching.

## 3.3 Teacher Retention

Murnane, Singer and Willett (1988) examined national panel data on teacher attrition over 12 years with proportional hazard models (breaking the sample into smaller groups and finding survival rates for each group, then putting them together to forecast future quits in the late 1980s). They found that younger women and elementary teachers were the most likely to quit. They also suggested that quit rates were lower in the 1980s because of demographics, but they fell short of predicting what quit rates would be in the 1990s, except to say that each teaching subject has different quit rates.

In a later study,(1989), they performed a similar analysis using data for the 5,863 teachers who were first hires in North Carolina between 1976 and 1978. The results from this study basically reconfirmed the results of their study using NLS data.

Murnane and Olson (1990) used an econometric model, developed by Olson and Wolpin (1983), to find the coefficients of the probability density function for the expected length of the teaching spell before quitting for 13,890 white North Carolina teachers hired during 1975-84. The sample was divided into two periods from 1975-79 and 1980-84 (no statistically significant difference was found for both periods though) and once again, it was found that different teaching specialties involve different teaching spells. Chemistry/Physics teachers were most likely to quit, while elementary teachers stayed the longest. They also found that a higher NTE score meant a higher probability of quitting while a higher salary meant a lower probability of quitting. These results were consistent with Schlechty and Vance(1983), and Manski(1987).

Grissmer and Kirby (1991) studied teacher attrition in Indiana. They examined panel data covering 24 years (from 1964-65 through 1988-89) on Indiana public school teachers and found that attrition rates have fallen over time. For teachers under 30, the attrition rates ranged about 15-25%, while the attrition rates of those over 30 were only about 2-4%. Hence, with the first three factors contributing to an older and more stable teaching force, attrition rates are expected to decline. However, the attrition rates have fallen to extremely low levels in the 1980s, and Grissmer and Kirby do not expect them to decline any further in the 1990s.

They proposed that the attrition rate observed in the 1980's could be expected to decline in

the 1990's due to five factors: 1] the increasing labor force participation of women, 2] aging of the present labor force, 3] increased entrance of older women, 4] declining student-teacher ratio and 5] increase in teacher salaries. Also, Grissmer and Kirby found that different teaching certification areas have different attrition rates.

## 3.4 Student Demography and Teacher Demand

Ahlberg (1982, 1985) found that changes in enrollment were actually more pronounced than the projections by the National Center for Educational Statistics. Hence, he expected the over-demand/supply of teachers to be worse than other studies using NCES projections.

However, Stapleton (1989) argued that this fear was unfounded. Using the example of the market for academic economists, Stapleton found that demographic models often exaggerate the potential shortage or oversupply of teachers. These demographic models suffer from four problems: 1] inadequate data, 2] poor modeling of the behavior of educational institutions, 3] inaccurate long range projections and 4]a lack of convincing evidence of market failure.

Zarkin (1985) applied the rational expectations model of Muth to the decision to become a teacher. In his model, prospective teachers take into account expected starting salaries and expected future demand conditions. He found that expected demand affects the decision to acquire secondary school certification, but not elementary school certification; the elasticity was 2.59. The number of primary school children enrolled in school prior to the teacher's employment were significant which is consistent with a myopic model of the labor market; on the other hand, the number of lagged secondary school children was unimportant in predicting the choice to become a secondary school teacher. Future children were unimportant in the decision to become an elementary school teacher.

Because he estimated a stock adjustment model, he found that the lagged effect of teachers was fairly large. He also found that the higher the present value of the opportunity wage, the lower the number of certificates awarded; the elasticity with respect to secondary school certificates was -1.18 and -.17 for primary school teachers (but not statistically significant). Zarkin then compared his rational model to a myopic, cobweb model used by Freeman and Leonard(1977); he found that both explain 97% of the observed variance in secondary school certificates issued, but they implied very different dynamics.

## 3.5 State-Specific Studies

Kirby, Grissmer and Hudson (1991) examined the success of the Indiana Beginning Teacher Internship Program in increasing the teaching spells of entrants, while Kirby, Hammond and Hudson (1989) found that non-traditional programs preparing non-education degree holders to enter teaching varied in their success in preparing these recruits to teach. The programs could not fully overcome other attributes of teaching that made recruitment and retention of teachers difficult. However, in this project, we consider entrants from all types of teacher certification programs, regardless of whether it is traditional (B.Ed.) or non-traditional (degree in other field with a certification in teaching). That is, we do not distinguish between programs at this level, but only whether or not the institution preparing new teachers is public or private.

The 1987 Massachusetts Institute for Social and Economic Research (MISER) study of Massachusetts teacher supply and demand simulated teacher demand and supply by matching enrollment forecasts and course taking behavior to the records of public school teachers, hiring activities of school districts and teacher certification applicants in Massachusetts, along with a survey of 41

of the 47 teacher certification programs in the state. However, the MISER study did not make predictions at the school district level.

The MISER study found that despite an aging labor force, the low hiring rate for newly-certified teachers (10-15%)is likely to continue. The Massachusetts study also found that the hiring rate for teachers trained in public institutions was slightly higher than that of private institutions, though not significant statistically. It also examined supply and demand of teachers for each different subject and forecasted that there may be a shortfall of secondary teachers in English, Mathematics, General Science, Social Studies, French and Vocational Studies in the 1990s, with a present under-supply of bilingual teachers.

More relevant to the evolving situation in Pennsylvania is the study, *Teacher Supply and Demand, 1989/90 and 1990/1*, released by the Pennsylvania Department of Education in August 1992. Based on a review of the most recent pattern of new teacher hires compared to the supply of new teachers on the production of new certificates by Pennsylvania certificate-granting institutions, it concluded that "...there appeared to be a more than adequate supply of certified teachers to meet the demand for classroom teachers."(p.14).

## 3.6 Summary and Implications for Research

This review of the recent research on teacher supply and demand suggests that conclusions about the adequacy or inadequacy of teacher supply in the future depends on the decisions made by college students to become a teacher, on student and teacher demographics, on teacher retirement and quit behavior, and the nature of curricula offerings. Also, this review indicates the importance of identifying the sources of teacher supply:

- newly trained teachers from differing types of training institutions;
- the reserve pool of certificated non-teachers; and,
- the reserve pool of retired teachers.

Finally, the review indicates the desirability of examining relationships between teachers of differing quality or background and actual educational outcomes.

Our research strategy below is to first develop demographic models of teacher demand which are driven by projected student enrollments. Because we are dealing with one state whose demography is changing (more counties lost than gained population from 1980 to 1990 in Pennsylvania), and whose student demography is equally varied, there is a need to make projections at the district level. Coupling these demographically driven teacher demand projections with historical attrition data and varying assumptions about the retirement decision, we can predict at the district level the hiring problem which each district will face through the close of the decade.

These demographic projections will then be compared to supply projections based on behavioral models of the decision to become a teacher, the decision to quit teaching and the decision to retire.

# Chapter 4

# A Demographic Model of the Demand for Pennsylvania's Public School Teachers

Below, we develop a simple inventory model which determines how many teachers will be hired over time. Each school district is assumed to maintain its current student-teacher ratio in the future. By assuming we know future enrollment with certainty, we may then calculate the number of future teachers needed to achieve this objective. The model is extended to allow for teacher retirement patterns, voluntary quits and the impact of elective curricula offerings on future teacher needs. Finally, the assumption that current curricula patterns will persist into the future is relaxed, and the implications of school districts changing to "best practice" offerings are examined.

## 4.1 Student and Teacher Demography

To begin, let us assume that new teachers are hired to reflect the size of student enrollment. Furthermore, we assume that the current student-teacher ratio is desirable, and will be maintained into the future. If we know from the demographics of current enrollment and data about live births in each district what total enrollment will be in the future, we may derive the number of teachers needed to maintain the desired student-teacher ratio.

For example, suppose we observe 3,000 students in a district and 100 classroom teachers this year, and assume that the student-teacher ratio of $3{,}000/100 = 30$ is desirable. Furthermore, let us presume from demographic projections that we can predict that the district's enrollment will be 25% larger in 8 years, or 3,750. In order to maintain class size at its current level of 30:1, 25% more teachers or 25 must be hired for the student-teacher ratio to be kept at 30:1.

Thus, given that we know the current enrollment, $E_{1991/2}$, the current number of teachers, $T_{1991/2}$, and have a prediction for future enrollment, $\hat{E}_{1999/2000}$, we may solve for the predicted number of new hires, $\hat{H}$, that will have to take place between now and the future in order for the future student-teacher ratio to be maintained:

$$\frac{E_{1991/2}}{T_{1991/2}} = \frac{\hat{E}_{1999/2000}}{(T_{1991/2} + \hat{H})} \tag{4.1}$$

We can rearrange 4.1 so that $\hat{H}$ is a function of current and future enrollment and the current

number of teachers:

$$\hat{H} = \frac{T_{1991/2}}{E_{1991/2}} \hat{E}_{1999/2000} - T_{1991/2} \tag{4.2}$$

Having accounted for changes in student enrollment due to changes in student demography, we now incorporate similar demographic considerations into 4.2 for the future inventory of teachers. In particular, we incorporate reductions in the future inventory of teachers due to retirement. If we can predict how many teachers will retire by the end period, 1999-2000, we may predict how many will remain. Then, we may replace $T_{1991/2}$ with the predicted number of teachers in 1999/2000. In the above example, suppose that 10 of the original 100 teachers were to retire. Then, new hires, given enrollment changes, would be composed of 25 new teachers needed to reflect enrollment growth, and 10 new teachers to replace the 10 who retired for a total of 35 needed new hires.

More generally, we can replace $T_{1991/2}$ with $\hat{T}_{1999/2000}$ on the right hand side of (1), and restate for $\hat{H}$ to obtain:

$$\hat{H} = \frac{T_{1991/2}}{E_{1991/2}} \hat{E}_{1999/2000} - T_{1999/2000} \tag{4.3}$$

It is evident that the new hires under 4.3 will be greater than under 4.2 since we have allowed for the retirement decision.

Given a model that combines the effects of both student and teacher demographics, we can decompose the model to ascertain the impact of each effect. This will be useful in our empirical work below.

If we assume that enrollments do not change in the future, e.g. $E_{1991/2} = \hat{E}_{1999/2000}$ in 4.3 above, then the number of new hires due just to retirement, $\hat{H}_r$, simply becomes the difference between the future stock and current stock of teachers:

$$\hat{H}_r = T_{1991/2} - T_{1999/2000} \tag{4.4}$$

If there are no retirements whatsoever, e.g. $T_{1991/2} = T_{1999/2000}$ in 4.3 above, then any new hires must be directly proportional to enrollment growth. Substituting this assumption into 4.3, and rearranging, we can state the number of new hires due just to enrollment changes, $\hat{H}_e$, as:

$$\hat{H}_e = [\frac{\hat{E}_{1999/2000}}{E_{1992/3}} - 1]T_{1991/2} \tag{4.5}$$

Finally, we note that the total number of new hires, $\hat{H}$, in 4.3 is the sum of these two demographic effects:

$$\hat{H} = \hat{H}_r + \hat{H}_e \tag{4.6}$$

Three kinds of assumptions will be entertained in identifying $\hat{T}_{1999/2000}$ vis a vis $T_{1991/2}$:

- **Retirement Assumption 1: teachers retire when they reach age 65;**
- **Retirement Assumption 2: teachers retire when they have completed 30 years of cumulative teaching service; or**
- **Retirement Assumption 3: teachers retire when they have completed 27 years of cumulative teaching service, as provided under the Mellow Bill**

The first assumption is consistent with the observed **third quartile ages**[1] of Pennsylvania's classroom teachers who have taken retirement in recent years, while the second assumption is consistent with the early retirement option which the Pennsylvania General Assembly has provided annually since 1982 to encourage retirement of teachers in their mid to late 50's. [2] Under the 30-years-of-service-window, or early retirement window, teachers may retire with full retirement benefits and without any actuarial reduction. Under the third assumption, teachers retire after 27 years of experience. This is a prominent feature of the Mellow Bill which was enacted in 1993.

Given the current age and experience distribution of teachers in Pennsylvania, the first assumption about retirement means that relatively fewer teachers will retire between now and 1999/2000, while the second and third assumptions mean that relatively more teachers will retire between now and the year 2000.

In the empirical work below, we identify hires resulting from application of the assumption of retirement at age 65 as $\hat{H}^a$, hires resulting from application of retirement after 30 years of experience as $\hat{H}^e$, and hires resulting from application of retirement after 27 years of experience as $\hat{H}^m$.

## 4.2 Curricula and Certification Considerations

Since we know each district's enrollment distribution by grade level for the future, we may also account for the number of teacher certifications that will be needed in the future. In order to teach in primary school grades, a teacher must be certified as a primary school teacher. Thus, if enrollment in the district's primary grades is projected to increase 20%, then, holding constant retirements, we may expect that 20% more primary school teachers will be needed in order to keep the student-teacher ratio at the same level as observed in 1991/2. We can thus modify 4.3 by examining enrollment projections for grades 1-6, and resolve for $\hat{H}$ in terms of needed primary school teachers. Again, we may account for retirements in the stock of primary school teachers by making the two earlier assumptions which delineate the likely outcomes by the school year 1999/2000.

At the secondary school level, however, specialized certifications are required to teach various secondary school courses as prescribed by the Regulations governing Chapter 5 of the Pennsylvania School Code. To teach biology in the secondary grades, one must be certified in biology and so forth. Also, many school districts do not offer many elective courses, so the analysis of the implications of curricula must account both for what is and is not offered in deriving future teacher needs.

Fortunately, with several plausible assumptions, we may empirically model future teacher needs by area of certification at the district level. In particular, if we entertain assumptions about the constancy of course offerings and enrollment, we can refine the above model and characterize the nature of teachers who will have to be hired to maintain current curricula and student-teacher ratios into the future.

Let $E_{j,1989/90}$ be the number of students enrolled in elective course j, j=1,..128, in 1989/90. School year 1989/90 is the most recent for which enrollment by course at the district level could be obtained from the Pennsylvania Department of Education. [3] Furthermore, let $T_{j,1989/90}$ be the

[1] Over the past decade, 75% of Pennsylvania's teachers retired at an age less than 65. By assuming that teachers stay on until age 65, we are making a strong assumption that relatively few teachers will elect to retire. See Table 5.24 for age and experience distributions for various types of teacher withdrawals.

[2] Consider a teacher who began teaching at age 25, and worked for 30 years. Under the early retirement option, the teacher would thus be eligible for retirement without actuarial reduction at age 55.

[3] See Chapter 5, Section 5.4.3 below for the list of secondary courses on which the Pennsylvania Department of Education routinely collects enrollment data.

number of teachers in a district certified to teach course j in 1989/90, and let $\hat{T}_{j,1999/2000}$ be the number of teachers certified to teach course j in 1999-2000 , e.g. taking into account retirements of teachers by certification area. Then, we may state the number of hires needed between now and 1999/2000 for the jth course, $H_j$, as:

$$\hat{H}_j = \frac{T_{j,1989/90}}{E_{j,1989/90}} \hat{E}_{j,1999/2000} - \hat{T}_{j,1999/2000} \tag{4.7}$$

Because we do not have separate projections of the number of students taking each of these 128 courses into the future, we presume that future enrollments in these courses are simply proportional to demographically projected enrollment in the secondary grades, or demographically projected enrollment in specific grades when they can be identified in relation to the specific courses. That is, we generally estimate $\hat{E}_{j,1999/2000}$ as:

$$\hat{E}_{j,1999/2000} = \frac{\hat{E}_{2nd,1999/2000}}{E_{2nd,1989/90}} E_{j,1989} \tag{4.8}$$

and substitute this into 4.7 above.

Our data on teacher certifications and course enrollments allow us to divide the hiring problem by using the above demographic methodology into four distinct parts:

- the hiring of kindergarten teachers, $\hat{H}_k$;
- the hiring of primary school teachers, $\hat{H}_p$;
- the hiring of secondary school teachers with known linkages between course enrollments and certifications, $\hat{H}_j$, j=1,...128; and,
- the hiring of all other secondary school teachers, $\hat{H}_s$.

Total projected hires for a district between 1991/2 and 1999/2000, $\hat{H}$, are then:

$$\hat{H} = \hat{H}_k + \hat{H}_p + \sum_{j=1}^{128} \hat{H}_j + \hat{H}_s \tag{4.9}$$

We will implement three versions of 4.9 which correspond to the three retirement assumptions discussed above.

## 4.3 Accounting for Voluntary Quits

In addition to replacements due to retires, new teachers are also hired to replace those who voluntarily leave a district. To simplify our later empirical work and to permit the ready analysis and aggregation of data at the district level, we assume that such departures can be best estimated from historical observations on voluntary quits by school district. [4]

[4] As noted in Section 3, Murnane and Olsen(1984), and Murnane, Singer, and Willett(1988) found that voluntary quit behavior varies with age or experience of the teacher, and with area of certification and assignment. Younger teachers are more likely to voluntarily quit, and are relatively more mobile, than older teachers. Assuming that quits in the 1990's will follow the experience of the 1980's may therefore overstate the actual number of quits in the forecast period since the teacher population will be getting generally older. However, since the stock of teachers in the 1980's had relatively few young teachers, say, under age 35, it is likely that the overstatement is not very large. Some rough calculations with age-dependent quit rates suggests that the overstatement is no more than 1,000 total quits over the entire forecast period.

Denoting historical quits in a district for the period 1982/3 through 1989/90 as $Q$, we may include in (9) these voluntary quits:

$$\hat{H} = \hat{H}_k + \hat{H}_p + \sum_{j=1}^{128} \hat{H}_j + \hat{H}_s + Q \tag{4.10}$$

## 4.4 The Hiring Implications of Staffing a "Best Practice" Curricula

Many districts are unable to offer a full set of elective courses in their secondary schools. For example, only 21 public school districts in Pennsylvania offered Advanced Placement Art in 1989/90, 119 districts offered Advanced Placement Biology, 127 offered Advanced Placement Chemistry, and a mere 69 offered Advanced Placement Physics. The absence of AP physics courses in most school districts may reflect funding problems, and in turn the absence of teachers qualified to teach such a course. The absence of more AP physics courses may also reflect a paucity of students with the necessary prerequisites and interests in such a course, or a lack of enough students to make the class educationally viable, e.g. at least five students in the classroom.

With several assumptions, we may estimate the number of teachers who would need to be hired were all districts in the state to move to a more complete set of course offerings. For each of the 128 elective courses for which enrollment is reported to the Pennsylvania Department of Education, we may identify by district whether or not the district offers the course. Among those districts which offer each of the j courses, we may calculate the median enrollment rate in 1989/90, $MER_j$, across such districts as:

$$MER_j = Median(E_{j,1989/90}/E_{s,1989/90}) \text{ , } for E_j > 0 \tag{4.11}$$

We can then use $MER_j$ to estimate the number of teachers needed for each elective in 1999/2000, $\hat{T}^{best}_{j,1999/2000}$, by assuming an average class size of 25 and an average course load of five contact sessions per day, or 125 students per teacher in the jth course:

$$\hat{T}^{best}_{j,1999/2000} = \frac{MER_j \hat{E}_{s,1999/2000}}{125} \tag{4.12}$$

The use of $\hat{T}^{best}_{j,1999/2000}$ in determining the total number of new hires needed in a district through 1999/2000 assumes that each student's course time can be readily expanded. This is undoubtedly a strong assumption and ignores possible differences in educational tastes and capacities across districts; however, since we do not readily know what students would take were they offered more academic elective courses, we entertain this assumption with the understanding that it will overstate the number of teachers needed to achieve this ambitious educational objective by 1999/2000.

## 4.5 The Complete Model of Hiring through 1999/2000

Our completed model of teacher hiring then is composed of six parts. Five of the six seek to maintain current student-teacher ratios for grade specific, course specific, and certification specific needs, while the sixth seeks to improve the quality of curricula offerings. The components of projected needs are:

- replacements due to changes in enrollment patterns and expected retirements of kindergarten (k) teachers; and
- replacements due to changes in enrollment patterns and expected retirements of primary (p) school teachers; and,
- replacements due to changes in enrollment patterns and expected retirements of secondary school teachers in known courses (j);
- replacements due to expected retirements of other secondary teachers; and,
- replacements due to historical, voluntary quits; and,
- additional hires to achieve elective offerings in secondary grades at an enrollment rate of the median district which offered such courses in 1989/90.

Using the notation above, our final model of hiring, $\hat{H}$, is:

$$\hat{H} = \hat{H}_k + \hat{H}_p + \sum_{j=1}^{128} \hat{H}_j + \hat{H}_s + Q + \sum_{j=1}^{128} \hat{T}^{best}_{j,1999/2000} \tag{4.13}$$

In the empirical work below, we will report each of the components of 4.13 so that we can test the validity of the determination of total hiring needs. Also, we will solve $\hat{H}$ each year, and find the number of teachers to be hired under 4.13.

# Chapter 5

# Historical Aspects of Teacher Demand and Supply

## 5.1 Introduction

The purpose of this chapter is to review empirically: i] several aspects of teacher training institutions; ii] recent characteristics of employed teachers in the 1980's; iii] recent characteristics of enrolled students in the 1980's; iv] characteristics of curricula in Pennsylvania's school districts; and v] the aggregate interactions of teacher supply and demand. Considerable attention is devoted to developing analysis both at the state, metropolitan, and county levels to enable the reader with geographic interests to identify particular trends.

## 5.2 Sources of Pennsylvania's Classroom Teachers

### 5.2.1 Traditional Sources of Teachers: Pennsylvania's Certificate Granting Institutions

According to the Pennsylvania Department of Education's certification records, since 1950 some 434,512 individuals have earned at least one approved teaching certificate which enables them to teach in Pennsylvania. Of these 434,512, 108,267 or about 25% hold certificates from unknown certificate granting institutions (See Table 5.1). The bulk of these teaching certificates were earned out of state since the Department's coding structure treats "unknown" and "out of state" identically. Of those individuals whose most recent certificate granting institution are known, each of 17 institutions[1] out of better than 90 institutions, which ever issued certificates, accounted for 2% or more of the total number of certificates issued; overall, these 17 institutions accounted for 70% of the total number of approved teaching certificates. Four institutions (Penn State, Temple, Indiana, and West Chester) accounted for 5% or more individually, or 25% of the total number of certificated teachers.

The issuance of teaching certificates has varied over time. If we focus only on those certificates issued since 1965, for which the data are most reliable, we observe the number of certificates issued

[1]Penn State, Temple, Indiana University of Pennsylvania, West Chester, University of Pittsburgh, Millersville University of Pennsylvania, California University of Pennsylvania, Slippery Rock University of Pennsylvania, Edinboro University of Pennsylvania, Bloomsburg University, Kutztown, Shippensburg, Clarion, Duquesne, East Stroudsburgh, Mansfield and Lock Haven, in descending size of total certificates granted.

grew from 56,556 in the period 1966-70 to a peak of 119,963 in 1976-80 and then fell to 82,857 in the 1986-90 period [2](See Table 5.2).

While the Pennsylvania Department of Education must approve any teacher certification program, the Commonwealth does not provide direct financial assistance to all approved programs. The historical teacher training institutions, which evolved from two to four year institutions and now graduate degree issuing institutions, receive virtually all of their funding from the Commonwealth. These are officially classified as "state universities". [3]

The second group of certificate granting institutions are classified as "state related", and receive a significant share of their overall operating budget (over 20%) from the Commonwealth.[4] Three private universities, Drexel University, University of Pennsylvania and the University of the Arts, receive state funds, and are classified as "private related". There are 60 entirely private colleges and universities which offer approved certification programs, classified as "private", and a residual category, which we classify as "other/non-Pennsylvania", of 34 institutions which did not train teachers in 1990/1, were out of state programs, or were "unknown" programs.

[2]It should be noted that these figures represent the unduplicated counts of individuals with at least one Pennsylvania approved teaching certificate, and is a far larger number than the number of individuals who graduated from a teacher training institution each year because individuals may earn a certificate without earning an education degree.

[3]The state universities of Pennsylvania are: California, Slippery Rock, Edinboro, Clarion, Lock Haven, Millersville, Kutztown, Shippensburg, Bloomsburg, Mansfield , East Stroudsburgh, West Chester, Cheyney, and Indiana.

[4]The four state related universities are: Penn State University, University of Pittsburgh, Temple University, and Lincoln University.

Table 5.1: Sources of Certificated Teachers in Pennsylvania by Descending Size: 1950-1990

| College | Graduates | Percent | Cum Pct | College | Graduates | Percent | Cum Pct |
|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | | [6] | [7] | [8] |
| Out of State | 108,267 | 24.92% | | CMU | 989 | 0.30% | 93.30% |
| Penn State U | 26,373 | 7.93% | 7.93% | Widener U | 972 | 0.29% | 93.59% |
| Temple U | 21,823 | 6.56% | 14.49% | Juniata Coll | 933 | 0.28% | 93.87% |
| Indiana U of Pa | 19,138 | 5.75% | 20.25% | Albright College | 908 | 0.27% | 94.14% |
| West Chester U of Pa | 16,841 | 5.06% | 25.31% | Thiel College | 882 | 0.27% | 94.41% |
| U of Pittsburgh | 15,183 | 4.57% | 29.88% | Muhlenberg College | 829 | 0.25% | 94.66% |
| Millersville U of Pa | 15,012 | 4.51% | 34.39% | York College of Pa | 781 | 0.23% | 94.89% |
| Cal U of Pa | 14,537 | 4.37% | 38.76% | Kings Coll | 760 | 0.23% | 95.12% |
| Slippery Rock U of P | 13,558 | 4.08% | 42.84% | Eastern College | 756 | 0.23% | 95.35% |
| Edinboro U of Pa | 12,823 | 3.86% | 46.69% | U of the Arts | 748 | 0.22% | 95.57% |
| Bloomsburg U of Pa | 11,499 | 3.46% | 50.15% | Dickinson Colleg | 708 | 0.21% | 95.78% |
| Kutztown U of Pa | 11,290 | 3.39% | 53.55% | Point Park Coll | 672 | 0.20% | 95.99% |
| Shippensburg U of Pa | 9,884 | 2.97% | 56.52% | Chatham Coll | 665 | 0.20% | 96.19% |
| Clarion U of Pa | 9,821 | 2.95% | 59.47% | Allegheny College | 605 | 0.18% | 96.37% |
| Duquesne U | 9,234 | 2.78% | 62.25% | Rosemont College | 605 | 0.18% | 96.55% |
| E Stroudsburgh U of | 8,192 | 2.46% | 64.71% | St Vincent College | 524 | 0.16% | 96.71% |
| Mansfield U of Pa | 7,368 | 2.22% | 66.93% | Wilson College | 520 | 0.16% | 96.86% |
| Lock Haven U | 6,518 | 1.96% | 68.89% | Alvernia College | 514 | 0.15% | 97.02% |
| Marywood Coll | 5,649 | 1.70% | 70.58% | Franklin and Marshal | 509 | 0.15% | 97.17% |
| U of Pennsylvania | 4,359 | 1.31% | 71.90% | Lafayette College | 416 | 0.13% | 97.30% |
| Cheyney U of Pa | 3,822 | 1.15% | 73.04% | Moore College of Art | 377 | 0.11% | 97.41% |
| Villanova U | 3,794 | 1.14% | 74.19% | Washington - Jeffers | 356 | 0.11% | 97.52% |
| Westminister College | 3,550 | 1.07% | 75.25% | Bryn Mawr Coll | 331 | 0.10% | 97.62% |
| Immaculata Coll | 3,006 | 0.90% | 76.16% | Robert Morris Coll | 275 | 0.08% | 97.70% |
| Lehigh U | 2,931 | 0.88% | 77.04% | Swarthmore College | 265 | 0.08% | 97.78% |
| Chestnut Hill Coll | 2,705 | 0.81% | 77.85% | Lincoln U | 249 | 0.07% | 97.85% |
| Wilkes U | 2,613 | 0.79% | 78.64% | St. Bonaventure of N | 207 | 0.06% | 97.92% |
| College Misericordia | 2,484 | 0.75% | 79.38% | Allentown Coll/St Fr | 126 | 0.04% | 97.95% |
| Beaver College | 2,426 | 0.73% | 80.11% | Neumann College | 114 | 0.03% | 97.99% |
| Grove City | 2,384 | 0.72% | 80.83% | Philadelphia Coll of | 106 | 0.03% | 98.02% |
| Geneva Coll | 2,263 | 0.68% | 81.51% | Alliance College | 71 | 0.02% | 98.04% |
| U of Scranton | 2,220 | 0.67% | 82.18% | Combs College of Mus | 45 | 0.01% | 98.06% |
| Carlow College | 2,188 | 0.66% | 82.84% | Delaware Valley Coll | 25 | 0.01% | 98.06% |
| Bucknell U | 2,094 | 0.63% | 83.47% | St Charles Seminary | 24 | 0.01% | 98.07% |
| St Josephs U | 2,045 | 0.61% | 84.08% | Phil College of Text | 23 | 0.01% | 98.08% |
| Elizabethtown Coll | 1,906 | 0.57% | 84.65% | Haverford College | 15 | 0.00% | 98.08% |
| Mercyhurst Coll | 1,846 | 0.56% | 85.21% | Phila Coll of Pharma | 10 | 0.00% | 98.08% |
| LaSalle U | 1,832 | 0.55% | 85.76% | Pa College of Optome | 10 | 0.00% | 98.09% |
| Seton Hill College | 1,780 | 0.54% | 86.29% | Ursinus College | 8 | 0.00% | 98.09% |
| St Francis College | 1,739 | 0.52% | 86.82% | Laroche College | 4 | 0.00% | 98.09% |
| Lebanon Valley Coll | 1,585 | 0.48% | 87.29% | Eastern Baptist Theo | 3 | 0.00% | 98.09% |
| Gettysburgh Coll | 1,582 | 0.48% | 87.77% | Curtis Music Institu | 3 | 0.00% | 98.09% |
| Cabrini Coll | 1,535 | 0.46% | 88.23% | Penn State-Harrisbur | 3 | 0.00% | 98.09% |
| Gwynedd-Mercy Coll | 1,455 | 0.44% | 88.67% | Gratz College | 2 | 0.00% | 98.09% |
| Antioch Univ | 1,400 | 0.42% | 89.09% | Mary Immaculate Semi | 1 | 0.00% | 98.09% |
| Villa Maria College | 1,317 | 0.40% | 89.49% | Allegh Comm College | 1 | 0.00% | 98.10% |
| Messiah Coll | 1,311 | 0.39% | 89.88% | Lutheran Theo Semina | 1 | 0.00% | 98.10% |
| Lycoming Coll | 1,260 | 0.38% | 90.26% | Lehigh Comm College | 1 | 0.00% | 98.10% |
| Ursinus Colege | 1,251 | 0.38% | 90.64% | Comm College of Beav | 1 | 0.00% | 98.10% |
| Moravian College | 1,226 | 0.37% | 91.00% | Hahnemann University | 1 | 0.00% | 98.10% |
| Susquehanna U | 1,202 | 0.36% | 91.37% | Pa Business Institut | 1 | 0.00% | 98.10% |
| Drexel U | 1,184 | 0.36% | 91.72% | Christ the Saviour S | 1 | 0.00% | 98.10% |
| Cedar Crest Coll | 1,172 | 0.35% | 92.07% | Northampton County A | 1 | 0.00% | 98.10% |
| Holy Family Colle | 1,046 | 0.31% | 92.39% | Butler Comm College | 1 | 0.00% | 98.10% |
| Waynesburgh Coll | 1,032 | 0.31% | 92.70% | Comm Coll of Philade | 1 | 0.00% | 98.10% |
| Gannon U | 998 | 0.30% | 93.00% | | | | |
| | | | | Grand Total | 434,512 | 100.00% | |

Source: Tabulations of Pennsylvania Department of Education certification file

Table 5.2: Certificated Teachers By Granting Institution: 1950-90

| Certificate Grant Inst | 1950-90 | < 1950 | 1951-5 | 1956-60 | 1961-65 | 1966-70 | 1971-5 | 1976-80 | 1981-5 | 1986-90 |
|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] |
| Albright College | 908 | 3 | 2 | 3 | 14 | 158 | 269 | 259 | 83 | 117 |
| Allegh Comm College | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Allegheny College | 605 | 6 | 4 | 17 | 28 | 141 | 156 | 130 | 50 | 73 |
| Allentown Coll/St Fran | 126 | 0 | 0 | 0 | 0 | 0 | 5 | 45 | 29 | 47 |
| Alliance College | 71 | 0 | 0 | 1 | 4 | 13 | 35 | 14 | 4 | 0 |
| Alvernia College | 514 | 16 | 0 | 0 | 0 | 52 | 102 | 144 | 68 | 132 |
| Antioch Univ | 1,400 | 0 | 0 | 0 | 1 | 0 | 51 | 469 | 377 | 502 |
| Beaver College | 2,426 | 6 | 5 | 7 | 26 | 281 | 270 | 495 | 555 | 781 |
| Bloomsburg U of Pa | 11,498 | 44 | 26 | 57 | 180 | 1,425 | 2,153 | 3,415 | 1,819 | 2,379 |
| Bryn Mawr College | 331 | 1 | 0 | 0 | 3 | 17 | 38 | 106 | 81 | 85 |
| Bucknell U | 2,094 | 15 | 18 | 21 | 30 | 316 | 431 | 578 | 316 | 369 |
| Butler Comm College | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Carnegie-Mellon U | 989 | 15 | 13 | 15 | 40 | 304 | 306 | 239 | 29 | 28 |
| Cabrini College | 1,535 | 0 | 0 | 0 | 10 | 136 | 243 | 359 | 339 | 448 |
| Cal U of Pa | 14,536 | 35 | 22 | 39 | 205 | 2,057 | 3,931 | 4,209 | 1,879 | 2,159 |
| Carlow College | 2,188 | 7 | 35 | 44 | 100 | 427 | 537 | 446 | 204 | 388 |
| Cedar Crest College | 1,172 | 6 | 1 | 1 | 15 | 273 | 311 | 261 | 135 | 169 |
| Chatham College | 665 | 7 | 3 | 7 | 15 | 104 | 179 | 151 | 63 | 136 |
| Chestnut Hill College | 2,705 | 7 | 3 | 5 | 18 | 668 | 695 | 587 | 314 | 408 |
| Cheyney U of Pa | 3,822 | 8 | 16 | 41 | 182 | 513 | 753 | 1,187 | 566 | 556 |
| Christ the Saviour Semina | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Clarion U of Pa | 9,821 | 15 | 25 | 48 | 173 | 1,402 | 2,405 | 2,848 | 1,388 | 1,517 |
| College Misericordia | 2,484 | 58 | 36 | 66 | 94 | 530 | 588 | 647 | 250 | 215 |
| Combs College of Music | 45 | 0 | 0 | 0 | 1 | 3 | 2 | 1 | 14 | 24 |
| Comm Coll of Philadelphia | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Comm College of Beaver Cn | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Curtis Music Institute | 3 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 |
| Delaware Valley College | 25 | 0 | 0 | 0 | 0 | 12 | 11 | 2 | 0 | 0 |
| Dickinson College | 708 | 5 | 3 | 6 | 13 | 131 | 155 | 165 | 115 | 115 |
| Drexel U | 1,184 | 7 | 7 | 5 | 21 | 202 | 329 | 377 | 106 | 130 |
| Duquesne U | 9,234 | 75 | 103 | 123 | 166 | 1,170 | 2,206 | 2,721 | 1,140 | 1,530 |
| E Stroudsburgh U of Pa | 8,192 | 27 | 18 | 39 | 102 | 955 | 1,541 | 2,773 | 1,391 | 1,346 |
| Eastern Baptist Theo Semi | 3 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 |
| Eastern College | 756 | 0 | 0 | 0 | 4 | 83 | 145 | 187 | 109 | 228 |
| Edinboro U of Pa | 12,823 | 22 | 11 | 38 | 146 | 1,392 | 3,248 | 4,088 | 1,788 | 2,090 |
| Elizabethtown College | 1,906 | 13 | 7 | 14 | 30 | 361 | 547 | 476 | 216 | 242 |
| Franklin and Marshall | 509 | 2 | 1 | 2 | 5 | 98 | 157 | 194 | 47 | 3 |
| Gannon U | 998 | 0 | 0 | 8 | 21 | 140 | 231 | 270 | 124 | 204 |
| Geneva College | 2,263 | 13 | 11 | 15 | 21 | 346 | 651 | 613 | 304 | 289 |
| Gettysburgh College | 1,582 | 4 | 3 | 7 | 36 | 331 | 334 | 455 | 222 | 190 |
| Gratz College | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| Grove City | 2,384 | 23 | 6 | 10 | 51 | 405 | 462 | 603 | 356 | 468 |
| Gwynedd-Mercy College | 1,455 | 0 | 0 | 0 | 0 | 120 | 361 | 348 | 247 | 379 |
| Hahnemann University | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Haverford College | 15 | 1 | 0 | 0 | 2 | 9 | 2 | 1 | 0 | 0 |
| Holy Family College | 1,046 | 0 | 0 | 0 | 3 | 102 | 235 | 327 | 136 | 243 |
| Immaculata College | 3,006 | 26 | 10 | 22 | 61 | 365 | 849 | 844 | 479 | 350 |
| Indiana U of Pa | 19,138 | 75 | 73 | 118 | 325 | 2,866 | 4,382 | 5,496 | 2,641 | 3,162 |
| Juniata College | 933 | 18 | 7 | 10 | 38 | 197 | 233 | 198 | 94 | 138 |
| Kings College | 760 | 1 | 1 | 2 | 12 | 125 | 202 | 240 | 82 | 95 |
| Kutztown U of Pa | 11,290 | 30 | 28 | 42 | 116 | 1,206 | 2,437 | 3,399 | 1,708 | 2,324 |
| LaSalle U | 1,832 | 2 | 2 | 13 | 53 | 227 | 307 | 577 | 275 | 376 |
| Lafayette College | 416 | 9 | 2 | 3 | 2 | 42 | 115 | 147 | 42 | 54 |
| Laroche College | 4 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 |
| Lebanon Valley College | 1,585 | 9 | 13 | 19 | 33 | 226 | 312 | 471 | 241 | 261 |
| Lehigh Comm College | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Lehigh U | 2,931 | 2 | 3 | 8 | 8 | 154 | 515 | 1,095 | 496 | 650 |
| Lincoln U | 249 | 2 | 1 | 5 | 12 | 30 | 37 | 67 | 52 | 43 |
| Lock Haven U | 6,518 | 25 | 29 | 30 | 155 | 839 | 1,382 | 1,790 | 1,128 | 1,140 |
| Lutheran Theo Seminary | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Lycoming College | 1,260 | 0 | 0 | 6 | 27 | 288 | 358 | 283 | 96 | 202 |
| Mansfield U of Pa | 7,368 | 36 | 22 | 23 | 88 | 1,106 | 1,974 | 2,207 | 892 | 1,020 |
| Mary Immaculate Seminary | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Marywood College | 5,649 | 99 | 56 | 167 | 157 | 937 | 1,244 | 1,512 | 745 | 732 |
| Mercyhurst College | 1,846 | 8 | 4 | 17 | 65 | 291 | 368 | 465 | 290 | 338 |
| Messiah College | 1,311 | 0 | 0 | 0 | 0 | 55 | 160 | 383 | 304 | 409 |
| Millersville U of Pa | 15,012 | 38 | 23 | 54 | 168 | 1,563 | 2,909 | 4,523 | 2,463 | 3,271 |
| Moore College of Art | 377 | 1 | 3 | 1 | 14 | 82 | 96 | 111 | 27 | 42 |
| Moravian College | 1,226 | 2 | 2 | 8 | 19 | 213 | 278 | 313 | 178 | 213 |
| Muhlenberg College | 829 | 6 | 2 | 4 | 15 | 180 | 213 | 240 | 82 | 87 |
| Neumann College | 114 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 38 | 70 |
| Northampton County Area C | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Pa Business Institute | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Pa College of Optometry | 10 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 9 |
| Penn State U | 26,373 | 62 | 85 | 133 | 423 | 3,551 | 5,799 | 8,310 | 3,755 | 4,255 |

[continued on next page]

| Certificate Grant Inst | 1950-90 | < 1950 | 1951-5 | 1956-60 | 1961-65 | 1966-70 | 1971-5 | 1976-80 | 1981-5 | 1986-90 |
|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] |
| Phil College of Textiles | 23 | 0 | 0 | 0 | 1 | 11 | 6 | 5 | 0 | 0 |
| Phila Coll of Pharmacy | 10 | 0 | 0 | 1 | 3 | 6 | 0 | 0 | 0 | 0 |
| Philadelphia Coll of Bibl | 106 | 0 | 0 | 0 | 0 | 2 | 3 | 1 | 0 | 100 |
| Point Park College | 672 | 0 | 0 | 0 | 0 | 62 | 238 | 186 | 71 | 115 |
| Robert Morris College | 275 | 0 | 0 | 0 | 0 | 0 | 21 | 73 | 81 | 100 |
| Rosemont College | 605 | 5 | 1 | 4 | 17 | 110 | 110 | 166 | 72 | 120 |
| Seton Hill College | 1,780 | 18 | 11 | 12 | 61 | 263 | 359 | 441 | 257 | 358 |
| Shippensburg U of Pa | 9,884 | 25 | 26 | 49 | 136 | 1,490 | 2,546 | 2,794 | 1,245 | 1,573 |
| Slippery Rock U of Pa | 13,558 | 24 | 26 | 38 | 135 | 1,451 | 3,219 | 4,288 | 2,004 | 2,373 |
| St Bonaventure U, NY | 207 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 76 | 117 |
| St Charles Seminary | 24 | 0 | 0 | 2 | 0 | 9 | 12 | 1 | 0 | 0 |
| St Francis College | 1,739 | 3 | 2 | 12 | 29 | 391 | 522 | 409 | 161 | 210 |
| St Josephs U | 2,045 | 1 | 0 | 4 | 30 | 302 | 545 | 613 | 214 | 336 |
| St Vincent College | 524 | 3 | 2 | 2 | 7 | 96 | 141 | 88 | 60 | 125 |
| Susquehanna U | 1,202 | 10 | 4 | 2 | 27 | 205 | 238 | 348 | 160 | 208 |
| Swarthmore College | 265 | 1 | 0 | 0 | 7 | 26 | 72 | 77 | 39 | 43 |
| Temple U | 21,823 | 93 | 92 | 225 | 556 | 2,764 | 4,272 | 7,279 | 3,417 | 3,125 |
| Thiel College | 882 | 2 | 1 | 4 | 30 | 192 | 269 | 236 | 66 | 82 |
| U of Pennsylvania | 4,359 | 46 | 39 | 65 | 168 | 687 | 886 | 1,199 | 615 | 654 |
| U of Pittsburgh | 15,183 | 60 | 79 | 124 | 174 | 1,359 | 3,193 | 4,697 | 2,397 | 3,100 |
| U of Scranton | 2,218 | 8 | 2 | 5 | 15 | 217 | 367 | 727 | 354 | 523 |
| U of the Arts | 748 | 1 | 6 | 7 | 11 | 175 | 166 | 207 | 99 | 76 |
| Unknown | 114,590 | 5,987 | 323 | 810 | 4,112 | 12,966 | 13,914 | 23,361 | 19,871 | 26,920 |
| Ursinus Colege | 1,251 | 13 | 11 | 9 | 29 | 230 | 301 | 369 | 145 | 144 |
| Ursinus College | 8 | 0 | 0 | 0 | 0 | 1 | 5 | 1 | 1 | 0 |
| Villa Maria College | 1,317 | 20 | 9 | 9 | 63 | 296 | 325 | 276 | 162 | 157 |
| Villanova U | 3,794 | 75 | 20 | 65 | 96 | 269 | 844 | 1,356 | 492 | 577 |
| Washington and Jefferson | 356 | 1 | 0 | 1 | 5 | 43 | 92 | 104 | 46 | 64 |
| Waynesburgh College | 1,032 | 11 | 4 | 8 | 30 | 301 | 296 | 180 | 86 | 116 |
| West Chester U of Pa | 16,841 | 96 | 64 | 118 | 289 | 2,187 | 3,745 | 5,279 | 2,564 | 2,499 |
| Westminister College | 3,550 | 14 | 12 | 10 | 55 | 562 | 827 | 1,048 | 522 | 500 |
| Widener U | 972 | 0 | 0 | 0 | 1 | 60 | 146 | 113 | 125 | 527 |
| Wilkes U | 2,613 | 0 | 2 | 6 | 23 | 465 | 703 | 853 | 235 | 326 |
| Wilson College | 520 | 3 | 2 | 7 | 9 | 125 | 129 | 79 | 13 | 153 |
| York College of Pa | 781 | 0 | 0 | 0 | 0 | 1 | 98 | 226 | 151 | 305 |
| Total Certificates Issued | 434,505 | 7,412 | 1,483 | 2,924 | 9,673 | 56,556 | 86,864 | 119,963 | 66,773 | 82,857 |

Source: Tabulations of Pennsylvania Department of Education certification file

Table 5.3 displays the aggregate numbers of certificate holders by type of institution in five year intervals. In a five year period, the state universities trained as many as 42% of certificate holders, while the state-related institutions trained approximately 17%, and the private institutions trained as many as 24%. Overall, the state universities accounted for 37% of the total number of certificated individuals, state related institutions accounted for 15%, the private related institutions accounted for 1.5%, private colleges and universities account for 26%, and the balance (26%) were from out of state.

Table 5.3: Teaching Certificates by Type of Institution: 1950-90

| Year | State Univ. | State Related | Private State-Rel. | Private Coll./U. | Other/ NonPa. | Total |
|---|---|---|---|---|---|---|
| <1950 | 500 | 217 | 54 | 618 | 6,024 | 7,413 |
| % Share | 6.74% | 2.93% | 0.73% | 8.34% | 81.26% | |
| 1951-5 | 409 | 257 | 52 | 421 | 344 | 1,483 |
| % Share | 27.58% | 17.33% | 3.51% | 28.39% | 23.20% | |
| 1956-60 | 734 | 487 | 77 | 791 | 835 | 2,924 |
| % Share | 25.10% | 16.66% | 2.63% | 27.05% | 28.56% | |
| 1961-5 | 2,400 | 1,165 | 200 | 1,684 | 4,224 | 9,673 |
| % Share | 24.81% | 12.04% | 2.07% | 17.41% | 43.67% | |
| 1966-70 | 20,452 | 7,704 | 1,064 | 13,671 | 13,662 | 56,553 |
| % Share | 36.16% | 13.62% | 1.88% | 24.17% | 24.16% | |
| 1971-5 | 36,625 | 13,301 | 1,381 | 20,732 | 14,825 | 86,864 |
| % Share | 42.16% | 15.31% | 1.59% | 23.87% | 17.07% | |
| 1976-80 | 48,296 | 20,353 | 1,783 | 24,822 | 24,709 | 119,963 |
| % Share | 40.26% | 16.97% | 1.49% | 20.69% | 20.60% | |
| 1981-85 | 23,476 | 9,621 | 820 | 12,160 | 20,696 | 66,773 |
| % Share | 35.16% | 14.41% | 1.23% | 18.21% | 30.99% | |
| 1986-90 | 27,409 | 10,523 | 860 | 16,189 | 27,876 | 82,857 |
| % Share | 33.08% | 12.70% | 1.04% | 19.54% | 33.64% | |
| Total | 160,301 | 63,628 | 6,291 | 91,088 | 113,195 | 434,503 |
| % Share | 36.89% | 14.64% | 1.45% | 20.96% | 26.05% | 100.00% |

Source: Tabulations of PDE certification file

The geographic distribution of certificating institutions and their graduates is quite varied. In the Erie MSA, 16,984 certificates have been awarded over the period 1950-1990 (See Table 5.4); however the vast bulk of the certificates (12,823 of the 16,984) were from the public university system. Five metropolitan areas (Erie, Harrisburg, Lancaster, Reading, and the non-MSA portion

of the state) granted 3/4 or more of their certificates from the public university system. On the other hand, six metropolitan areas, (Allentown, Johnstown, Sharon, Williamsport, York, and Beaver) granted 99% or more of their certificates from private colleges and universities. (See Table 5.5).

Table 5.4: Total Certifications by Metropolitan Statistical Area of Training and Type of Institution: 1950-1990

| MSA | State Univ. | State Related | Private Related | Private | Other/ Non-Pa. | Total All Types |
|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] |
| Allentown | 0 | 0 | 0 | 6,700 | 4 | 6,704 |
| Erie | 12,823 | 0 | 0 | 2,844 | 1,317 | 16,984 |
| Harrisburg | 9,884 | 0 | 0 | 3,604 | 0 | 13,488 |
| Johnstown | 0 | 0 | 0 | 1,739 | 1 | 1,740 |
| Lancaster | 15,012 | 0 | 0 | 1,906 | 509 | 17,427 |
| Scranton | 19,691 | 0 | 0 | 13,726 | 0 | 33,417 |
| Philadelphia | 20,663 | 22,072 | 6,291 | 23,378 | 2,813 | 75,217 |
| Pittsburgh | 14,537 | 15,183 | 0 | 16,683 | 5 | 46,408 |
| Reading | 11,290 | 0 | 0 | 1,422 | 0 | 12,712 |
| Sharon | 0 | 0 | 0 | 3,266 | 0 | 3,266 |
| State College | 0 | 26,373 | 0 | 0 | 0 | 26,373 |
| Williamsport | 0 | 0 | 0 | 1,260 | 0 | 1,260 |
| York | 0 | 0 | 0 | 2,363 | 1 | 2,364 |
| Beaver | 0 | 0 | 0 | 2,263 | 1 | 2,264 |
| NonMSA | 56,403 | 0 | 0 | 9,936 | 72 | 66,411 |
| NonPa | 0 | 0 | 0 | 0 | 108,475 | 108,475 |
| Total | 160,303 | 63,628 | 6,291 | 91,090 | 113,198 | 434,510 |

Source: tabulations of Pennsylvania Department of Education certification file.

Table 5.5: % Total Certifications by Metropolitan Statistical Area of Training and Type of Institution: 1950-1990

| MSA | % State Univ. | % State Related | % Private Related | % Private | % Other/ Non-Pa. |
|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] |
| Allentown | 0.0% | 0.0% | 0.0% | 99.9% | 0.1% |
| Erie | 75.5% | 0.0% | 0.0% | 16.7% | 7.8% |
| Harrisburg | 73.3% | 0.0% | 0.0% | 26.7% | 0.0% |
| Johnstown | 0.0% | 0.0% | 0.0% | 99.9% | 0.1% |
| Lancaster | 86.1% | 0.0% | 0.0% | 10.9% | 2.9% |
| Scranton | 58.9% | 0.0% | 0.0% | 41.1% | 0.0% |
| Philadelphia | 27.5% | 29.3% | 8.4% | 31.1% | 3.7% |
| Pittsburgh | 31.3% | 32.7% | 0.0% | 35.9% | 0.0% |
| Reading | 88.8% | 0.0% | 0.0% | 11.2% | 0.0% |
| Sharon | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% |
| State College | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% |
| Williamsport | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% |
| York | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% |
| Beaver | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% |
| NonMSA | 84.9% | 0.0% | 0.0% | 15.0% | 0.1% |
| NonPa | 0.0% | 0.0% | 0.0% | 0.0% | 100.0% |

Source: tabulations of Pennsylvania Department of Education certification file.

The number of certificated individuals employed in Pennsylvania local area school districts is, of course, far smaller than the total number of individuals ever certificated. In 1981/2, 123,696 certificated persons were employed by local public educational institutions as administrators, classroom teachers, and coordinators. By 1990/1, this number had grown to 132,281 (a 6.9% increase) (See Table 5.6). [5] It should also be noted that the total number of classroom teachers shown at the bottom of Table 5.6 includes teachers employed by intermediate units and area vocational schools. Of interest is the rather marked increase (60%) in the number of coordinators by the close of the 1980's vis a vis the beginning of the decade.

In terms of round figures, there have been approximately 98,000 classroom teachers in Pennsylvania's public schools (excluding intermediate units and area vocational schools) in the 1950-1990 period. Table 5.7 displays the distribution of these classroom teachers for the beginning, middle,

[5]Some caution should be exercised in interpreting professional personnel figures for Philadelphia. Prior to 1990/1, the figures for Philadelphia may be less accurate due to differences in definition and record keeping in Philadelphia. Also, Philadelphia figures do not reflect the significant number of permanent, temporary teachers which it employs.

and end of the decade by class of school district. The numbers of elementary and secondary school teachers has been roughly equivalent, on the order of 40,000 each, and there are an additional 18,000 special education teachers; note that the number of special education teachers grew from 13,374 to 18,421 (a 37.7% increase in the 1980's).

Table 5.6: Distribution of Certificated Professional Personnel: 1981/2, 1984/5 and 1990/1

| School District | Administrators | | | Teachers | | | Coordinators | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1981/2 | 1984/5 | 1990/1 | 1981/2 | 1984/5 | 1990/1 | 1981/2 | 1984/5 | 1990/1 |
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| Philadelphia | 786 | 768 | 929 | 12,092 | 11,739 | 11,831 | 1,276 | 1,204 | 2,599 |
| Pittsburgh | 215 | 210 | 243 | 2,838 | 2,757 | 2,813 | 279 | 254 | 486 |
| 2nd Class | 1,751 | 1,693 | 1,836 | 28,471 | 27,994 | 27,823 | 3,130 | 2,856 | 4,812 |
| 3rd Class | 3,023 | 2,966 | 3,462 | 52,904 | 52,174 | 53,772 | 5,120 | 5,089 | 8,256 |
| 4th Class | 98 | 95 | 105 | 1,533 | 1,524 | 1,628 | 150 | 151 | 252 |
| Intermediate Units | 415 | 412 | 419 | 5,806 | 5,989 | 6,998 | 1,069 | 986 | 1,390 |
| Area Vo Techs | 234 | 224 | 216 | 2,241 | 2,165 | 2,115 | 265 | 246 | 296 |
| Total | 6,522 | 6,368 | 7,210 | 105,885 | 104,342 | 106,980 | 11,289 | 10,786 | 18,091 |

Source: Analysis of Pennsylvania Department of Education professional personnel files

Table 5.7: Distribution of Types of Classroom Teachers by Type of Employer

| Teacher Assign. | Philadelphia | | | District Pittsburgh | | | 2nd Class | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1981/2 | 1984/5 | 1990/1 | 1981/2 | 1984/5 | 1990/1 | 1981/2 | 1984/5 | 1990/1 |
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| Elementary | 6,799 | 6,664 | 5,356 | 1,316 | 945 | 1,280 | 11,492 | 11,051 | 11,799 |
| Secondary | 2,922 | 2,657 | 3,202 | 1,146 | 883 | 1,064 | 13,740 | 12,880 | 11,939 |
| Special, K-12 | 75 | 85 | 1,201 | 0 | 561 | 124 | 1,170 | 1,895 | 1,620 |
| Special Ed | 2,096 | 2,146 | 1,910 | 323 | 299 | 297 | 1,679 | 1,814 | 2,335 |
| Speech Correction | 0 | 0 | 162 | 45 | 43 | 48 | 110 | 112 | 130 |
| Dept. Head | 200 | 187 | | 18 | 26 | | 280 | 242 | |
| Total | 12,092 | 11,739 | 11,831 | 2,838 | 2,757 | 2,813 | 28,471 | 27,994 | 27,823 |

| | 3rd Class | | | 4th Class | | | Interm. Units | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1981/2 | 1984/5 | 1990/1 | 1981/2 | 1984/5 | 1990/1 | 1981/2 | 1984/5 | 1990/1 |
| | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] | [20] |
| Elementary | 22,895 | 22,036 | 23,549 | 660 | 647 | 689 | 183 | 176 | 251 |
| Secondary | 26,044 | 25,468 | 24,615 | 737 | 742 | 736 | 96 | 77 | 300 |
| Special, K-12 | 2,070 | 2,685 | 3,230 | 91 | 88 | 126 | 75 | 84 | 53 |
| Special Ed | 1,433 | 1,553 | 2,324 | 45 | 47 | 77 | 4,287 | 4,489 | 5,084 |
| Speech Correction | 44 | 42 | 54 | 0 | 0 | 0 | 1,163 | 1,162 | 1,310 |
| Dept. Head | 418 | 390 | | 0 | 0 | | 2 | 1 | |
| Total | 52,904 | 52,174 | 53,772 | 1,533 | 1,524 | 1,628 | 5,806 | 5,989 | 6,998 |

| | Area Votechs | | | All Schools | | |
|---|---|---|---|---|---|---|
| | 1981/2 | 1984/5 | 1990/1 | 1981/2 | 1984/5 | 1990/1 |
| | [22] | [23] | [24] | [25] | [26] | [27] |
| Elementary | 2 | 2 | 5 | 43,337 | 41,521 | 42,929 |
| Secondary | 2,206 | 2,139 | 2,069 | 46,891 | 44,846 | 43,925 |
| Special, K-12 | 0 | | 7 | 3,481 | 5,398 | 6,361 |
| Special Ed | 30 | 24 | 33 | 9,893 | 10,372 | 12,060 |

*continued on next page*

| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
|---|---|---|---|---|---|---|---|---|---|
| Speech Correction | 0 | 0 | 1 | | | | 1,362 | 1,359 | 1,705 |
| Dept. Head | 3 | 0 | NA | | | | 921 | 846 | NA |
| Total | 2,241 | 2,165 | 2,115 | | | | 105,885 | 104,342 | 106,980 |

Source: Analysis of Pennsylvania Department of Education professional personnel files.

### 5.2.2 The Latent Supplies of Teachers: Retirees and Certificated Non-Teachers

Under Pennsylvania school retirement law, a teacher becomes eligible for retirement benefits after 10 years of total service. While relatively few teachers choose to retire after only 10 years of service, there are many retired teachers living in Pennsylvania who are still young enough to teach. We explore here the numbers of retirees by certification to ascertain if they might constitute a significant additional source of teachers should the need arise.

We compare the certifications of employed classroom teachers in 1990/1 with these two potential measures of latent teacher supply: the numbers of persons ever certified under the age of 70, drawn from the Department of Education's certification files (Latent $S_1$), and the number of retired classroom teachers who reside in Pennsylvania and who are under the age of 65 (Latent $S_2$). Table 5.8 compares the distribution of employed teachers by first certification area to these measures of latent supply, and computes the ratio of the number currently employed, by first area of certificated assignment, to the two measures of latent supply. Column [5] indicates that there are 316,032 certificated persons not teaching. This is, of course, the upper bound on the size of the potential supply, since retirees are included. Column [6] displays the number of retired classroom teachers; there are 11,460 such individuals, and probably represents a lower bound on the number of potential teachers who might be encouraged to return to teaching on at least a part-time basis.

We may consider the ratio of retirees to currently employed teachers in a given certification area as the maximum replacement rate which could be achieved were retirees enticed back into the classroom. It is evident that this ratio varies substantially. Areas with less than a 10% potential supply replacement rate include: Art, General Elementary, Early Childhood, French, Spanish, Health/Physical Education, Home Economics, Mathematics, Music, Biology, Chemistry, Earth/Space Science, Physics, Mentally/Physically Handicapped, and Visually Impaired (See Table 5.8).

Table 5.8: 1990/1 Employed vrs. Total and Retired Certified Teachers: 1st Certification Area

| Code | Certification Title | Total # 22<Age<70 | Current 1990/1 | Tot-Curr Latent $S_1$ | PA Retired Latent $S_2$ | Latent $S_1$/ Current | Latent $S_2$/ Current |
|---|---|---|---|---|---|---|---|
| | | [3] | [4] | [5] | [6] | [7] | [8] |
| 1100 | Adm/Supervisory | 5,408 | 925 | 4,483 | 955 | 484.6% | 103.2% |
| 1150 | Coordinate Service | 19,365 | 341 | 19,024 | 819 | 5578.9% | 240.2% |
| 1200 | Agriculture | 947 | 231 | 716 | 42 | 310.0% | 18.2% |
| 1600 | Business Education | 8,039 | 1,940 | 6,099 | 237 | 314.4% | 12.2% |
| 2000 | Vocational Ed | 5,914 | 789 | 5,125 | 431 | 649.6% | 54.6% |
| 2100 | Vocational Tech Ed | 376 | 26 | 350 | 28 | 1346.2% | 107.7% |
| 2200 | Vocational Health | 333 | 17 | 316 | 17 | 1858.8% | 100.0% |
| 2300 | Art | 11,791 | 2,857 | 8,934 | 234 | 312.7% | 8.2% |
| 2810 | General Elementary | 150,375 | 37,301 | 113,074 | 2,982 | 303.1% | 8.0% |
| 2840 | Early Childhood | 6,917 | 1,109 | 5,808 | 52 | 523.7% | 4.7% |
| 3200 | English | 34,956 | 6,965 | 27,991 | 1,350 | 401.9% | 19.4% |

[continued on next page]

| Code | Certification Title | Total # 22<Age<70 | Current 1990/1 | Tot-Curr Latent $S_1$ | PA Retired Latent $S_2$ | Latent $S_1$/ Current | Latent $S_2$/ Current |
|---|---|---|---|---|---|---|---|
| | | [3] | [4] | [5] | [6] | [7] | [8] |
| 4410 | French | 5,174 | 996 | 4,178 | 92 | 419.5% | 9.2% |
| 4420 | German | 1,954 | 455 | 1,499 | 50 | 329.5% | 11.0% |
| 4430 | Spanish | 5,615 | 1,223 | 4,392 | 97 | 359.1% | 7.9% |
| 4490 | Other Languages | 1,030 | 177 | 853 | 25 | 481.9% | 14.1% |
| 4800 | Health/Phys Education | 23,140 | 5,350 | 17,790 | 316 | 332.5% | 5.9% |
| 5200 | Driver Education | 314 | 106 | 208 | 35 | 196.2% | 33.0% |
| 5600 | Home Economics | 7,950 | 1,856 | 6,094 | 190 | 328.3% | 10.2% |
| 6000 | Industrial Arts | 5,849 | 2,082 | 3,767 | 232 | 180.9% | 11.1% |
| 6800 | Mathematics | 18,327 | 5,139 | 13,188 | 482 | 256.6% | 9.4% |
| 7200 | Music | 14,762 | 3,677 | 11,085 | 256 | 301.5% | 7.0% |
| 7600 | Reading Specialist | 1,796 | 194 | 1,602 | 134 | 825.8% | 69.1% |
| 8410 | Biology | 10,202 | 2,588 | 7,614 | 253 | 294.2% | 9.8% |
| 8420 | Chemistry | 2,677 | 763 | 1,914 | 52 | 250.9% | 6.8% |
| 8430 | Earth/Space | 1,521 | 475 | 1,046 | 20 | 220.2% | 4.2% |
| 8450 | General Science | 2,778 | 795 | 1,983 | 279 | 249.4% | 35.1% |
| 8470 | Physics | 1,559 | 441 | 1,118 | 38 | 253.5% | 8.6% |
| 8490 | Other Science | 714 | 241 | 473 | 146 | 196.3% | 60.6% |
| 8800 | Social Studies | 34,119 | 6,433 | 27,686 | 1,026 | 430.4% | 15.9% |
| 9200 | Hearing Impaired | 1,158 | 46 | 1,112 | 20 | 2417.4% | 43.5% |
| 9210 | Gifted | 7 | 0 | 7 | 0 | 0.0% | 0.0% |
| 9230 | Mental/Phys Handicap | 16,975 | 3,325 | 13,650 | 169 | 410.5% | 5.1% |
| 9270 | Speech/Lang Impaired | 7,302 | 419 | 6,883 | 52 | 1642.7% | 12.4% |
| 9280 | Visually Impaired | 246 | 21 | 225 | 2 | 1071.4% | 9.5% |
| 9290 | Other Handicap | 987 | 132 | 855 | 18 | 647.7% | 13.6% |
| 9900 | Not Listed Elsewhere | 3,270 | 8,432 | 5,162 | 329 | | |
| 9901 | No Certification Area | 52 | 0 | 52 | 0 | | |
| | Total | 413,899 | 97,867 | 316,032 | 11,460 | 322.9% | 11.7% |

Source: Tabulations of Pennsylvania Department of Education and Pennsylvania school employees retirement system master file; 1990/1 personnel file.
Definitions:
[3]number of persons ever certified in area, age 22-70
[4] 1990/1 employed teachers
[5] column [3]-column[4]
[6]retirees in Pennsylvania under 70
[7][5]/[4]
[8] [6]/[4]

On the other hand, if one examines the second and third certifications of retirees, then only a few certification areas have potential supply replacement rates of 10% or less. (See Tables 5.9 and 5.10). More importantly, if one examines the ratio of non-teaching certificated individuals to the number currently employed, the potential supply replacement rates are virtually all 100% or more. (See Column [7] of Tables 5.8- 5.10). Of course locating these individuals and enticing them back into teaching are both significant informational activities. It seems reasonable to conjecture that many of those who are certificated but are not teaching now are doing other things which they find more rewarding.

Table 5.9: 1990/1 Employed vrs. Total and Retired Certified Teachers: 2nd Certification Area

| Code | Certification Title | Total # 22<Age<70 | Current 1990/1 | Tot-Curr Latent $S_1$ | PA Retired Latent $S_2$ | Latent $S_1$/ Current | Latent $S_2$/ Current |
|---|---|---|---|---|---|---|---|
| | | [3] | [4] | [5] | [6] | [7] | [8] |
| 1100 | Adm/Supervisory | 9,685 | 3,116 | 6,569 | 740 | 210.8% | 23.7% |
| 1150 | Coordinate Service | 12,649 | 1,889 | 10,760 | 546 | 569.6% | 28.9% |
| 1200 | Agriculture | 184 | 43 | 141 | 29 | 327.9% | 67.4% |
| 1600 | Business Education | 7,383 | 1,862 | 5,521 | 211 | 296.5% | 11.3% |
| 2000 | Vocational Education | 5,964 | 1,014 | 4,950 | 424 | 488.2% | 41.8% |
| 2100 | Vocational Tech Ed | 263 | 18 | 245 | 9 | 1361.1% | 50.0% |
| 2200 | Vocational Health | 275 | 23 | 252 | 17 | 1095.7% | 73.9% |
| 2300 | Art | 729 | 219 | 510 | 31 | 232.9% | 14.2% |
| 2810 | General Elementary | 12,494 | 3,800 | 8,694 | 585 | 228.8% | 15.4% |
| 2840 | Early Childhood | 9,747 | 2,369 | 7,378 | 106 | 311.4% | 4.5% |
| 3200 | English | 6,860 | 1,785 | 5,075 | 477 | 284.3% | 26.7% |
| 4410 | French | 1,892 | 579 | 1,313 | 95 | 226.8% | 16.4% |
| 4420 | German | 750 | 232 | 518 | 39 | 223.3% | 16.8% |
| 4430 | Spanish | 2,221 | 677 | 1,544 | 130 | 228.1% | 19.2% |
| 4490 | Other Languages | 764 | 225 | 539 | 39 | 239.6% | 17.3% |
| 4800 | Health/Phys Education | 1,708 | 555 | 1,153 | 156 | 207.7% | 28.1% |
| 5200 | Driver Education | 2,917 | 1,235 | 1,682 | 123 | 136.2% | 10.0% |
| 5600 | Home Economics | 524 | 142 | 382 | 63 | 269.0% | 44.4% |
| 6000 | Industrial Arts | 1,968 | 819 | 1,149 | 242 | 140.3% | 29.5% |
| 6800 | Mathematics | 3,261 | 1,113 | 2,148 | 214 | 193.0% | 19.2% |
| 7200 | Music | 617 | 199 | 418 | 48 | 210.1% | 24.1% |
| 7600 | Reading Specialist | 11,415 | 2,603 | 8,812 | 278 | 338.5% | 10.7% |
| 8410 | Biology | 1,928 | 638 | 1,290 | 181 | 202.2% | 28.4% |

[continued on next page]

| Code | Certification Title | Total # 22<Age<70 [3] | Current 1990/1 [4] | Tot-Curr Latent $S_1$ [5] | PA Retired Latent $S_2$ [6] | Latent $S_1$/ Current [7] | Latent $S_2$/ Current [8] |
|---|---|---|---|---|---|---|---|
| 8420 | Chemistry | 1,169 | 374 | 795 | 41 | 212.6% | 11.0% |
| 8430 | Earth/Space | 703 | 293 | 410 | 15 | 139.9% | 5.1% |
| 8450 | General Science | 8,630 | 2,753 | 5,877 | 406 | 213.5% | 14.7% |
| 8470 | Physics | 915 | 331 | 584 | 35 | 176.4% | 10.6% |
| 8490 | Other Science | 446 | 111 | 335 | 99 | 301.8% | 89.2% |
| 8800 | Social Studies | 11,921 | 3,469 | 8,452 | 1,285 | 243.6% | 37.0% |
| 9200 | Hearing Impaired | 725 | 45 | 680 | 12 | 1511.1% | 26.7% |
| 9210 | Gifted | 7 | 1 | 6 | 1 | 600.0% | 100.0% |
| 9230 | Mental/Phys Handicap | 16,103 | 4,388 | 11,715 | 311 | 267.0% | 7.1% |
| 9270 | Speech/Lang Impaired | 660 | 93 | 567 | 29 | 609.7% | 31.2% |
| 9280 | Visually Impaired | 678 | 57 | 621 | 15 | 1089.5% | 26.3% |
| 9290 | Other Handicap | 2,187 | 466 | 1,721 | 33 | 369.3% | 7.1% |
| 9900 | Not Listed Elsewhere | 16,593 | 10,145 | 6,448 | 709 | | |
| 9901 | No Certification Area | 257,269 | 50,186 | 207,083 | 3,686 | | |
| | Total | 414,204 | 97,867 | 316,337 | 11,460 | 323.2% | 11.7% |

Source: Tabulations of Pennsylvania Department of Education and Pennsylvania school employees retirement system master files.
For column definitions, see Table 5.8

## Table 5.10: 1990/1 Employed vrs. Total and Retired Certified Teachers: 3rd Certification Area

| Code | Certification Title | Total # 22<Age<70 [3] | Current 1990/1 [4] | Tot-Curr Latent $S_1$ [5] | PA Retired Latent $S_2$ [6] | Latent $S_1$/ Current [7] | Latent $S_2$/ Current [8] |
|---|---|---|---|---|---|---|---|
| 1100 | Adm/Supervisory | 9,648 | 2,529 | 7,119 | 797 | 281.5% | 31.5% |
| 1150 | Coordinate Service | 5,515 | 727 | 4,788 | 426 | 658.6% | 58.6% |
| 1200 | Agriculture | 80 | 22 | 58 | 13 | 263.6% | 59.1% |
| 1600 | Business Education | 5,223 | 1,454 | 3,769 | 212 | 259.2% | 14.6% |
| 2000 | Vocational Education | 4,271 | 846 | 3,425 | 298 | 404.8% | 35.2% |
| 2100 | Vocational Tech Ed | 212 | 20 | 192 | 5 | 960.0% | 25.0% |
| 2200 | Vocational Health | 268 | 22 | 246 | 11 | 1118.2% | 50.0% |
| 2300 | Art | 215 | 58 | 157 | 11 | 270.7% | 19.0% |
| 2810 | General Elementary | 3,132 | 1,056 | 2,076 | 291 | 196.6% | 27.6% |
| 2840 | Early Childhood | 463 | 142 | 321 | 27 | 226.1% | 19.0% |
| 3200 | English | 1,838 | 524 | 1,314 | 149 | 250.8% | 28.4% |
| 4410 | French | 362 | 120 | 242 | 35 | 201.7% | 29.2% |
| 4420 | German | 190 | 76 | 114 | 14 | 150.0% | 18.4% |
| 4430 | Spanish | 567 | 189 | 378 | 75 | 200.0% | 39.7% |
| 4490 | Other Languages | 346 | 107 | 239 | 27 | 223.4% | 25.2% |
| 4800 | Health/Phys Education | 670 | 236 | 434 | 94 | 183.9% | 39.8% |
| 5200 | Driver Education | 884 | 416 | 468 | 107 | 112.5% | 25.7% |
| 5600 | Home Economics | 158 | 42 | 116 | 13 | 276.2% | 31.0% |
| 6000 | Industrial Arts | 1,443 | 611 | 832 | 192 | 136.2% | 31.4% |
| 6800 | Mathematics | 1,195 | 404 | 791 | 81 | 195.8% | 20.0% |
| 7200 | Music | 143 | 32 | 111 | 13 | 346.9% | 40.6% |
| 7600 | Reading Specialist | 4,453 | 1,072 | 3,381 | 145 | 315.4% | 13.5% |
| 8410 | Biology | 628 | 181 | 447 | 46 | 247.0% | 25.4% |
| 8420 | Chemistry | 452 | 164 | 288 | 14 | 175.6% | 8.5% |
| 8430 | Earth/Space | 338 | 175 | 163 | 15 | 93.1% | 8.6% |
| 8450 | General Science | 2,040 | 673 | 1,367 | 162 | 203.1% | 24.1% |
| 8470 | Physics | 392 | 173 | 219 | 14 | 126.6% | 8.1% |
| 8490 | Other Science | 156 | 42 | 114 | 27 | 271.4% | 64.3% |
| 8800 | Social Studies | 3,920 | 1,032 | 2,888 | 576 | 279.8% | 55.8% |
| 9200 | Hearing Impaired | 235 | 20 | 215 | 13 | 1075.0% | 65.0% |
| 9210 | Gifted | 7 | 0 | 7 | 0 | ERR | ERR |
| 9230 | Mental/Phys Handicap | 2,794 | 882 | 1,912 | 120 | 216.8% | 13.6% |
| 9270 | Speech/Lang Impaired | 167 | 13 | 154 | 10 | 1184.6% | 76.9% |
| 9280 | Visually Impaired | 174 | 24 | 150 | 4 | 625.0% | 16.7% |
| 9290 | Other Handicap | 893 | 211 | 682 | 22 | 323.2% | 10.4% |
| 9900 | Not Listed Elsewhere | 6,657 | 3,696 | 2,961 | 416 | 80.1% | 11.3% |
| 9901 | No Certication Area | 354,945 | 79,876 | 275,069 | 6,985 | 344.4% | 8.7% |

Source: author's tabulations of Pennsylvania Department of Education and Pennsylvania school employees retirement system master file.
For column definitions, see Table 5.8

## 5.3 Characteristics of Pennsylvania's Employed Teachers: 1981-1991

### 5.3.1 The Demographics of Pennsylvania's Employed Teachers: 1981-90

During the 1980's, Pennsylvania's teachers grew older, accordingly became more experienced, and generally looked like their national counterparts. At the beginning of the decade (1981/2), the median age of teachers was 37 years; this was identical to the national median. [6] In terms of gender, women became relatively more prevalent in Pennsylvania; their ranks grew from 59.4% of the teaching force in 1981/2 to 63.5% in 1990/1; however, in 1981, the national figure for women was 66.9%. In the late 1980's, 8.0% of the nation's public school teachers were black, while 6.1% of Pennsylvania's public school teachers were black. (See Table 5.11).

Table 5.11: Teacher Demographics: Median Age, Experience, % Female and %Black: 1981-1991

| Type of Teacher | 1981-82 | | | | 1984-85 | | | | 1990-91 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Age | Exp. | % Female | % Black | Age | Exp. | % Female | % Black | Age | Exp. | % Female | % Black |
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Kindergarten | 37 | 13 | 98.7 | 2 | 39 | 14 | 98.1 | 2.6 | | | | |
| Elementary | 37 | 13 | 75.5 | 9.3 | 39 | 14 | 75.3 | 9.4 | 43 | 18 | 81.7 | 7.4 |
| Secondary | 38 | 14 | 40.5 | 3.1 | 38 | 16 | 39.7 | 2.9 | 45 | 19 | 42.5 | 3.7 |
| Specialized, K-12 | 35 | 12 | 53 | 1.4 | 38 | 14 | 53 | 4.4 | 42 | 17 | 49.3 | 7.7 |
| Special Ed | 32 | 8 | 74.6 | 10.8 | 35 | 9 | 75.3 | 11.2 | 39 | 12 | 79.5 | 9.9 |
| Speech Correction | 31 | 9 | 86.4 | 1.7 | 34 | 10 | 86.7 | 1.8 | 39 | 14 | 89.2 | 3.8 |
| Department Head | 47 | 22 | 27.3 | 3.8 | 48 | 22 | 29.5 | 3.9 | | | | |
| Total | 37 | 13 | 59.4 | 6.1 | 39 | 14 | 59.1 | 6.2 | 43 | 18 | 63.5 | 6.1 |

Source: Tabulations of Pennsylvania Department of Education professional personnel files

By the beginning of the 1990's, the fraction of the total number of Pennsylvania teachers with masters degrees dropped somewhat; compare the figure of 47.8% in 1981/2 to 45.5% in 1990/1.(See Table 5.12).

Table 5.12: Teacher Educational Background: 1981-91

| Type of Teacher | 1981-82 | | | 1984-85 | | | 1990-91 | | |
|---|---|---|---|---|---|---|---|---|---|
| | % BA | % MA | % PhD | % BA | % MA | % PhD | % BA | % MA | % PhD |
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| Kindergarten | 66.4 | 32.5 | 0 | 64.2 | 35.3 | 0.1 | | | |
| Elementary | 50.6 | 48.3 | 0.3 | 49.2 | 49.6 | 0.4 | 56.4 | 43 | 0.4 |
| Secondary | 48.9 | 47.2 | 0.7 | 48.3 | 48 | 0.8 | 50.3 | 46.3 | 1.0 |
| Specialized, K-12 | 52.4 | 46.6 | 0.5 | 52.5 | 46.5 | 0.4 | 57.8 | 41.2 | 0.8 |
| Special Ed | 48.4 | 49.5 | 0.3 | 47.5 | 50.8 | 0.3 | 48.8 | 50.6 | 0.4 |
| Speech Correction | 44.9 | 53.8 | NA | 42.5 | 56.8 | 0.2 | 33.1 | 66.2 | 0.3 |
| Department Head | 16.7 | 78.7 | 4.1 | 15 | 79.1 | 5.7 | | | |
| Total | 49.7 | 47.8 | 0.5 | 48.8 | 48.9 | 0.6 | 52.8 | 45.5 | 0.7 |

Source: tabulations of Pennsylvania Department of Education professional personnel files

Another way to analyze the current inventory of public school teachers is to examine their age distribution by area of certificated assignment. Table 5.13 displays the major assignment areas.[7] The median ages vary considerably across assignment areas: contrast the median age of 37 for those in Early Childhood Education with the median age of 51 for those in General Science, or with the median age of 55 for those in Other Science.

[6] See National Center for Education Statistics, *Digest of Education Statistics: 1991*, Table 64.

[7] These groupings follow those used by the Pennsylvania Department of Education's August 1992 report on the supply and demand of teachers.

These age distribution figures may be translated into replacement needs by simply making some assumptions about the likely retirement age. For example, in the area of Other Science, we know that half or 120 (241/2) are over the age of 55. If these 120 are uniformly distributed between the ages of 55 and 65 (12 per age-year), and they retire at age 65, then in order to meet current pupil-teacher ratios, 12 teachers will need to be hired each year for 10 years. Alternatively, if we divided the percentage to the right of the age of interest, and divide by the difference between that age and the assumed age, we can calculate the annual replacement rate. If 50% of the teachers are over age 55, and are uniformly distributed between age 55 and an assumed retirement age of 65, then 5% of the total number of teachers must be replaced each year which yields 12 (50%/10 years * 241 = 12.5). Similarly, if we know the number of years of experience at time of retirement, and we know the distribution of experience, we can calculate the replacement hiring needs. Thus, the models developed in Chapter 4 coupled with the complete distribution of teachers by age, experience, and assignment area will allow us to make much more precise calculations.

Table 5.13: Age of Classroom Teachers in 1990/1 by First Certification Area

| Code | Certification Title | Number of Teachers | Teacher Age at 25th % | Median | 75th % | 90th % | 95th % |
|---|---|---|---|---|---|---|---|
| | | [3] | [4] | [5] | [6] | [7] | [8] |
| 1100 | Adm/Supervisory | 925 | 52 | 55 | 59 | 62 | 64 |
| 1150 | Coordinate Services | 341 | 46 | 52 | 56 | 60 | 63 |
| 1200 | Agriculture | 231 | 34 | 41 | 47 | 53 | 56 |
| 1600 | Business Education | 1,940 | 40 | 45 | 50 | 56 | 60 |
| 2000 | Vocational Education | 789 | 42 | 51 | 59 | 63 | 65 |
| 2100 | Vocational Tech Ed | 26 | 48 | 53 | 61 | 64 | 64 |
| 2200 | Vocational Health | 17 | 48 | 55 | 58 | 63 | 63 |
| 2300 | Art | 2,857 | 37 | 42 | 46 | 52 | 56 |
| 2810 | General Elementary | 37,301 | 38 | 43 | 47 | 54 | 59 |
| 2840 | Early Childhood | 1,109 | 30 | 37 | 43 | 52 | 57 |
| 3200 | English | 6,965 | 41 | 45 | 51 | 58 | 61 |
| 4410 | French | 996 | 39 | 43 | 47 | 51 | 57 |
| 4420 | German | 455 | 39 | 43 | 48 | 53 | 60 |
| 4430 | Spanish | 1,223 | 38 | 43 | 46 | 51 | 56 |
| 4490 | Other Languages | 177 | 42 | 45 | 51 | 58 | 61 |
| 4800 | Health/Phys Ed | 5,350 | 37 | 41 | 45 | 49 | 52 |
| 5200 | Driver Education | 106 | 45 | 51 | 54 | 60 | 62 |
| 5600 | Home Economics | 1,856 | 38 | 42 | 48 | 56 | 61 |
| 6000 | Industrial Arts | 2,082 | 37 | 43 | 48 | 54 | 58 |
| 6800 | Mathematics | 5,139 | 38 | 43 | 47 | 52 | 56 |
| 7200 | Music | 3,677 | 34 | 40 | 45 | 49 | 54 |
| 7600 | Reading Specialist | 194 | 48 | 53 | 58 | 62 | 64 |
| 8410 | Biology | 2,588 | 38 | 44 | 48 | 53 | 57 |
| 8420 | Chemistry | 763 | 37 | 44 | 49 | 53 | 57 |
| 8430 | Earth/Space | 475 | 35 | 40 | 44 | 48 | 52 |
| 8450 | General Science | 795 | 42 | 51 | 56 | 60 | 63 |
| 8470 | Physics | 441 | 37 | 44 | 48 | 51 | 56 |
| 8490 | Other Science | 241 | 52 | 55 | 60 | 63 | 65 |
| 8800 | Social Studies | 6,433 | 41 | 45 | 49 | 55 | 59 |
| 9200 | Hearing Impaired | 46 | 35 | 43 | 50 | 60 | 62 |
| 9230 | Mental/Phys Handicapped | 3,325 | 31 | 36 | 41 | 47 | 52 |
| 9270 | Speech/Lang Impaired | 419 | 36 | 39 | 43 | 48 | 53 |
| 9280 | Visually Impaired | 21 | 42 | 44 | 47 | 55 | 58 |
| 9290 | Other Handicap | 132 | 40 | 43 | 50 | 56 | 59 |
| 9900 | Not Listed Elsewhere | 8,432 | 51 | 54 | 58 | 62 | 64 |
| | Total | 97,867 | | | | | |

Source: author's tabulations of Pennsylvania Department of Education professional personnel files.

Table 5.14 displays demographic and salary characteristics of classroom teachers by MSA and county. Column [4] shows the ratio of 1991 student enrollment in the county to 1990 population. This enrollment percentage varies widely from a low of 11% in Montgomery and Centre counties to a high of 20% in Potter County. This suggests a very wide variation in the extent to which families have children in the public schools, and may suggest differential willingness to support the costs of public education. The age and experience statistics are the quartiles of all classroom teachers in the county. A few counties seem to have somewhat more experienced classroom teachers than others. The 75th percentile of experience is 18 years in Monroe County, which is relatively low. Counties with a 75th percentile of experience of 25 years (or more) are: Cambria, Allegheny, Fayette, Westmoreland, Mercer, Armstrong, Cameron (28 years), Elk, Lawrence (26 years), Mifflin,

and Tioga. Early retirement incentives for those with 27 or more years of experience, encouraged under Senator Mellow's legislation, could within a few years lead to the retirement of 1/4 of these counties' classroom teachers.

Teacher salaries in Pennsylvania are governed by collective bargaining agreements. Educational attainment and years of service in the school district create salary differentials within each district, and the ability to bargain effectively also creates differences both within and across school districts. The salary distributions, shown by MSA in Table 5.14, differ markedly across the state in terms of salary dispersion within each county. For example, in many of the Non-MSA counties, even though there are often differences of 10 or more years between the 25th and 75th percentiles of age or experience, the salary differentials are often less than $10,000. On the other hand, in the more populous and more prosperous parts of the state, the differentials are much larger: in Allegheny County, the differential is $11,600; in Bucks County the differential is $17,887. Undoubtedly, the higher salaries some districts are able to offer enables them to be more selective when hiring and retaining classroom teachers.

Table 5.14: Demographic & Salary Characteristics of Classroom Teachers by Metropolitan Statistical Area

| Area | Pop 1990 | PCY 1989 | Enr % | # SDs | Age 25% | Age 50% | Age 75% | Exp 25% | Exp 50% | Exp 75% | Sal 25% | Sal 50% | Sal 75% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] | [14] |
| Allentown-Bethlehem MSA (3) | | | | | | | | | | | | | |
| Carbon County | 56,907 | $9,057 | 14% | 5 | 37 | 42 | 48 | 9 | 18 | 23 | $26,300 | $32,077 | $35,960 |
| Lehigh County | 272,548 | $12,794 | 14% | 9 | 37 | 43 | 49 | 10 | 18 | 23 | $30,100 | $37,712 | $44,000 |
| Northampton County | 266,599 | $11,574 | 13% | 8 | 38 | 43 | 49 | 10 | 18 | 23 | $28,288 | $34,855 | $39,876 |
| Altoona MSA (1) | | | | | | | | | | | | | |
| Blair County | 134,811 | $8,232 | 16% | 7 | 38 | 43 | 50 | 11 | 18 | 24 | $26,930 | $30,880 | $33,315 |
| Erie MSA (1) | | | | | | | | | | | | | |
| Erie County | 281,987 | $9,500 | 15% | 13 | 38 | 43 | 49 | 9 | 17 | 23 | $26,500 | $32,820 | $36,920 |
| Harrisburg-Lebanon MSA (4) | | | | | | | | | | | | | |
| Cumberland County | 224,801 | $12,737 | 15% | 9 | 37 | 43 | 49 | 10 | 17 | 23 | $27,650 | $33,935 | $37,202 |
| Dauphin County | 233,326 | $11,630 | 14% | 10 | 36 | 42 | 48 | 7 | 16 | 22 | $24,386 | $30,680 | $36,458 |
| Lebanon County | 113,744 | $10,802 | 15% | 6 | 37 | 43 | 49 | 10 | 18 | 24 | $27,542 | $33,205 | $36,302 |
| Perry County | 41,924 | $9,717 | 18% | 4 | 34 | 41 | 46 | 7 | 15 | 21 | $23,985 | $29,107 | $33,400 |
| Johnstown MSA (1) | | | | | | | | | | | | | |
| Cambria County | 159,602 | $7,764 | 14% | 12 | 39 | 44 | 51 | 13 | 20 | 25 | $29,455 | $32,195 | $34,193 |
| Somerset County | 79,376 | $7,745 | 17% | 11 | 36 | 41 | 47 | 8 | 17 | 22 | $24,105 | $29,008 | $31,865 |
| Lancaster MSA (1) | | | | | | | | | | | | | |
| Lancaster County | 419,065 | $12,213 | 14% | 16 | 35 | 42 | 49 | 7 | 15 | 23 | $26,675 | $31,706 | $38,270 |
| Scranton-Wilkes-Barre MSA (4) | | | | | | | | | | | | | |
| Columbia County | 74,147 | $8,864 | 14% | 6 | 36 | 42 | 48 | 8 | 16 | 22 | $25,934 | $28,985 | $32,847 |
| Lackawanna County | 215,410 | $9,363 | 12% | 10 | 40 | 43 | 49 | 14 | 19 | 23 | $32,000 | $34,636 | $38,765 |
| Luzerne County | 330,600 | $9,262 | 12% | 11 | 40 | 44 | 49 | 15 | 20 | 24 | $31,427 | $36,800 | $39,935 |
| Monroe County | 98,927 | $10,143 | 16% | 4 | 30 | 39 | 45 | 4 | 11 | 18 | $26,461 | $29,650 | $36,315 |
| Wyoming County | 28,297 | $9,555 | 18% | 2 | 39 | 43 | 49 | 13 | 18 | 23 | $29,671 | $36,038 | $38,605 |
| Philadelphia MSA (5) | | | | | | | | | | | | | |
| Bucks County | 538,589 | $14,051 | 14% | 13 | 38 | 43 | 49 | 10 | 18 | 23 | $37,166 | $49,630 | $55,053 |
| Chester County | 375,833 | $17,005 | 14% | 12 | 37 | 44 | 50 | 8 | 16 | 23 | $29,850 | $37,654 | $45,088 |
| Delaware County | 539,477 | $12,926 | 11% | 15 | 39 | 44 | 50 | 10 | 18 | 23 | $31,878 | $40,824 | $46,522 |
| Montgomery County | 669,993 | $18,155 | 11% | 21 | 39 | 44 | 50 | 10 | 18 | 24 | $32,500 | $44,676 | $51,530 |
| Phildadelphia | 1,585,577 | $6,842 | 12% | 1 | 40 | 45 | 52 | 7 | 16 | 22 | $36,090 | $41,200 | $44,364 |
| Pittsburgh MSA (4) | | | | | | | | | | | | | |
| Allegheny County | 1,335,916 | $11,501 | 12% | 43 | 41 | 45 | 50 | 15 | 20 | 25 | $36,600 | $44,480 | $48,200 |
| Fayette County | 137,048 | $6,883 | 16% | 6 | 40 | 44 | 50 | 15 | 20 | 25 | $31,150 | $37,325 | $37,725 |
| Washington County | 203,857 | $9,519 | 15% | 14 | 39 | 44 | 49 | 13 | 19 | 24 | $29,276 | $33,688 | $37,400 |
| Westmoreland County | 379,093 | $9,984 | 14% | 17 | 40 | 44 | 50 | 15 | 20 | 25 | $31,535 | $36,703 | $39,460 |
| Reading MSA (1) | | | | | | | | | | | | | |
| Berks County | 357,727 | $12,143 | 14% | 18 | 38 | 44 | 49 | 10 | 18 | 24 | $28,850 | $36,100 | $42,800 |

[continued on next page]

| Area | Pop 1990 [2] | PCY 1989 [3] | Enr% % [4] | # SDs [5] | Age 25% [6] | Age 50% [7] | Age 75% [8] | Exp 25% [9] | Exp 50% [10] | Exp 75% [11] | Sal 25% [12] | Sal 50% [13] | Sal 75% [14] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sharon MSA (1) | | | | | | | | | | | | | |
| Mercer County | 121,093 | $8,388 | 16% | 12 | 39 | 44 | 51 | 11 | 18 | 25 | $27,727 | $32,653 | $35,657 |
| State College MSA (1) | | | | | | | | | | | | | |
| Centre County | 113,912 | $9,341 | 11% | 4 | 37 | 43 | 51 | 10 | 16 | 23 | $27,000 | $32,500 | $37,000 |
| Williamsport MSA (1) | | | | | | | | | | | | | |
| Lycoming County | 119,904 | $9,346 | 16% | 8 | 38 | 43 | 49 | 10 | 18 | 24 | $29,150 | $34,200 | $36,650 |
| York MSA (2) | | | | | | | | | | | | | |
| Adams County | 78,274 | $10,400 | 15% | 6 | 36 | 41 | 46 | 8 | 15 | 21 | $25,579 | $30,139 | $34,291 |
| York County | 316,737 | $12,581 | 15% | 15 | 35 | 42 | 48 | 7 | 17 | 23 | $25,859 | $32,279 | $38,100 |
| Beaver MSA (1) | | | | | | | | | | | | | |
| Beaver County | 183,127 | $8,445 | 15% | 14 | 40 | 44 | 50 | 13 | 20 | 25 | $29,016 | $34,005 | $36,700 |
| Non-MSA Pa (35) | | | | | | | | | | | | | |
| Armstrong County | 77,286 | $8,478 | 16% | 4 | 39 | 44 | 49 | 13 | 19 | 25 | $31,500 | $34,045 | $37,095 |
| Bedford County | 49,580 | $6,988 | 17% | 5 | 37 | 42 | 48 | 10 | 18 | 23 | $26,552 | $29,322 | $31,500 |
| Bradford County | 63,587 | $8,660 | 19% | 7 | 38 | 44 | 50 | 11 | 18 | 24 | $26,925 | $33,650 | $37,463 |
| Butler County | 145,514 | $10,163 | 16% | 7 | 38 | 43 | 49 | 11 | 17 | 24 | $29,222 | $35,148 | $37,925 |
| Cameron County | 5,913 | $8,657 | 19% | 1 | 36 | 43 | 52 | 10 | 19 | 28 | $24,151 | $31,835 | $34,762 |
| Clarion County | 49,354 | $7,614 | 17% | 7 | 38 | 42 | 50 | 11 | 17 | 23 | $28,562 | $31,229 | $34,262 |
| Clearfield County | 93,681 | $8,169 | 17% | 8 | 38 | 42 | 49 | 12 | 18 | 23 | $27,235 | $30,321 | $33,100 |
| Clinton County | 35,977 | $7,817 | 16% | 1 | 38 | 43 | 51 | 11 | 18 | 24 | $28,483 | $33,083 | $36,150 |
| Crawford County | 71,213 | $8,544 | 17% | 3 | 39 | 43 | 49 | 11 | 18 | 23 | $27,750 | $30,875 | $32,871 |
| Elk County | 34,132 | $10,074 | 13% | 3 | 40 | 43 | 49 | 13 | 19 | 25 | $27,563 | $31,652 | $34,740 |
| Forest County | 5,388 | $6,532 | 15% | 1 | 37 | 43 | 48 | 10 | 16 | 23 | $24,350 | $27,275 | $30,300 |
| Franklin County | 114,375 | $10,358 | 15% | 5 | 37 | 43 | 48 | 10 | 17 | 23 | $26,953 | $31,141 | $34,550 |
| Fulton County | 13,837 | $8,261 | 18% | 3 | 38 | 43 | 49 | 10 | 18 | 25 | $24,095 | $28,615 | $31,975 |
| Greene County | 39,550 | $6,596 | 18% | 5 | 38 | 41 | 46 | 9 | 16 | 21 | $27,550 | $30,710 | $35,710 |
| Huntingdon County | 42,070 | $7,156 | 16% | 4 | 37 | 43 | 50 | 9 | 18 | 23 | $25,142 | $28,000 | $30,239 |
| Indiana County | 87,235 | $7,936 | 16% | 7 | 37 | 42 | 48 | 11 | 17 | 22 | $27,445 | $31,642 | $34,453 |
| Jefferson County | 40,557 | $8,484 | 18% | 3 | 38 | 43 | 49 | 12 | 19 | 22 | $27,985 | $31,825 | $34,649 |
| Juniata County | 20,132 | $8,885 | 17% | 1 | 34 | 40 | 46 | 8 | 17 | 22 | $23,804 | $28,629 | $32,333 |
| Lawrence County | 97,068 | $8,145 | 15% | 8 | 40 | 45 | 51 | 13 | 20 | 26 | $28,707 | $34,470 | $36,800 |
| Mckean County | 48,155 | $8,159 | 17% | 5 | 38 | 44 | 49 | 11 | 18 | 24 | $25,526 | $30,741 | $34,479 |
| Mifflin County | 43,075 | $8,087 | 15% | 1 | 38 | 43 | 50 | 11 | 18 | 25 | $28,525 | $30,620 | $33,075 |
| Montour County | 18,749 | $11,301 | 14% | 1 | 37 | 41 | 50 | 10 | 16 | 23 | $28,900 | $31,402 | $34,871 |
| Northumberland Count | 97,267 | $8,261 | 15% | 6 | 38 | 42 | 49 | 12 | 18 | 23 | $26,550 | $29,709 | $32,277 |
| Pike County | 15,821 | $9,951 | 18% | 1 | 31 | 39 | 44 | 5 | 11 | 19 | $25,725 | $30,625 | $36,750 |
| Potter County | 16,931 | $7,507 | 20% | 5 | 33 | 41 | 48 | 6 | 16 | 22 | $22,620 | $29,496 | $32,531 |
| Schuylkill County | 148,625 | $8,670 | 13% | 12 | 38 | 42 | 47 | 12 | 18 | 22 | $25,490 | $29,446 | $31,824 |
| Snyder County | 36,680 | $9,012 | 15% | 2 | 38 | 42 | 48 | 10 | 17 | 23 | $25,335 | $29,701 | $32,237 |
| Sullivan County | 6,104 | $7,916 | 16% | 1 | 37 | 42 | 46 | 9 | 18 | 22 | $26,578 | $33,093 | $37,703 |
| Susquehanna County | 44,338 | $7,932 | 19% | 6 | 37 | 42 | 47 | 9 | 17 | 22 | $27,000 | $31,326 | $33,993 |
| Tioga County | 41,070 | $7,894 | 17% | 3 | 39 | 44 | 51 | 11 | 19 | 25 | $28,025 | $32,774 | $35,645 |
| Union County | 31,104 | $9,463 | 13% | 2 | 37 | 43 | 49 | 9 | 15 | 22 | $27,400 | $30,360 | $34,046 |
| Venango County | 67,127 | $8,303 | 17% | 5 | 39 | 44 | 51 | 12 | 19 | 24 | $27,935 | $31,904 | $34,785 |
| Warren County | 41,805 | $9,739 | 17% | 1 | 40 | 45 | 50 | 12 | 19 | 24 | $26,074 | $31,956 | $35,606 |
| Wayne County | 45,713 | $8,896 | 17% | 3 | 36 | 41 | 47 | 9 | 16 | 21 | $27,057 | $32,475 | $35,745 |

Source: Tabulations of Pennsylvania Department of Education professional personnel files.
Definitions:
[2]: 1990 census of population
[3]: 1989 money income/1990 census of population
[4]: 1991 total school enrollment/1990 census of population
[6]: 25th percentile of age of teachers in MSA
[7]: median age of teachers in MSA
[8]: 75th percentile of age of teachers in MSA
[9]: 25th percentile of total professional experience in school districts in MSA
[10]: 50th percentile of experience in MSA
[11]: 75th percentile of experience in MSA
[12]: 25th percentile of salaries of teachers in MSA
[13]: 50th percentile of salaries of teachers in MSA
[14]: 75th percentile of salaries of teachers in MSA

### 5.3.2 Recent Demographics of Newly Employed Teachers: 1983/4-1989/90

In the 1980's, there was evidence that teachers hired for the first time were older than the historical trend. For example, in 1981/2, the median age of a secondary school teacher, first-time hire was 26 years of age. By 1990/1, this median age had risen to 29 years of age (See Table 5.15). Note also that the third quartile of the ages of first-time hired teachers rose for every type of teacher from 30 to 36 years of age (See Column [3] and [11] of Table 5.15).

This rising age of newly hired teachers is consistent with the view that those interested in finding classroom teaching positions have had to wait increasingly longer for teaching opportunities to develop.

Table 5.15: Demographic Characteristics of New Teachers by Type of Teacher: 1981-91

| | 1981-82 | | | | 1984-85 | | | | 1990-91 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type of Teacher | Age | 3rd Q 1st Q | % F | % Black | Age | 3rd Q 1st Q | % F | % Black | Age | 3rd Q 1st Q | % F | % Black |
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Kindergarden | 24 | 30/23 | 96.1 | 0 | 26 | 34/24 | 95.7 | 2.1 | NA | NA | NA | NA |
| Elementary | 27 | 35/23 | 78.5 | 16.1 | 31 | 39/35 | 79.4 | 14.6 | 28 | 39/24 | 88.5 | 8.1 |
| Secondary | 26 | 34/23 | 60.2 | 4.2 | 27 | 36/24 | 60.1 | 4.8 | 29 | 38/24 | 54.8 | 3.5 |
| Special,K-12 | 23 | 27/22 | 84.4 | 0 | 25 | 30/24 | 57.9 | 6.6 | 29 | 38/25 | 65.3 | 8.4 |
| Special Ed | 28 | 33/24 | 81.8 | 15.7 | 27 | 34/24 | 87.6 | 22.9 | 28 | 37/24 | 84.4 | 8 |
| Speech Correct. | 26 | 30/24 | 92.6 | 1.1 | 26 | 30/24 | 97.4 | 0 | 30 | 36/25 | 96.9 | 9.4 |
| Total | 27 | 33/23 | 73.3 | 9.8 | 28 | 36/24 | 73.7 | 11.9 | 28 | 38/24 | 75.4 | 6.6 |

Source: Tabulations of Pennsylvania Department of Education professional personnel files.

While the overall fraction of first-time hired teachers increasingly began teaching with just BA degrees (See Column [2] and [8] of Table 5.16), this was due entirely to the growth in employment of special education teachers. Every other type of teacher displayed a relatively higher level of education in 1990/1 than in 1981/2.

Table 5.16: Educational Characteristics of New Teachers by Type of Teacher: 1981-91

| | 1981-82 | | | 1984-85 | | | 1990-91 | | |
|---|---|---|---|---|---|---|---|---|---|
| Type of Teacher | % BA | % MA | % PhD | % BA | % MA | % PhD | % BA | % MA | % PhD |
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| Kindergarden | 86.3 | 0 | 0 | 93.6 | 2.1 | 0 | NA | NA | NA |
| Elementary | 83.8 | 9.6 | 0.2 | 85.7 | 11 | 0.7 | 89.6 | 10 | 0.4 |
| Secondary | 78.5 | 8.5 | 0.3 | 82.5 | 6.9 | 0.6 | 81.3 | 12.1 | 10 |
| Special,k-12 | 87.5 | 7.8 | 0 | 92.1 | 7.9 | 0 | 87.4 | 11.4 | 1.2 |
| Special Ed | 52.1 | 31.8 | 0.5 | 62.8 | 32.4 | 0.2 | 76.2 | 23.2 | 0.7 |
| Speech Correct. | 37.2 | 45.7 | 0 | 59.0 | 41 | 0 | 0.5 | 62.5 | 0 |
| Total | 71.7 | 16.2 | .3 | 78.6 | 15 | 0.5 | 84.3 | 13.3 | 0.7 |

Source: Tabulations of Pennsylvania Department of Education professional personnel files.

Most different types of school districts displayed this general upgrading of credentials. Also note that Philadelphia and Pittsburgh, under federal court order in the 1980's to increase employment of black teachers, were significantly able to recruit new black teachers in the 1980's (See Table 5.17, columns [5], [9] and [13]).

Table 5.17: Demographic Characteristics of New Teachers by Type of District: 1981-1991

| | 1981-82 | | | | 1984-85 | | | | 1990-91 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| School District | % BA | % MA | % F | % Black | % BA | % MA | % F | % Black | % BA | % MA | % F | % Black |
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Philadelphia | 64.5 | 29.7 | 65.6 | 43.4 | 60.4 | 36.8 | 71.5 | 47.2 | 79.1 | 19.1 | 81.0 | 22.4 |
| Pittsburgh | 80.0 | 20.0 | 52.0 | 12.0 | 100.0 | 0.0 | 100. | 66.7 | 80.0 | 20.0 | 82.9 | 14.3 |
| 2nd Class | 73.7 | 11.2 | 77.0 | 3.9 | 85.4 | 9.4 | 74.9 | 4.3 | 81.8 | 16.3 | 78.3 | 6.3 |
| 3rd Class | 87.6 | 5.9 | 74.9 | 0.4 | 40.8 | 2.9 | 73.4 | 0.4 | 92.2 | 7.7 | 73.4 | 0.8 |
| 4th Class | 94.1 | 0.0 | 76.5 | 0.0 | 92.6 | 7.4 | 77.8 | 0 | 89.2 | 10.8 | 67.6 | 0 |
| Intermediate U. | 41.3 | 35.2 | 85.0 | 0.6 | 71.0 | 19.6 | 91.6 | 0.5 | 72.1 | 26.5 | 83.7 | 0 |
| Area Vo Techs | 37.0 | 1.2 | 35.8 | 0.0 | 27.8 | 0.0 | 31.9 | 4.2 | 40.9 | 6.1 | 30.3 | 0 |
| Total | 71.7 | 16.2 | 73.3 | 9.8 | 78.6 | 15.0 | 73.7 | 11.9 | 84.3 | 13.3 | 75.4 | 6.6 |

Source: Tabulations of Pennsylvania Department of Education professional personnel Files

### 5.3.3 Spatial Aspects of Newly Trained Teachers: 1990/1

In 1990/1, 8,236 individuals graduated from the various certificate granting institutions. The question arises if the spatial concentration of new graduates followed the pattern observed in Tables 5.4 and 5.5 above. Tables 5.18 and 5.19 show the spatial distribution of 1990/1 graduates. It is evident that the pattern of concentrations of teachers from private and public institutions in the total inventory of teachers is quite similar to that of the 1990/1 graduates. Allentown's teacher preparation institutions graduated 146 teachers in 1990/1; all were from private institutions. Sharon (146 new teachers) and Beaver (47 new teachers) follow the same pattern.

Table 5.18: New Teaching Degree Graduates Produced by Type of Institution and Metropolitan Statistical Area: 1990/91

| MSA | State Univers. | State Related | Private Related | Private | Other/ Non-Pa. | Total All Types |
|---|---|---|---|---|---|---|
| | [1] | [2] | [3] | [4] | [5] | [6] |
| Allentown | 0 | 0 | 0 | 146 | 0 | 146 |
| Erie | 325 | 0 | 0 | 82 | 0 | 407 |
| Harrisburg | 234 | 0 | 0 | 152 | 0 | 386 |
| Johnstown | 0 | 0 | 0 | 35 | 0 | 35 |
| Lancaster | 504 | 0 | 0 | 57 | 0 | 561 |
| Scranton | 467 | 0 | 0 | 225 | 0 | 692 |
| Philadelphia | 391 | 238 | 97 | 880 | 0 | 1,606 |
| Pittsburgh | 272 | 406 | 0 | 486 | 0 | 1,164 |
| Reading | 382 | 0 | 0 | 39 | 0 | 421 |
| Sharon | 0 | 0 | 0 | 124 | 0 | 124 |
| State Coll. | 0 | 730 | 0 | 0 | 0 | 730 |
| Williamsport | 0 | 0 | 0 | 40 | 0 | 40 |
| York | 0 | 0 | 0 | 113 | 0 | 113 |
| Beaver | 0 | 0 | 0 | 47 | 0 | 47 |
| NonMSA | 1,541 | 0 | 0 | 223 | 0 | 1,764 |
| NonPa | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 4,116 | 1,374 | 97 | 2,649 | 0 | 8,236 |

Source: Tabulations of PED master files

Table 5.19: % New Teaching Degree Graduates Produced by Type of Institution and Metropolitan Statistical Area: 1990/91

| MSA | % State Univers. | % State Related | % Private Related | % Private | % Other/ Non-Pa. |
|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] |
| Allentown | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% |
| Erie | 79.9% | 0.0% | 0.0% | 20.1% | 0.0% |
| Harrisburg | 60.6% | 0.0% | 0.0% | 39.4% | 0.0% |
| Johnstown | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% |
| Lancaster | 89.8% | 0.0% | 0.0% | 10.2% | 0.0% |
| Scranton | 67.5% | 0.0% | 0.0% | 32.5% | 0.0% |
| Philadelphia | 24.3% | 14.8% | 6.0% | 54.8% | 0.0% |
| Pittsburgh | 23.4% | 34.9% | 0.0% | 41.8% | 0.0% |
| Reading | 90.7% | 0.0% | 0.0% | 9.3% | 0.0% |
| Sharon | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% |
| State Coll. | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% |
| Williamsport | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% |
| York | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% |
| Beaver | 0.0% | 0.0% | 0.0% | 100.0% | 0.0% |
| NonMSA | 87.4% | 0.0% | 0.0% | 12.6% | 0.0% |

Source: Tabulations of PDE master files

### 5.3.4 Geographic Breadth of Pennsylvania's Market for New Teachers

Related to the spatial distribution of certificating institutions is the spatial relationship between metropolitan areas which hire teachers and those which produce them. Of interest is the extent to which various geographic areas "trade" with each other in teacher training and hiring. We can gain some insight into the geographic breadth of the market for public school teachers by focusing on the metropolitan areas which hired newly trained teachers.

The linear distance from MSA to MSA was measured in miles, and the 1990/1 MSA of training of each newly certificated teachers was noted. Excluded from the analysis were teachers trained or hired by the non-MSA portions of the state, because the areas are so dispersed. Also excluded

from the analysis were teachers trained out of state. Overall, 1,338 newly trained teachers could be matched up between MSA of origin and MSA of destination out of the 1,845 who became employed.

Surprisingly, in every MSA, better than 60% of the newly hired teachers came from certificating institutions under 70 miles from the hiring MSA, or a little over an hour of driving time. The market for teachers would thus appear to be quite localized. Five MSAs (Allentown, Erie, Lancaster, Pittsburgh, and Sharon), hired better than 90% of their new teachers from within a 70 miles radius; four MSAs (Johnston, Philadelphia, Reading, and Williamsport) hired better than 80% of their new teachers from within this radius; two MSAs (Harrisburg and Beaver) hired 70% of their new teachers from within this distance; and four MSAs (Altoona, Scranton, State College, and York) hired 60% of their new teachers from within this radius. Table 5.20 shows the detailed results.

Table 5.20: Area of Institutional Source of New Teaching Hires by Distance from Hiring Districts' MSA: 1990/1

| MSA Source | Miles | Hires |
|---|---|---|
| **Allentown** | 0 | 10 |
| Reading | 31 | 19 |
| Philadelphia | 49 | 5 |
| Scranton | 57 | 11 |
| Lancaster | 59 | 3 |
| Harrisburg | 76 | 0 |
| York | 81 | 0 |
| Williamsport | 95 | 0 |
| State College | 131 | 3 |
| Altoona | 153 | 0 |
| Johnstown | 185 | 0 |
| Pittsburgh | 239 | 0 |
| Beaver | 258 | 0 |
| Erie | 264 | 0 |
| Sharon | 265 | 0 |
| Total New Hires | | 51 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Altoona** | 0 | 0 |
| Johnstown | 30 | 6 |
| State College | 37 | 4 |
| Harrisburg | 82 | 2 |
| Pittsburgh | 86 | 2 |
| Williamsport | 90 | 0 |
| York | 96 | 0 |
| Beaver | 106 | 0 |
| Lancaster | 115 | 0 |
| Sharon | 120 | 0 |
| Reading | 130 | 0 |
| Erie | 144 | 0 |
| Allentown | 153 | 0 |
| Scranton | 156 | 1 |
| Philadelphia | 175 | 0 |
| Total New Hires | | 15 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Erie** | 0 | 18 |
| Sharon | 68 | 2 |
| Beaver | 99 | 0 |
| Pittsburgh | 116 | 1 |
| Johnstown | 142 | 0 |
| Altoona | 144 | 0 |
| State College | 144 | 1 |
| Williamsport | 168 | 0 |
| Harrisburg | 212 | 0 |
| York | 230 | 0 |
| Scranton | 236 | 0 |
| Lancaster | 245 | 0 |
| Reading | 250 | 0 |
| Allentown | 264 | 0 |
| Philadelphia | 298 | 0 |
| Total New Hires | | 22 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Harrisburg** | 0 | 24 |
| York | 24 | 2 |
| Lancaster | 35 | 25 |
| Reading | 51 | 9 |
| State College | 68 | 29 |
| Williamsport | 69 | 1 |
| Allentown | 76 | 0 |
| Altoona | 82 | 0 |
| Philadelphia | 98 | 12 |
| Scranton | 102 | 10 |
| Johnstown | 105 | 0 |
| Pittsburgh | 165 | 5 |
| Beaver | 187 | 0 |
| Sharon | 199 | 0 |
| Erie | 212 | 3 |
| Total New Hires | | 120 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Johnstown** | 0 | 1 |
| Altoona | 30 | 0 |
| State College | 61 | 2 |
| Pittsburgh | 62 | 14 |
| Beaver | 85 | 0 |
| Philadelphia | 94 | 0 |
| Harrisburg | 105 | 0 |
| Sharon | 105 | 0 |
| York | 115 | 0 |
| Williamsport | 119 | 0 |
| Lancaster | 138 | 0 |
| Erie | 142 | 2 |
| Reading | 154 | 0 |
| Allentown | 185 | 0 |
| Scranton | 185 | 2 |
| Total New Hires | | 21 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Lancaster** | 0 | 56 |
| York | 23 | 2 |
| Reading | 30 | 0 |
| Harrisburg | 35 | 6 |
| Allentown | 59 | 1 |
| Philadelphia | 62 | 1 |
| Williamsport | 93 | 0 |
| Scranton | 102 | 2 |
| State College | 103 | 2 |
| Altoona | 115 | 0 |
| Johnstown | 138 | 0 |
| Pittsburgh | 197 | 0 |
| Beaver | 220 | 0 |
| Sharon | 235 | 1 |
| Erie | 245 | 0 |
| Total New Hires | | 71 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Scranton** | 0 | 44 |
| Allentown | 57 | 3 |
| Williamsport | 73 | 0 |
| Reading | 76 | 6 |
| Harrisburg | 102 | 4 |
| Lancaster | 102 | 2 |
| Philadelphia | 105 | 5 |
| York | 116 | 1 |
| State College | 122 | 10 |
| Altoona | 156 | 0 |
| Johnstown | 185 | 0 |
| Erie | 236 | 0 |
| Pittsburgh | 236 | 2 |
| Sharon | 250 | 0 |
| Beaver | 250 | 0 |
| Total New Hires | | 77 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Philadelphia** | 0 | 502 |
| Allentown | 49 | 6 |
| Reading | 50 | 33 |
| Lancaster | 62 | 37 |
| York | 84 | 6 |
| Johnstown | 94 | 0 |
| Harrisburg | 98 | 14 |
| Scranton | 105 | 36 |
| Williamsport | 135 | 0 |
| State College | 150 | 60 |
| Altoona | 175 | 0 |
| Pittsburgh | 260 | 10 |
| Beaver | 281 | 0 |
| Sharon | 292 | 2 |
| Erie | 298 | 4 |
| Total New Hires | | 710 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Pittsburgh** | 0 | 109 |
| Beaver | 27 | 0 |
| Sharon | 55 | 2 |
| Johnstown | 62 | 0 |
| Altoona | 86 | 0 |
| Erie | 116 | 5 |
| State College | 120 | 3 |
| Williamsport | 164 | 0 |
| Harrisburg | 165 | 0 |
| York | 175 | 0 |
| Lancaster | 197 | 0 |
| Reading | 214 | 0 |
| Scranton | 236 | 0 |
| Allentown | 239 | 0 |
| Philadelphia | 260 | 0 |
| Total New Hires | | 119 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Reading** | 0 | 11 |
| Lancaster | 30 | 4 |
| Allentown | 31 | 1 |
| Philadelphia | 50 | 4 |
| York | 50 | 0 |
| Harrisburg | 51 | 5 |
| Scranton | 76 | 1 |
| Williamsport | 86 | 0 |
| State College | 103 | 4 |
| Altoona | 130 | 0 |
| Beaver | 134 | 0 |
| Johnstown | 154 | 0 |
| Pittsburgh | 214 | 0 |
| Sharon | 247 | 0 |
| Erie | 250 | 0 |
| Total New Hires | | 30 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Sharon** | 0 | 1 |
| Beaver | 34 | 0 |
| Pittsburgh | 55 | 0 |
| Erie | 68 | 5 |
| Johnstown | 105 | 0 |
| Altoona | 120 | 0 |
| State College | 140 | 0 |
| Williamsport | 179 | 0 |
| Harrisburg | 199 | 0 |
| York | 212 | 0 |
| Lancaster | 235 | 0 |
| Reading | 247 | 0 |
| Scranton | 250 | 0 |
| Allentown | 265 | 0 |
| Philadelphia | 292 | 0 |
| Total New Hires | | 6 |

| MSA Source | Miles | Hires |
|---|---|---|
| **State College** | 0 | 3 |
| Altoona | 37 | 0 |
| Williamsport | 52 | 0 |
| Johnstown | 61 | 0 |
| Harrisburg | 68 | 0 |
| York | 80 | 0 |
| Lancaster | 103 | 0 |
| Reading | 103 | 0 |
| Pittsburgh | 120 | 1 |
| Scranton | 122 | 0 |
| Allentown | 131 | 0 |
| Beaver | 136 | 0 |
| Sharon | 140 | 0 |
| Erie | 144 | 1 |
| Philadelphia | 150 | 0 |
| Total New Hires | | 5 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Williamsport** | 0 | 1 |
| State College | 52 | 3 |
| Harrisburg | 69 | 0 |
| Scranton | 73 | 1 |
| Reading | 86 | 0 |
| Altoona | 90 | 0 |
| York | 91 | 0 |
| Lancaster | 93 | 0 |
| Allentown | 95 | 0 |
| Johnstown | 119 | 0 |
| Philadelphia | 135 | 0 |
| Pittsburgh | 164 | 0 |
| Erie | 168 | 0 |
| Beaver | 177 | 0 |
| Sharon | 179 | 0 |
| Total New Hires | | 5 |

| MSA Source | Miles | Hires |
|---|---|---|
| **York** | 0 | 16 |
| Lancaster | 23 | 16 |
| Harrisburg | 24 | 13 |
| Reading | 50 | 3 |
| State College | 80 | 7 |
| Allentown | 81 | 0 |
| Philadelphia | 84 | 2 |
| Williamsport | 91 | 1 |
| Altoona | 96 | 0 |
| Johnstown | 115 | 0 |
| Scranton | 116 | 6 |
| Pittsburgh | 175 | 4 |
| Beaver | 199 | 0 |
| Sharon | 212 | 3 |
| Erie | 230 | 1 |
| Total New Hires | | 72 |

| MSA Source | Miles | Hires |
|---|---|---|
| **Beaver** | 0 | 8 |
| Pittsburgh | 27 | 3 |
| Sharon | 34 | 0 |
| Johnstown | 85 | 0 |
| Erie | 99 | 2 |
| Altoona | 106 | 0 |
| State College | 136 | 1 |
| Williamsport | 177 | 0 |
| Harrisburg | 187 | 0 |
| York | 199 | 0 |
| Lancaster | 220 | 0 |
| Reading | 234 | 0 |
| Scranton | 250 | 0 |
| Allentown | 258 | 0 |
| Philadelphia | 281 | 0 |
| Total New Hires | | 14 |

### 5.3.5 The Demographics of Recent Withdrawals from Teaching

Originally, the Department of Education's professional personnel data identified 13 different reasons why a person may leave a school district. In 1990, the Department changed its withdrawal classification system to eight categories. During the 1980's, between 6,062 and 7,588 persons, either voluntarily or involuntarily, left a local school district. Retirement was typically the reason. In fact, between 1,801 and 2,726 persons retired during this period. The 1984/5 school year was the most active year for retirements and withdrawals (See Table 5.21).

Table 5.21: Withdrawals from School District By Year and Reason:1982-90

| | Last Active Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 82-3 | 83-4 | 84-5 | 85-6 | 86-7 | 87-8 | 88-9 | Total |
| Reason for Withdrawal | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
| Move other School | 407 | 538 | 724 | 730 | 912 | 777 | 810 | 4,898 |
| Move to Non-Pa School | 124 | 180 | 213 | 196 | 172 | 153 | 160 | 1,198 |
| Move to Private Sect. | 60 | 66 | 85 | 70 | 80 | 76 | 85 | 522 |
| Replaced | 788 | 732 | 833 | 807 | 893 | 926 | 864 | 5,843 |
| Laid Off | 689 | 451 | 348 | 308 | 279 | 324 | 222 | 2,621 |
| Returned to College | 84 | 67 | 83 | 46 | 66 | 71 | 64 | 481 |
| Marriage/Maternity | 590 | 574 | 554 | 419 | 430 | 355 | 348 | 3,270 |
| Move to Priv Industry | 256 | 319 | 322 | 233 | 234 | 226 | 183 | 1,773 |
| Move due to Spouse | 261 | 306 | 314 | 234 | 261 | 249 | 251 | 1,876 |
| Retirement | 1,801 | 1,982 | 2,400 | 2,726 | 2,188 | 2,045 | 2,294 | 15,436 |
| Illness | 33 | 32 | 58 | 45 | 31 | 37 | 27 | 263 |
| Death | 152 | 159 | 180 | 165 | 145 | 186 | 155 | 1,142 |
| Other-Unknown | 817 | 728 | 1,474 | 551 | 653 | 1,183 | 1,112 | 6,518 |
| Total | 6,062 | 6,134 | 7,588 | 6,530 | 6,344 | 6,608 | 6,575 | 45,841 |

Source: Tabulations of Pennsylvania Department of Education professional personnel files.

If we focus on *classroom* teachers, we find that between 4,665 and 5,805 left classroom teaching either voluntarily or involuntarily; of those who left, between 1,328 and 2,054 retired (See Table 5.22).

Table 5.22: Classroom Teacher Withdrawals By Year and Reason:1982-90

| | Last Active Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 82-3 | 83-4 | 84-5 | 85-6 | 86-7 | 87-8 | 88-9 | Total |
| Reason for Withdrawal | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
| Move to Other District | 268 | 365 | 487 | 472 | 574 | 503 | 499 | 3,168 |
| Move to Non-Pa School | 102 | 131 | 164 | 138 | 143 | 124 | 120 | 922 |
| Move to Private Sect. | 48 | 49 | 64 | 51 | 55 | 68 | 59 | 394 |
| Replaced | 621 | 531 | 647 | 619 | 673 | 704 | 675 | 4,470 |
| Laid Off | 530 | 322 | 260 | 233 | 212 | 226 | 174 | 1,957 |
| Returned to College | 68 | 61 | 75 | 36 | 58 | 59 | 51 | 408 |
| Marriage/Mater | 532 | 501 | 468 | 357 | 369 | 311 | 302 | 2,840 |
| Move to Priv Industry | 217 | 264 | 255 | 177 | 189 | 186 | 138 | 1,426 |
| Move due to Spouse | 225 | 254 | 263 | 195 | 206 | 210 | 209 | 1,562 |
| Retirement | 1,328 | 1,474 | 1,832 | 2,054 | 1,623 | 1,529 | 1,719 | 11,559 |
| Illness | 26 | 29 | 51 | 38 | 27 | 28 | 21 | 220 |

[continued on next page]

| | Last Active Year | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 82-3 | 83-4 | 84-5 | 85-6 | 86-7 | 87-8 | 88-9 | Total |
| Reason for Withdrawal | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
| Death | 119 | 119 | 141 | 129 | 121 | 148 | 125 | 902 |
| Other-Unknown | 645 | 565 | 1,098 | 415 | 474 | 889 | 806 | 4,892 |
| Total | 4,729 | 4,665 | 5,805 | 4,914 | 4,724 | 4,985 | 4,898 | 34,720 |

Source: Tabulations of Pennsylvania Department of Education professional personnel files.

During the 1980's, there was a marked increase in the median age of classroom teachers who withdrew from teaching. In 1982/3 the median age was 37, and median years of experience was 12.2, by 1988/9 the median age grew to 43, and median years of experience grew to 15.3 years. The first and third quartiles of the age and experience distributions displayed similar trends. Since many districts were able to increase salaries during the 1980's beyond the rate of inflation, the general pattern of higher ages of retention is consistent with the idea that certificated individuals found these salaries relatively more attractive than other pursuits (See Table 5.23).

Table 5.23: Withdrawals From Teaching

| Last | | Age of Withdrawals | | | | Total Years of Experience | | |
|---|---|---|---|---|---|---|---|---|
| Active | N | Q1 | Median | Mean | Q3 | Q1 | Median | Q3 |
| Year | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
| 82-3 | 4729 | 30 | 37 | 42.9 | 57 | 9 | 12.2 | 18 |
| 83-4 | 4665 | 32 | 38 | 43.8 | 58 | 11 | 13.7 | 21 |
| 84-5 | 5805 | 33 | 39 | 44.6 | 58 | 11 | 14.6 | 23 |
| 85-6 | 4914 | 33 | 43 | 45.7 | 59 | 13 | 15.6 | 27 |
| 86-7 | 4724 | 33 | 41 | 44.4 | 58 | 12 | 14.4 | 24 |
| 87-8 | 4985 | 33 | 42 | 44.8 | 58 | 12 | 14.5 | 24 |
| 88-9 | 4898 | 33 | 43 | 45.5 | 59 | 13 | 15.3 | 26 |

Source: Tabulations of Pennsylvania Department of Education professional personnel files.
Q1 is 25th percentile of age of professionals withdrawing from teaching
Q3 is 75th percentile of age of professionals withdrawing from teaching

On the other hand, if we focus on the median age and median experience of classroom teachers who retired, we see that the age fell slightly, but that the median experience also grew slightly. (See Table 5.24).

Table 5.24: Retirement from Teaching

| Last | | Age of Retirees | | | | Total Years of Experience | | | |
|---|---|---|---|---|---|---|---|---|---|
| Active | N | Q1 | Median | Mean | Q3 | Q1 | Median | Mean | Q3 |
| Year | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| 82-3 | 1328 | 59 | 63 | 60.0 | 65 | 19 | 26 | 25.1 | 33 |
| 83-4 | 1474 | 58 | 62 | 59.1 | 65 | 19 | 26 | 25.7 | 32 |
| 84-5 | 1832 | 57 | 61 | 59.3 | 64 | 20 | 27 | 26.3 | 33 |
| 85-6 | 2054 | 56 | 60 | 58.3 | 63 | 22 | 28 | 26.8 | 32 |
| 86-7 | 1623 | 57 | 61 | 59.1 | 64 | 21 | 28 | 26.3 | 32 |
| 87-8 | 1529 | 57 | 62 | 59.8 | 64 | 22 | 28 | 27.8 | 33 |
| 88-9 | 1719 | 57 | 61 | 59.3 | 64 | 22 | 29 | 27.4 | 33 |

Source: Tabulations of Pennsylvania Department of Education professional personnel files.
Q1 is 25th percentile of age of professionals withdrawing from teaching
Q3 is 75th percentile of age of professionals withdrawing from teaching

Table 5.21 showed the total number of person who withdrew from teaching for various reasons. It is also interesting to examine withdrawals by district, and ascertain the representative retirement rate, since in the model below, we are interested in the personnel hiring problem which each district must solve in the balance of the decade.

In the 1980's, the median district experienced retirement rates which varied from 1.1% to 1.8%. By 1989/90, the median retirement rate was 1.3% (See Table 5.25). Note that in each year the range of retirement rates was quite large, from 0 to 3.1%. This is consistent with the variations in age and experience distributions noted earlier in Table 5.11.

Table 5.25: State-Wide Retirement Rates: 1982-3 thru 1989-90

| Year | 25% | Median | Mean | 75% | 90% |
|---|---|---|---|---|---|
| 1982/3 | .0000000 | 0.011673 | 0.013387 | 0.019419 | 0.030688 |
| 1983/4 | .0000000 | 0.010990 | 0.013267 | 0.019109 | 0.030189 |
| 1984/5 | .0063392 | 0.014084 | 0.016678 | 0.024438 | 0.034843 |
| 1985/6 | .0081633 | 0.018654 | 0.021168 | 0.029925 | 0.044366 |
| 1986/7 | .0000000 | 0.012658 | 0.014875 | 0.022305 | 0.032025 |
| 1987/8 | .0023037 | 0.012578 | 0.014202 | 0.020513 | 0.031537 |
| 1988/9 | .0055248 | 0.013043 | 0.015914 | 0.023255 | 0.033669 |
| 1989/90 | .0050262 | 0.013304 | 0.015590 | 0.021739 | 0.031496 |

Source: Tabulations of Pennsylvania Department of Education professional personnel files

While retirement rates varied considerably in the 1980's, it is also evident from Table 5.26 that withdrawals for other reasons, which we call quit rates, were more stable. The median quit rate was between 3.0% and 3.5% during the 1980's. For districts at the 90th percentile, the quit rates were consistently over 6%.

Table 5.26: Quit Rates Excluding Retirement: 1982-3 thru 1989-90

| Year | 25% | Median | Mean | 75% | 90% |
|---|---|---|---|---|---|
| 1982/3 | 0.019204 | 0.035430 | 0.038655 | 0.056066 | 0.075508 |
| 1983/4 | 0.018645 | 0.033956 | 0.037539 | 0.051058 | 0.068227 |
| 1984/5 | 0.019417 | 0.034660 | 0.040120 | 0.054159 | 0.081166 |
| 1985/6 | 0.016181 | 0.032411 | 0.035999 | 0.050934 | 0.068768 |
| 1986/7 | 0.018434 | 0.032258 | 0.036511 | 0.050000 | 0.070088 |
| 1987/8 | 0.017857 | 0.031746 | 0.037279 | 0.048858 | 0.067682 |
| 1988/9 | 0.017241 | 0.030303 | 0.034509 | 0.046667 | 0.061404 |
| 1989/90 | 0.018223 | 0.032825 | 0.035127 | 0.046875 | 0.064278 |

Source: Tabulations of Pennsylvania Department of Education professional personnel files.

The total withdrawal rates, shown in Table 5.27, reflect the results of the above analysis. The median district in the 1980's faced classroom teacher turnover of between 4.6% and 5.3%. In some districts at the 90th percentile of total withdrawal rates, total turnover rates were as high as 10% per year.

Table 5.27: Total Withdrawal Rates 1982-3 thru 1989-90

| Year | 25% | Median | Mean | 75% | 90% |
|---|---|---|---|---|---|
| 1982/3 | 0.031903 | 0.048077 | 0.052042 | 0.070032 | 0.09512 |
| 1983/4 | 0.030457 | 0.048387 | 0.050806 | 0.065789 | 0.08445 |
| 1984/5 | 0.034602 | 0.052632 | 0.056798 | 0.072860 | 0.10000 |
| 1985/6 | 0.034052 | 0.053384 | 0.057167 | 0.077396 | 0.10061 |
| 1986/7 | 0.031299 | 0.048514 | 0.051386 | 0.068042 | 0.08717 |
| 1987/8 | 0.029740 | 0.046287 | 0.051481 | 0.065682 | 0.08964 |
| 1988/9 | 0.031250 | 0.047170 | 0.050423 | 0.065574 | 0.08065 |
| 1989/90 | 0.031250 | 0.047619 | 0.050717 | 0.066667 | 0.08347 |

Source: Tabulations of Pennsylvania Department of Education professional personnel files

Table 5.28 displays median retirement, quit and total withdrawal (denoted by "total quit" in the table) rates by MSA and county for 1982/3, 1985/6 and 1989/90. Although it is difficult to generalize about these various withdrawal rates, it is generally true that the median retirement rates have been below 2% for virtually all districts.

## Table 5.28: Retirement and Quit Rates by MSA and County

| Area | Pop90 | PCY 89 | Enroll % | # Dist | Median Dist Retire.% 82/3 | 85/6 | 89/9 | Median Dist Other Quit% 82/3 | 85/6 | 89/90 | Median Dist Total Quit% 82/3 | 85/6 | 89/90 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] | [14] |
| Allentown-Bethlehem MSA (3) | | | | | | | | | | | | | |
| Carbon County | 56,907 | $9,057 | 14% | 5 | 2.2% | 1.9% | 1.4% | 1.4% | 3.1% | 4.3% | 4.3% | 5.2% | 5.9% |
| Lehigh County | 272,548 | $12,794 | 14% | 9 | .96% | 1.5% | .90% | 3.7% | 4.0% | 4.3% | 4.8% | 6.7% | 5.5% |
| Northampton County | 266,599 | $11,574 | 13% | 8 | 1.8% | 1.9% | 1.1% | 3.1% | 2.7% | 3.2% | 4.4% | 5.2% | 4.3% |
| Altoona MSA (1) | | | | | | | | | | | | | |
| Blair County | 134,811 | $8,232 | 16% | 7 | 2.5% | .47% | 1.9% | 3.5% | 4.0% | 2.4% | 5.0% | 5.4% | 3.8% |
| Erie MSA (1) | | | | | | | | | | | | | |
| Erie County | 281,987 | $9,500 | 15% | 13 | 1.1% | 2.3% | 1.7% | 3.9% | 4.9% | 3.5% | 5.4% | 7.7% | 5.1% |
| Harrisburg-Lebanon MSA (4) | | | | | | | | | | | | | |
| Cumberland County | 224,801 | $12,737 | 15% | 9 | .92% | 1.3% | 1.1% | 3.2% | 4.7% | 3.7% | 4.9% | 5.9% | 5.5% |
| Dauphin County | 233,326 | $11,630 | 14% | 10 | 1.6% | 1.3% | 1.7% | 4.9% | 4.6% | 5.3% | 5.8% | 6.1% | 7.1% |
| Lebanon County | 113,744 | $10,802 | 15% | 6 | 1.6% | 1.8% | .99% | 3.0% | 3.3% | 2.0% | 4.8% | 5.2% | 2.8% |
| Perry County | 41,924 | $9,717 | 18% | 4 | 1.1% | .63% | .37% | 6.4% | 5.0% | 3.5% | 7.8% | 6.3% | 4.5% |
| Johnstown MSA (2) | | | | | | | | | | | | | |
| Cambria County | 159,602 | $7,764 | 14% | 12 | 1.5% | 1.0% | .18% | 4.0% | 1.9% | 2.1% | 5.6% | 3.7% | 2.9% |
| Somerset County | 79,376 | $7,745 | 17% | 11 | .00% | 1.0% | 1.2% | 4.3% | 5.1% | 4.8% | 4.3% | 5.7% | 6.7% |
| Lancaster MSA (1) | | | | | | | | | | | | | |
| Lancaster County | 419,065 | $12,213 | 14% | 16 | 1.5% | 1.8% | 1.5% | 5.1% | 4.8% | 4.6% | 6.9% | 6.3% | 5.8% |
| Scranton-Wilkes-Barre MSA (5) | | | | | | | | | | | | | |
| Columbia County | 74,147 | $8,864 | 14% | 6 | 1.9% | .87% | .64% | 4.4% | 3.8% | 3.2% | 4.8% | 5.6% | 3.8% |
| Lackawanna County | 215,410 | $9,363 | 12% | 10 | .85% | .85% | .31% | 1.9% | 3.7% | 1.2% | 3.0% | 3.9% | 1.4% |
| Luzerne County | 330,600 | $9,262 | 12% | 11 | .84% | .84% | 1.0% | 3.4% | 1.6% | 1.9% | 4.2% | 2.4% | 3.4% |
| Monroe County | 98,927 | $10,143 | 16% | 4 | 1.5% | 1.0% | 1.0% | 4.1% | 6.2% | 3.8% | 5.6% | 7.3% | 4.8% |
| Wyoming County | 28,297 | $9,555 | 17% | 2 | 2.5% | 2.1% | .90% | 3.2% | 1.6% | 2.7% | 5.8% | 3.7% | 3.6% |
| Philadelphia MSA (5) | | | | | | | | | | | | | |
| Bucks County | 538,589 | $14,051 | 14% | 13 | .82% | .00% | 1.5% | 3.1% | 3.5% | 5.5% | 4.6% | 4.7% | 5.9% |
| Chester County | 375,833 | $17,005 | 14% | 12 | .00% | 3.2% | 1.8% | .00% | 6.5% | 5.2% | .00% | 9.6% | 7.1% |
| Delaware County | 539,477 | $12,926 | 11% | 15 | 1.8% | 1.6% | 2.2% | 5.5% | 3.9% | 3.3% | 6.7% | 6.2% | 5.6% |
| Montgomery County | 669,993 | $18,155 | 11% | 21 | 1.4% | 1.6% | 1.3% | 3.7% | 4.3% | 3.3% | 4.3% | 5.5% | 4.5% |
| Phildadelphia | 1,585,577 | $6,842 | 12% | 1 | 1.5% | 1.9% | 3.0% | 2.1% | 1.2% | 3.7% | 3.6% | 3.1% | 6.7% |
| Pittsburgh MSA (4) | | | | | | | | | | | | | |
| Allegheny County | 1,335,916 | $11,501 | 12% | 43 | 1.1% | 1.5% | 1.7% | 4.3% | 2.3% | 1.9% | 6.3% | 3.6% | 4.0% |
| Fayette County | 137,048 | $6,883 | 16% | 6 | 2.1% | 1.7% | 1.8% | 1.8% | 2.0% | 1.1% | 3.6% | 3.4% | 4.0% |
| Washington County | 203,857 | $9,519 | 15% | 14 | 1.2% | 1.2% | 1.2% | 2.1% | 2.6% | 1.8% | 3.5% | 4.7% | 3.1% |
| Westmoreland County | 379,093 | $9,984 | 14% | 17 | 1.4% | 1.7% | 1.9% | 2.1% | 2.1% | 2.4% | 3.8% | 3.7% | 3.9% |
| Reading MSA (1) | | | | | | | | | | | | | |
| Berks County | 357,727 | $12,143 | 14% | 18 | .88% | 1.0% | 1.5% | 3.3% | 3.3% | 3.3% | 4.3% | 4.7% | 4.6% |
| Sharon MSA (1) | | | | | | | | | | | | | |
| Mercer County | 121,093 | $8,388 | 16% | 12 | 1.2% | 1.6% | 2.2% | 4.2% | 4.3% | 2.6% | 5.2% | 5.9% | 4.4% |
| State College MSA (1) | | | | | | | | | | | | | |
| Centre County | 113,912 | $9,341 | 11% | 4 | 1.6% | 1.7% | 1.3% | 2.2% | 4.7% | 5.7% | 4.2% | 6.3% | 7.5% |
| Williamsport MSA (1) | | | | | | | | | | | | | |
| Lycoming County | 119,904 | $9,346 | 16% | 8 | 1.3% | 1.3% | 2.4% | 2.2% | 2.9% | 3.9% | 3.6% | 4.9% | 6.3% |
| York MSA (2) | | | | | | | | | | | | | |
| Adams County | 78,274 | $10,400 | 15% | 6 | .58% | .46% | 1.4% | 3.0% | 6.1% | 3.8% | 4.0% | 6.5% | 4.1% |
| York County | 316,737 | $12,581 | 15% | 15 | 1.3% | 1.7% | .88% | 4.1% | 3.6% | 3.5% | 6.1% | 4.8% | 5.0% |
| Beaver MSA (1) | | | | | | | | | | | | | |
| Beaver County | 183,127 | $8,445 | 15% | 14 | 1.6% | .95% | 1.6% | 3.0% | 2.0% | 2.3% | 5.9% | 3.8% | 3.5% |
| Non-MSA Pa (34) | | | | | | | | | | | | | |
| Armstrong County | 77,286 | $8,478 | 16% | 4 | .47% | 2.7% | 1.7% | 2.3% | 1.5% | 4.9% | 3.4% | 4.0% | 6.6% |
| Bedford County | 49,580 | $6,988 | 17% | 5 | 1.3% | 2.3% | 2.4% | 3.3% | 4.4% | 4.7% | 4.7% | 6.1% | 7.3% |
| Bradford County | 63,587 | $8,660 | 19% | 7 | 1.2% | 1.7% | .93% | 2.7% | 2.8% | 1.6% | 4.0% | 4.7% | 3.7% |
| Butler County | 145,514 | $10,163 | 16% | 7 | 1.4% | .90% | .68% | 3.8% | 2.4% | 3.4% | 5.6% | 3.9% | 4.1% |
| Cameron County | 5,913 | $8,657 | 19% | 1 | .00% | .00% | 3.1% | 6.1% | 3.2% | 3.1% | 6.1% | 3.2% | 6.3% |
| Clarion County | 49,354 | $7,614 | 17% | 7 | 1.8% | 1.6% | 1.6% | 3.6% | 4.4% | 3.7% | 6.3% | 4.7% | 4.9% |
| Clearfield County | 93,681 | $8,169 | 17% | 8 | .25% | .00% | 2.4% | 3.7% | 3.5% | 1.9% | 4.3% | 5.0% | 3.6% |
| Clinton County | 35,977 | $7,817 | 16% | 1 | 3.1% | 1.1% | 2.1% | 1.4% | 1.9% | 4.1% | 4.5% | 2.9% | 6.2% |
| Crawford County | 71,213 | $8,544 | 17% | 3 | 1.6% | 1.3% | 1.1% | 3.8% | 1.7% | 4.8% | 5.5% | 3.7% | 5.9% |

[continued on next page]

| Area | Pop90 | PCY 89 | Enroll % | # Dist | Median Dist Retire.% 82/3 | 85/6 | 89/9 | Median Dist Other Quit% 82/3 | 85/6 | 89/90 | Median Dist Total Quit% 82/3 | 85/6 | 89/90 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] | [14] |
| Elk County | 34,132 | $10,074 | 13% | 3 | .70% | .75% | .78% | 7.7% | 3.0% | 3.8% | 9.8% | 3.7% | 7.2% |
| Forest County | 5,388 | $6,532 | 15% | 1 | .00% | .00% | .00% | 1.7% | 5.3% | 5.0% | 1.7% | 5.3% | 5.0% |
| Franklin County | 114,375 | $10,358 | 15% | 5 | 1.2% | 1.1% | 1.1% | 4.1% | 4.2% | 2.7% | 5.2% | 5.4% | 4.0% |
| Fulton County | 13,837 | $8,261 | 18% | 3 | .00% | .00% | .00% | 2.9% | 2.0% | .00% | 2.9% | 2.0% | .00% |
| Greene County | 39,550 | $6,596 | 18% | 5 | 1.2% | .67% | 1.3% | 4.8% | 2.7% | 5.1% | 4.8% | 3.1% | 5.8% |
| Huntingdon County | 42,070 | $7,156 | 16% | 4 | .00% | 1.7% | .57% | 4.2% | 4.2% | 3.4% | 4.2% | 6.8% | 4.0% |
| Indiana County | 87,235 | $7,936 | 16% | 7 | 1.0% | .83% | .94% | 4.8% | 3.5% | 4.1% | 6.0% | 3.5% | 5.8% |
| Jefferson County | 40,557 | $8,484 | 18% | 3 | 1.8% | .00% | 1.6% | 5.0% | 2.5% | 3.7% | 6.0% | 2.5% | 4.9% |
| Juniata County | 20,132 | $8,885 | 17% | 1 | 1.2% | .64% | 1.8% | 3.1% | 2.5% | 6.1% | 4.4% | 3.2% | 8.0% |
| Lawrence County | 97,068 | $8,145 | 15% | 8 | 1.4% | 1.2% | 1.8% | 3.0% | 2.4% | 2.4% | 5.2% | 3.4% | 3.7% |
| Mckean County | 48,155 | $8,159 | 17% | 5 | .00% | 1.3% | 1.1% | 3.3% | 6.5% | 5.4% | 4.4% | 7.0% | 6.5% |
| Mifflin County | 43,075 | $8,087 | 15% | 1 | .00% | 1.4% | 2.6% | 4.9% | 2.3% | .94% | 4.9% | 3.7% | 3.5% |
| Montour County | 18,749 | $11,301 | 14% | 1 | 2.1% | 1.3% | .00% | 1.4% | 4.4% | 1.4% | 3.5% | 5.7% | 1.4% |
| Northumberland Count | 97,267 | $8,261 | 15% | 6 | .71% | 1.0% | .35% | 5.7% | 2.8% | 3.3% | 5.7% | 4.4% | 4.4% |
| Pike County | 15,821 | $9,951 | 18% | 1 | 1.8% | .81% | .65% | 6.2% | 4.8% | 3.3% | 8.0% | 5.6% | 3.9% |
| Potter County | 16,931 | $7,507 | 20% | 5 | .00% | 1.7% | .00% | 5.8% | 6.9% | 6.1% | 5.8% | 8.6% | 6.1% |
| Schuylkill County | 148,625 | $8,670 | 13% | 12 | .38% | 1.0% | .29% | 2.5% | 1.9% | 3.6% | 3.8% | 3.3% | 5.6% |
| Snyder County | 36,680 | $9,012 | 15% | 2 | 2.1% | 1.2% | .90% | 3.7% | 1.9% | 4.8% | 5.7% | 3.2% | 5.7% |
| Sullivan County | 6,104 | $7,916 | 16% | 1 | 8.2% | .00% | .00% | 3.3% | 7.9% | 4.5% | 11% | 7.9% | 4.5% |
| Susquehanna County | 44,338 | $7,932 | 19% | 6 | .00% | .00% | .00% | 4.4% | 2.1% | 2.4% | 4.4% | 3.1% | 2.4% |
| Tioga County | 41,070 | $7,894 | 17% | 3 | .97% | 2.4% | 1.8% | 5.2% | 5.0% | 2.8% | 6.8% | 7.2% | 4.7% |
| Union County | 31,104 | $9,463 | 13% | 2 | 1.3% | 1.3% | 2.5% | 9.0% | 3.1% | 3.7% | 10% | 4.4% | 6.2% |
| Venango County | 67,127 | $8,303 | 17% | 5 | .54% | .00% | 1.3% | 2.6% | 4.6% | 3.2% | 3.2% | 4.7% | 4.6% |
| Warren County | 41,805 | $9,739 | 17% | 1 | .92% | 2.6% | 1.4% | 1.6% | 2.8% | 3.7% | 2.5% | 5.4% | 5.2% |
| Wayne County | 45,713 | $8,896 | 17% | 3 | .84% | 1.2% | 1.3% | 3.6% | 4.7% | 3.8% | 5.0% | 4.9% | 4.5% |

Source: Tabulations of Pennsylvania Department of Education professional personnel files.
Definitions:
[2]: 1990 census of population
[3]: 1989 money income/1990 census of population
[4]: 1991 total school enrollment/1990 census of population
[6]: median districts retirement rate in 1982/3
[7]: median districts retirement rate in 1985/6
[8]: median districts retirement rate in 1989/90
[9]: median districts withdrawal rate for reasons other than retirement in 1982/3
[10]: median districts withdrawal rate for reasons other than retirement in 1985/6
[11]: median districts withdrawal rate for reasons other than retirement in 1989/90
[12]: median districts withdrawal rate for any reason other than retirement in 1982/3
[13]: median districts withdrawal rate for any reason other than retirement in 1985/6
[14]: median districts withdrawal rate for any reason other than retirement in 1989/90

## 5.4 Sources of Demand for Classroom Teachers

We now turn to characterize the sources of demand for classroom teachers in Pennsylvania. The demographic model developed in Chapter 4 requires general enrollment data, as well as enrollment by curricula. These two dimensions are analyzed below.

### 5.4.1 Recent and Projected Student Enrollments

Pennsylvania's public school enrollment reached its minima in 1989 at 1.621 million students, and is projected by the Department of Education to grow steadily to 1.779 million by the close of the decade. This modest growth in enrollment will be accompanied by a change in the composition of public school students. In 1990, secondary students (grades 7-12) were 44.3% of statewide enrollment, while in 2000, they are projected to be 47% of total student enrollment. Also, we know that secondary teachers are generally older and more experienced than primary teachers. Thus, it is reasonable to expect that districts will need to find more secondary teachers than primary school teachers in the balance of the decade, both because their current inventory of secondary school teachers may be retiring relatively more frequently than their primary school counterparts, and because student demand for such teachers will be increasing (See Table 5.29).

Table 5.29: Student Enrollment by Level: 1981/2 through 2000/1

| School Year | Kindergarden Enrollment | % Change | Primary Grades(1-6) Enrollment | % Change | Secondary Grades(7-12) Enrollment | % Change | Total Enrollment | % Change |
|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
| 2000 | 125,318 | -0.6% | 817,347 | -0.7% | 836,101 | 0.9% | 1,778,766 | 0.1% |
| 1999 | 126,063 | -0.6% | 822,773 | -0.2% | 828,634 | 0.7% | 1,777,470 | 0.2% |
| 1998 | 126,822 | -0.6% | 824,041 | 0.2% | 823,059 | 0.6% | 1,773,920 | 0.3% |
| 1997 | 127,602 | -0.6% | 822,497 | 0.2% | 818,014 | 1.2% | 1,768,112 | 0.6% |
| 1996 | 128,397 | -3.9% | 820,787 | 1.2% | 808,392 | 1.4% | 1,757,575 | 0.9% |
| 1995 | 133,668 | 0.4% | 810,928 | 0.9% | 797,557 | 2.3% | 1,742,154 | 1.5% |
| 1994 | 133,091 | 2.0% | 803,911 | 0.7% | 779,440 | 2.7% | 1,716,443 | 1.7% |
| 1993 | 130,468 | 2.1% | 798,165 | 0.6% | 758,837 | 2.3% | 1,687,470 | 1.5% |
| 1992 | 127,825 | 1.5% | 793,696 | 0.6% | 741,455 | 2.0% | 1,662,977 | 1.3% |
| 1991 | 125,955 | -0.2% | 788,896 | 1.1% | 727,082 | 0.9% | 1,641,933 | 0.9% |
| 1990 | 126,232 | 1.0% | 780,125 | 1.2% | 720,592 | -0.6% | 1,626,947 | 0.4% |
| 1989 | 125,035 | 0.2% | 771,095 | 2.0% | 725,141 | -2.3% | 1,621,271 | 0.1% |
| 1988 | 124,750 | 0.6% | 756,196 | 2.8% | 742,284 | -4.0% | 1,623,230 | -0.6% |
| 1987 | 123,980 | 0.2% | 735,249 | 2.3% | 773,018 | -2.7% | 1,632,245 | -0.3% |
| 1986 | 123,793 | 1.4% | 718,610 | 1.9% | 794,810 | -3.1% | 1,637,214 | -0.6% |
| 1985 | 122,134 | 1.6% | 705,387 | 1.0% | 820,275 | -3.0% | 1,647,796 | -1.0% |
| 1984 | 120,171 | 2.0% | 698,715 | -1.9% | 845,750 | -2.8% | 1,664,636 | -2.1% |
| 1983 | 117,799 | 0.6% | 712,091 | -3.7% | 870,151 | -2.2% | 1,700,041 | -2.5% |
| 1982 | 117,121 | 2.5% | 739,458 | -4.2% | 889,734 | -2.6% | 1,743,313 | -3.2% |
| 1981 | 114,285 | | 772,092 | | 913,786 | | 1,800,163 | |

Source: tabulations of Pennsylvania Department of Education enrollment projection data files.

The statewide 2.7% higher enrollment of secondary students by the close of the decade masks much greater regional changes. Eleven counties will experience secondary enrollment ratios which are 4 to 5% higher than in 1991/2[8] while six will experience secondary enrollment ratios which are 7 to 10% higher than in 1991/2.[9] Table 5.30 shows enrollments by county, MSA and level for 1981/2, 1991/2 and 2000/1. Not all areas will experience enrollment growth: Johnstown, Washington, Fayette, Westmoreland, Mercer, Beaver and Clearfield counties will all experience overall enrollment decreases in the 1990's. It should be noted that educating upper division students is usually more expensive than educating primary school children.

[8]Carbon, Northhampton, Dauphin, Bucks, Chester, Philadelphia, Berks, Lycoming, Adams, Montour and Wayne counties.

[9]Monroe, Delaware, Montgomery, Allegheny, Cameron and Pike counties.

Table 5.30: Primary and Secondary Enrollment Levels by Metropolitan Statistical Area: 1981-2000

| Area | Pop90 | PCY 89 | # Dists | 1981/2 | | | 1991/2 | | | 2000/1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | % Prim. | % Sec | Tot Enr | % Prim. | % Sec | Tot Enr | % Prim. | % Sec | Tot Enr |
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Allentown-Bethlehem | | | | | | | | | | | | |
| Carbon County | 56,907 | $9,057 | 5 | 50% | 50% | 8,326 | 54% | 46% | 8,214 | 50% | 50% | 9,407 |
| Lehigh County | 272,548 | $12,794 | 9 | 50% | 50% | 40,115 | 56% | 44% | 39,068 | 53% | 47% | 44,304 |
| Northampton County | 266,599 | $11,574 | 8 | 48% | 52% | 36,554 | 56% | 44% | 36,381 | 52% | 48% | 42,983 |
| Altoona MSA (1) | | | | | | | | | | | | |
| Blair County | 134,811 | $8,232 | 7 | 49% | 51% | 23,071 | 54% | 46% | 21,173 | 52% | 48% | 22,083 |
| Erie MSA (1) | | | | | | | | | | | | |
| Erie County | 281,987 | $9,500 | 13 | 51% | 49% | 44,769 | 55% | 45% | 41,633 | 54% | 46% | 43,358 |
| Harrisburg-Labanon M | | | | | | | | | | | | |
| Cumberland County | 224,801 | $12,737 | 9 | 50% | 50% | 35,421 | 55% | 45% | 33,223 | 54% | 46% | 36,738 |
| Dauphin County | 233,326 | $11,630 | 10 | 54% | 46% | 34,454 | 59% | 41% | 34,338 | 54% | 46% | 36,430 |
| Lebanon County | 113,744 | $10,802 | 6 | 51% | 49% | 18,509 | 56% | 44% | 16,804 | 56% | 44% | 18,685 |
| Perry County | 41,924 | $9,717 | 4 | 53% | 47% | 7,584 | 55% | 45% | 7,608 | 55% | 45% | 8,762 |
| Johnstown MSA (1) | | | | | | | | | | | | |
| Cambria County | 159,602 | $7,764 | 12 | 51% | 49% | 26,628 | 52% | 48% | 21,502 | 53% | 47% | 18,692 |
| Somerset County | 79,376 | $7,745 | 11 | 53% | 47% | 15,070 | 53% | 47% | 13,021 | 56% | 44% | 12,025 |
| Lancaster MSA (1) | | | | | | | | | | | | |
| Lancaster County | 419,065 | $12,213 | 16 | 52% | 48% | 56,412 | 57% | 43% | 61,173 | 54% | 46% | 75,194 |
| Scranton-Wilkes-Barr | | | | | | | | | | | | |
| Columbia County | 74,147 | $8,864 | 6 | 52% | 48% | 11,246 | 56% | 44% | 10,783 | 54% | 46% | 12,165 |
| Lackawanna County | 215,410 | $9,363 | 10 | 49% | 51% | 30,172 | 54% | 46% | 26,469 | 54% | 46% | 27,224 |
| Luzerne County | 330,600 | $9,262 | 11 | 49% | 51% | 46,820 | 54% | 46% | 39,147 | 53% | 47% | 39,378 |
| Monroe County | 98,927 | $10,143 | 4 | 51% | 49% | 11,922 | 56% | 44% | 18,319 | 48% | 52% | 32,251 |
| Wyoming County | 28,297 | $9,555 | 2 | 55% | 45% | 5,406 | 56% | 44% | 4,880 | 56% | 44% | 5,059 |
| Philadelphia MSA (5) | | | | | | | | | | | | |
| Bucks County | 538,589 | $14,051 | 13 | 48% | 52% | 80,153 | 56% | 44% | 77,186 | 52% | 48% | 91,206 |
| Chester County | 375,833 | $17,005 | 12 | 51% | 49% | 52,108 | 58% | 42% | 53,152 | 54% | 46% | 65,452 |
| Delaware County | 539,477 | $12,926 | 15 | 46% | 54% | 66,454 | 58% | 42% | 59,804 | 51% | 49% | 65,930 |
| Montgomery County | 669,993 | $18,155 | 21 | 46% | 54% | 83,479 | 57% | 43% | 79,320 | 51% | 49% | 94,993 |
| Phildadelphia | 1,585,577 | $6,842 | 1 | 49% | 51% | 214,514 | 57% | 43% | 198,272 | 52% | 48% | 210,324 |
| Pittsburgh MSA (4) | | | | | | | | | | | | |
| Allegheny County | 1,335,916 | $11,501 | 43 | 46% | 54% | 194,009 | 55% | 45% | 159,170 | 50% | 50% | 164,601 |
| Fayette County | 137,048 | $6,883 | 6 | 51% | 49% | 26,751 | 53% | 47% | 21,330 | 55% | 45% | 19,372 |
| Washington County | 203,857 | $9,519 | 14 | 50% | 50% | 36,557 | 52% | 48% | 29,338 | 54% | 46% | 27,081 |
| Westmoreland County | 379,093 | $9,984 | 17 | 47% | 53% | 65,962 | 52% | 48% | 53,933 | 51% | 49% | 52,756 |
| Reading MSA (1) | | | | | | | | | | | | |
| Berks County | 357,727 | $12,143 | 18 | 50% | 50% | 52,131 | 58% | 42% | 53,102 | 54% | 46% | 64,054 |
| Sharon MSA (1) | | | | | | | | | | | | |
| Mercer County | 121,093 | $8,388 | 12 | 50% | 50% | 21,992 | 53% | 47% | 18,246 | 53% | 47% | 16,566 |
| State College MSA (1 | | | | | | | | | | | | |
| Centre County | 113,912 | $9,341 | 4 | 48% | 52% | 13,942 | 55% | 45% | 12,703 | 53% | 47% | 14,169 |
| Williamsport MSA (2) | | | | | | | | | | | | |
| Lycoming County | 119,904 | $9,346 | 8 | 51% | 49% | 21,472 | 57% | 43% | 19,659 | 53% | 47% | 19,290 |
| York MSA (2) | | | | | | | | | | | | |
| Adams County | 78,274 | $10,400 | 6 | 52% | 48% | 11,983 | 58% | 42% | 12,679 | 53% | 47% | 15,734 |
| York County | 316,737 | $12,581 | 15 | 53% | 47% | 49,970 | 58% | 42% | 48,732 | 55% | 45% | 58,328 |
| Beaver MSA (1) | | | | | | | | | | | | |
| Beaver County | 183,127 | $8,445 | 14 | 50% | 50% | 33,497 | 53% | 47% | 27,559 | 52% | 48% | 25,721 |
| Non-MSA Pa (35) | | | | | | | | | | | | |
| Armstrong County | 77,286 | $8,478 | 4 | 52% | 48% | 13,995 | 55% | 45% | 12,341 | 57% | 43% | 12,024 |
| Bedford County | 49,580 | $6,988 | 5 | 51% | 49% | 9,702 | 54% | 46% | 8,353 | 56% | 44% | 8,479 |
| Bradford County | 63,587 | $8,660 | 7 | 50% | 50% | 13,758 | 56% | 44% | 12,129 | 56% | 44% | 12,103 |
| Butler County | 145,514 | $10,163 | 7 | 49% | 51% | 26,192 | 54% | 46% | 23,973 | 54% | 46% | 25,288 |
| Cameron County | 5,913 | $8,657 | 1 | 50% | 50% | 1,308 | 61% | 39% | 1,067 | 52% | 48% | 1,027 |
| Clarion County | 49,354 | $7,614 | 7 | 51% | 49% | 9,101 | 53% | 47% | 7,882 | 59% | 41% | 8,003 |
| Clearfield County | 93,681 | $8,169 | 8 | 52% | 48% | 18,918 | 55% | 45% | 15,423 | 60% | 40% | 14,782 |
| Clinton County | 35,977 | $7,817 | 1 | 49% | 51% | 6,297 | 53% | 47% | 5,822 | 57% | 43% | 6,127 |
| Crawford County | 71,213 | $8,544 | 3 | 51% | 49% | 14,017 | 55% | 45% | 11,679 | 56% | 44% | 11,302 |
| Elk County | 34,132 | $10,074 | 3 | 45% | 55% | 5,495 | 51% | 49% | 4,311 | 52% | 48% | 4,181 |

[continued on next page]

| Area | Pop90 | PCY 89 | # Dists | 1981/2 | | | 1991/2 | | | 2000/1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | % Prim. | % Sec | Tot Enr | % Prim. | % Sec | Tot Enr | % Prim. | % Sec | Tot Enr |
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Forest County | 5,388 | $6,532 | 1 | 47% | 53% | 995 | 50% | 50% | 721 | 58% | 42% | 576 |
| Franklin County | 114,375 | $10,358 | 5 | 51% | 49% | 19,527 | 55% | 45% | 17,566 | 54% | 46% | 18,512 |
| Fulton County | 13,837 | $8,261 | 3 | 52% | 48% | 2,656 | 56% | 44% | 2,476 | 60% | 40% | 2,539 |
| Greene County | 39,550 | $6,596 | 5 | 53% | 47% | 8,218 | 53% | 47% | 6,834 | 59% | 41% | 6,341 |
| Huntingdon County | 42,070 | $7,156 | 4 | 53% | 47% | 7,812 | 55% | 45% | 6,598 | 57% | 43% | 6,682 |
| Indiana County | 87,235 | $7,936 | 7 | 51% | 49% | 15,368 | 53% | 47% | 13,562 | 59% | 41% | 13,705 |
| Jefferson County | 40,557 | $8,484 | 3 | 54% | 46% | 7,779 | 56% | 44% | 7,030 | 58% | 42% | 6,722 |
| Juniata County | 20,132 | $8,885 | 1 | 52% | 48% | 3,632 | 55% | 45% | 3,344 | 55% | 45% | 3,475 |
| Lawrence County | 97,068 | $8,145 | 8 | 52% | 48% | 17,191 | 57% | 43% | 14,746 | 57% | 43% | 13,939 |
| Mckean County | 48,155 | $8,159 | 5 | 50% | 50% | 9,909 | 54% | 46% | 7,899 | 55% | 45% | 7,512 |
| Mifflin County | 43,075 | $8,087 | 1 | 48% | 52% | 7,658 | 54% | 46% | 6,188 | 53% | 47% | 6,237 |
| Montour County | 18,749 | $11,301 | 1 | 50% | 50% | 2,778 | 57% | 43% | 2,607 | 53% | 47% | 2,706 |
| Northumberland Count | 97,267 | $8,261 | 6 | 50% | 50% | 16,549 | 54% | 46% | 14,218 | 52% | 48% | 14,105 |
| Pike County | 15,821 | $9,951 | 1 | 51% | 49% | 1,740 | 62% | 38% | 3,172 | 52% | 48% | 5,931 |
| Potter County | 16,931 | $7,507 | 5 | 51% | 49% | 3,658 | 55% | 45% | 3,200 | 56% | 44% | 3,109 |
| Schuylkill County | 148,625 | $8,670 | 12 | 49% | 51% | 21,177 | 54% | 46% | 19,411 | 50% | 50% | 18,622 |
| Snyder County | 36,680 | $9,012 | 2 | 51% | 49% | 5,861 | 56% | 44% | 5,426 | 58% | 42% | 6,353 |
| Sullivan County | 6,104 | $7,916 | 1 | 49% | 51% | 1,141 | 54% | 46% | 1,017 | 57% | 43% | 1,028 |
| Susquehanna County | 44,338 | $7,932 | 6 | 51% | 49% | 8,535 | 57% | 43% | 8,206 | 56% | 44% | 8,547 |
| Tioga County | 41,070 | $7,894 | 3 | 51% | 49% | 8,068 | 55% | 45% | 6,733 | 58% | 42% | 6,584 |
| Union County | 31,104 | $9,463 | 2 | 50% | 50% | 4,201 | 57% | 43% | 3,905 | 60% | 40% | 4,555 |
| Venango County | 67,127 | $8,303 | 5 | 51% | 49% | 12,832 | 54% | 46% | 11,205 | 56% | 44% | 9,865 |
| Warren County | 41,805 | $9,739 | 1 | 49% | 51% | 8,116 | 55% | 45% | 6,877 | 56% | 44% | 6,507 |
| Wayne County | 45,713 | $8,896 | 3 | 50% | 50% | 6,968 | 57% | 43% | 8,091 | 52% | 48% | 10,983 |

Source: Tabulations of Pennsylvania Department of Education enrollment projection files.
Definitions:
[2]: 1990 census of population
[3]: 1989 money income/1990 census of population
[4]: 1991 total school enrollment/1990 census of population
[5]: enrollment in grades K-6/total enrollment in 1981/2
[6]: enrollment in grades 7-12/total enrollment in 1981/2
[7]: total enrollment in grades K-12 in 1981/2
[5]: enrollment in grades K-6/total enrollment in 1991/2
[6]: enrollment in grades 7-12/total enrollment in 1991/2
[7]: total enrollment in grades K-12 in 1991/2
[5]: projected enrollment in grades K-6/total enrollment in 2000/1
[6]: projected enrollment in grades 7-12/total enrollment in 2000/1
[7]: projected total enrollment in grades K-12 in 2000/1

### 5.4.2 Recent Student-Teacher Ratios

The second step in predicting future teacher hiring needs is to determine the student-teacher ratio which school districts may use to plan future hires. We have seen that in the 1980's both teacher employment generally grew (e.g. see Table 5.7), and student enrollment generally fell (e.g. see Table 5.29). The combination of these trends was a generally falling student-teacher ratio. In 1983/4, the statewide student-teacher ratio was 19.3, and by 1989/90, it had fallen to 16.3 (See Table 5.31). If Pennsylvania's school districts are to maintain an aggregate student teacher ratio of 16.3, then the total number of teachers in districts, intermediate units and area vocational schools must rise to 109,127 (1,778,766/16.3). If, on the other hand student-teacher ratios are allowed to rise back up to 19.3, then the total number of teachers needed would be 92,164 (1,778,766/19.3) which is lower than the current number of total teachers.

Table 5.31: Pennsylvania Classroom Teachers and Enrollment: 1982/3-1989/90

| School Year | Total Classroom Teachers | Newly Trained Hires | Exper. Hires | New Hire Rate | Exper. Hiring Rate | Student Enrollment | Student Teacher Ratio |
|---|---|---|---|---|---|---|---|
| 1983/4 | 94,364 | 2,078 | 1,818 | 2.2% | 1.9% | 1,817,840 | 19.3 |
| 1984/5 | 95,970 | 1,732 | 1,764 | 1.8% | 1.8% | 1,784,807 | 18.6 |
| 1985/6 | 95,716 | 2,515 | 1,862 | 2.6% | 1.9% | 1,647,796 | 17.2 |
| 1986/7 | 97,093 | 2,815 | 2,214 | 2.9% | 2.3% | 1,637,213 | 16.9 |
| 1987/8 | 97,288 | 2,037 | 1,931 | 2.1% | 2.0% | 1,632,247 | 16.8 |
| 1988/9 | 98,341 | 3,284 | 1,944 | 3.3% | 2.0% | 1,623,230 | 16.5 |
| 1989/90 | 99,328 | 3,679 | 1,945 | 3.7% | 2.0% | 1,621,271 | 16.3 |
| Average | 96,980 | 2,481 | 1,848 | 2.6% | 1.9% | 1,703,198 | 17.6 |

Source: Tabulations of Pennsylvania Department of Education files.

Table 5.32: Recent Student Teacher Ratios:1981-91

| Area | Pop90 | PCY 89 | Enroll % | #Dist | Prim $T_{81}$ | Prim $T_{91}$ | PRat. 1981/2 | PRat. 1990/1 | Sec $T_{81}$ | Sec $T_{91}$ | SRat. 1981/2 | SRat. 1990/1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Allentown-Bethlehem MSA (3) | | | | | | | | | | | | |
| Carbon County | 56,907 | $9,057 | 14% | 5 | 159 | 186 | 26.0 | 20.6 | 209 | 198 | 20.1 | 18.5 |
| Lehigh County | 272,548 | $12,794 | 14% | 9 | 791 | 962 | 25.1 | 19.2 | 916 | 1,002 | 22.1 | 16.8 |
| Northampton County | 266,599 | $11,574 | 13% | 8 | 750 | 917 | 23.5 | 18.8 | 926 | 892 | 20.5 | 17.7 |
| Altoona MSA (1) | | | | | | | | | | | | |
| Blair County | 134,811 | $8,232 | 16% | 7 | 450 | 489 | 25.0 | 20.4 | 540 | 536 | 21.9 | 18.0 |
| Erie MSA (1) | | | | | | | | | | | | |
| Erie County | 281,987 | $9,500 | 15% | 13 | 864 | 995 | 26.3 | 19.8 | 1,045 | 1,031 | 21.1 | 18.0 |
| Harrisburg-Lebanon MSA (4) | | | | | | | | | | | | |
| Cumberland County | 224,801 | $12,737 | 15% | 9 | 679 | 830 | 26.3 | 18.9 | 980 | 982 | 17.9 | 15.3 |
| Dauphin County | 233,326 | $11,630 | 14% | 10 | 776 | 1,046 | 23.9 | 15.9 | 879 | 947 | 18.1 | 14.7 |
| Lebanon County | 113,744 | $10,802 | 15% | 6 | 403 | 468 | 23.6 | 17.4 | 457 | 433 | 19.7 | 17.4 |
| Perry County | 41,924 | $9,717 | 18% | 4 | 173 | 193 | 23.1 | 18.8 | 163 | 179 | 22.0 | 18.5 |
| Johnstown MSA (2) | | | | | | | | | | | | |
| Cambria County | 159,602 | $7,764 | 14% | 12 | 549 | 519 | 24.7 | 19.0 | 635 | 550 | 20.5 | 19.0 |
| Somerset County | 79,376 | $7,745 | 17% | 11 | 322 | 340 | 24.7 | 18.1 | 366 | 348 | 19.4 | 17.7 |
| Lancaster MSA (1) | | | | | | | | | | | | |
| Lancaster County | 419,065 | $12,213 | 14% | 16 | 1,296 | 1,608 | 22.8 | 18.4 | 1,358 | 1,542 | 19.8 | 16.6 |
| Scranton-Wilkes-Barre MSA (5) | | | | | | | | | | | | |
| Columbia County | 74,147 | $8,864 | 14% | 6 | 237 | 282 | 24.5 | 18.7 | 271 | 291 | 20.1 | 15.9 |
| Lackawanna County | 215,410 | $9,363 | 12% | 10 | 638 | 648 | 23.2 | 18.4 | 833 | 689 | 18.5 | 17.6 |
| Luzerne County | 330,600 | $9,262 | 12% | 11 | 940 | 973 | 24.6 | 18.9 | 1,143 | 1,061 | 20.7 | 16.8 |
| Monroe County | 98,927 | $10,143 | 16% | 4 | 280 | 444 | 21.6 | 18.7 | 302 | 398 | 19.5 | 18.5 |
| Wyoming County | 28,297 | $9,555 | 17% | 2 | 112 | 103 | 26.6 | 22.6 | 128 | 131 | 18.9 | 16.6 |
| Philadelphia MSA (5) | | | | | | | | | | | | |
| Bucks County | 538,589 | $14,051 | 14% | 13 | 1,593 | 1,887 | 24.2 | 19.1 | 2,283 | 1,986 | 18.2 | 16.9 |
| Chester County | 375,833 | $17,005 | 14% | 12 | 1,112 | 1,433 | 23.8 | 17.7 | 1,456 | 1,574 | 17.6 | 14.0 |
| Delaware County | 539,477 | $12,926 | 11% | 15 | 1,336 | 1,530 | 23.1 | 19.0 | 1,854 | 1,569 | 19.2 | 15.6 |
| Montgomery County | 669,993 | $18,155 | 11% | 21 | 1,755 | 2,167 | 21.9 | 17.4 | 2,541 | 2,194 | 17.8 | 15.2 |
| Phildadelphia | 1,585,577 | $6,842 | 12% | 1 | 6,688 | 5,344 | 15.6 | 18.2 | 2,912 | 3,200 | 37.8 | 26.1 |
| Pittsburgh MSA (4) | | | | | | | | | | | | |
| Allegheny County | 1,335,916 | $11,501 | 12% | 43 | 4,243 | 4,430 | 20.8 | 16.8 | 5,406 | 4,584 | 19.5 | 15.5 |
| Fayette County | 137,048 | $6,883 | 16% | 6 | 553 | 519 | 24.6 | 19.2 | 664 | 482 | 19.8 | 21.4 |
| Washington County | 203,857 | $9,519 | 15% | 14 | 736 | 737 | 24.7 | 18.3 | 868 | 841 | 21.2 | 16.9 |
| Westmoreland County | 379,093 | $9,984 | 14% | 17 | 1,308 | 1,289 | 23.5 | 19.2 | 1,757 | 1,371 | 20.1 | 18.8 |
| Reading MSA (1) | | | | | | | | | | | | |
| Berks County | 357,727 | $12,143 | 14% | 18 | 1,120 | 1,380 | 23.2 | 18.6 | 1,378 | 1,350 | 19.0 | 16.2 |
| Sharon MSA (1) | | | | | | | | | | | | |
| Mercer County | 121,093 | $8,388 | 16% | 12 | 439 | 454 | 25.2 | 18.7 | 546 | 498 | 20.0 | 17.3 |
| State College MSA (1) | | | | | | | | | | | | |

[continued on next page]

| Area | Pop90 | PCY 89 | Enroll % | #Dist | Prim $T_{81}$ | Prim $T_{91}$ | PRat. 1981/2 | PRat. 1990/1 | Sec $T_{81}$ | Sec $T_{91}$ | SRat. 1981/2 | SRat. 1990/1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Centre County | 113,912 | $9,341 | 11% | 4 | 295 | 343 | 22.7 | 17.0 | 371 | 373 | 19.5 | 15.3 |
| Williamsport MSA (1) | | | | | | | | | | | | |
| Lycoming County | 119,904 | $9,346 | 16% | 8 | 432 | 466 | 25.2 | 20.7 | 552 | 531 | 19.2 | 15.9 |
| York MSA (2) | | | | | | | | | | | | |
| Adams County | 78,274 | $10,400 | 15% | 6 | 250 | 321 | 25.1 | 19.0 | 283 | 319 | 20.2 | 16.4 |
| York County | 316,737 | $12,581 | 15% | 15 | 1,025 | 1,264 | 25.7 | 18.9 | 1,146 | 1,246 | 20.6 | 16.2 |
| Beaver MSA (1) | | | | | | | | | | | | |
| Beaver County | 183,127 | $8,445 | 15% | 14 | 679 | 687 | 24.6 | 18.7 | 791 | 707 | 21.2 | 18.1 |
| Non-MSA Pa (34) | | | | | | | | | | | | |
| Armstrong County | 77,286 | $8,478 | 16% | 4 | 339 | 300 | 21.5 | 19.8 | 408 | 344 | 16.4 | 16.2 |
| Bedford County | 49,580 | $6,988 | 17% | 5 | 221 | 224 | 22.4 | 17.4 | 240 | 230 | 19.8 | 16.9 |
| Bradford County | 63,587 | $8,660 | 19% | 7 | 280 | 332 | 24.8 | 17.5 | 334 | 306 | 20.4 | 17.7 |
| Butler County | 145,514 | $10,163 | 16% | 7 | 523 | 577 | 24.6 | 19.1 | 592 | 577 | 22.5 | 19.0 |
| Cameron County | 5,913 | $8,657 | 19% | 1 | 26 | 30 | 25.0 | 17.9 | 35 | 36 | 18.8 | 12.0 |
| Clarion County | 49,354 | $7,614 | 17% | 7 | 194 | 205 | 23.7 | 18.0 | 220 | 220 | 20.5 | 17.1 |
| Clearfield County | 93,681 | $8,169 | 17% | 8 | 408 | 416 | 24.3 | 17.6 | 435 | 405 | 20.7 | 17.6 |
| Clinton County | 35,977 | $7,817 | 16% | 1 | 146 | 152 | 21.3 | 18.1 | 158 | 132 | 20.2 | 20.5 |
| Crawford County | 71,213 | $8,544 | 17% | 3 | 291 | 320 | 24.6 | 17.6 | 341 | 345 | 20.1 | 15.4 |
| Elk County | 34,132 | $10,074 | 13% | 3 | 105 | 109 | 23.7 | 17.9 | 154 | 123 | 19.5 | 17.1 |
| Forest County | 5,388 | $6,532 | 15% | 1 | 18 | 21 | 26.2 | 15.8 | 27 | 29 | 19.4 | 13.2 |
| Franklin County | 114,375 | $10,358 | 15% | 5 | 426 | 443 | 23.5 | 18.6 | 437 | 430 | 21.8 | 18.8 |
| Fulton County | 13,837 | $8,261 | 18% | 3 | 56 | 64 | 24.4 | 18.5 | 62 | 65 | 20.8 | 17.2 |
| Greene County | 39,550 | $6,596 | 18% | 5 | 175 | 171 | 24.9 | 18.8 | 182 | 196 | 21.2 | 16.8 |
| Huntingdon County | 42,070 | $7,156 | 16% | 4 | 181 | 185 | 22.9 | 16.8 | 156 | 192 | 23.5 | 15.7 |
| Indiana County | 87,235 | $7,936 | 16% | 7 | 322 | 351 | 24.3 | 18.2 | 407 | 398 | 18.5 | 16.1 |
| Jefferson County | 40,557 | $8,484 | 18% | 3 | 190 | 188 | 21.9 | 18.4 | 176 | 183 | 20.6 | 16.9 |
| Juniata County | 20,132 | $8,885 | 17% | 1 | 73 | 87 | 25.8 | 18.2 | 69 | 67 | 25.3 | 22.8 |
| Lawrence County | 97,068 | $8,145 | 15% | 8 | 394 | 400 | 22.9 | 18.7 | 445 | 364 | 18.4 | 17.2 |
| Mckean County | 48,155 | $8,159 | 17% | 5 | 206 | 211 | 24.2 | 17.7 | 278 | 250 | 17.7 | 14.7 |
| Mifflin County | 43,075 | $8,087 | 15% | 1 | 174 | 176 | 20.9 | 16.4 | 204 | 170 | 19.7 | 16.9 |
| Montour County | 18,749 | $11,301 | 14% | 1 | 53 | 69 | 26.0 | 18.4 | 76 | 68 | 18.4 | 16.2 |
| Northumberland County | 97,267 | $8,261 | 15% | 6 | 341 | 343 | 24.3 | 19.1 | 390 | 391 | 21.2 | 16.8 |
| Pike County | 15,821 | $9,951 | 18% | 1 | 40 | 90 | 22.0 | 17.5 | 40 | 64 | 21.5 | 17.3 |
| Potter County | 16,931 | $7,507 | 20% | 5 | 80 | 95 | 23.5 | 16.7 | 93 | 102 | 19.1 | 13.7 |
| Schuylkill County | 148,625 | $8,670 | 13% | 12 | 425 | 464 | 24.6 | 18.8 | 499 | 520 | 21.5 | 17.1 |
| Snyder County | 36,680 | $9,012 | 15% | 2 | 123 | 141 | 24.3 | 17.9 | 144 | 141 | 20.0 | 17.5 |
| Sullivan County | 6,104 | $7,916 | 16% | 1 | 28 | 30 | 19.8 | 15.6 | 31 | 32 | 18.9 | 13.5 |
| Susquehanna County | 44,338 | $7,932 | 19% | 6 | 172 | 206 | 25.4 | 19.9 | 218 | 192 | 19.1 | 18.1 |
| Tioga County | 41,070 | $7,894 | 17% | 3 | 168 | 175 | 24.4 | 18.4 | 198 | 173 | 20.0 | 17.9 |
| Union County | 31,104 | $9,463 | 13% | 2 | 78 | 107 | 27.0 | 17.6 | 100 | 110 | 20.9 | 15.7 |
| Venango County | 67,127 | $8,303 | 17% | 5 | 279 | 280 | 23.6 | 18.4 | 287 | 290 | 21.8 | 18.1 |
| Warren County | 41,805 | $9,739 | 17% | 1 | 184 | 183 | 21.6 | 18.0 | 203 | 163 | 20.4 | 18.9 |
| Wayne County | 45,713 | $8,896 | 17% | 3 | 171 | 218 | 20.5 | 17.7 | 188 | 194 | 18.4 | 17.4 |

Source: Tabulations of Pennsylvania Department of Education professional personnel and enrollment projection files.
Definitions:
[2]: 1990 census of population
[3]: 1989 money income/1990 census of population
[4]: 1991 total school enrollment/1990 census of population
[6]: total # of classroom teachers engaged in primary education in 1981/2
[7]: total # of classroom teachers engaged in primary education in 1990/1
[8]: primary student/teacher ratio in 1981/2
[9]: primary student/teacher ratio in 1990/1
[10]: total # of classroom teachers engaged in secondary education in 1981/2
[11]: total # of classroom teachers engaged in secondary education in 1990/1
[12]: secondary student/teacher ratio in 1981/2
[13]: secondary student/teacher ratio in 1990/1

### 5.4.3 Curricula Requirements, Prevalence and Best Practice

The final step in developing the demographic model involves accounting for differential curricula. Chapter 5.5 of the Code of Pennsylvania provides for annual and periodic curricula requirements for elementary and secondary students.

At the primary school level, "appropriate planned courses" are to include 11 subjects annually:

1. English
2. Reading
3. Spelling
4. Writing
5. Mathematics

6. Science
7. Social Studies
8. Health
9. Physical Education
10. Music, and
11. Art

Under Chapter 5, teachers certified in Primary Education are able to teach these various subjects. Also, more specialized certifications are provided for that enable such teachers to teach in areas such as reading, art and special education across all grade levels. In addition to these annual subjects which must be part of the grades 1-6 curricula, elementary school students are required to take, at least once during this six year period, each of the following separate planned courses:

1. History of the United States
2. History of Pennsylvania
3. Geography
4. Civics, and
5. Safety Education

The Pennsylvania curricula requirements for secondary students (grades 7-12) are composed of i] subject areas which students must take in order to earn a high school diploma; ii] minimum (in terms of subjects and contact hours) course offering requirements, iii] mandatory course requirements for students and mandatory courses which districts must offer.

In order to earn a high school diploma in Pennsylvania, a student must take 21 Carnegie Units[10] as follows:

- 4 units of English
- 3 units of Mathematics
- 3 units of Science
- 3 units of Social Studies
- 2 units of Arts or Humanities or both
- 1 unit of Health and Physical Education
- 5 units from courses approved by the local district for graduation including vocational education

Chapter 5.13 of the School Code and Departmental regulations details further the nature of these courses.

The second part of the secondary curricula requirements obligate each school district to offer various other courses. With respect to languages, each district must offer at least two foreign languages. At least one must be a modern foreign language, and at least one must be implemented for a four year sequence. Furthermore, English training for non-native speakers must be made available (Chapter 5.6). Other courses which are required to be taught are:

[10] A Carnegie Unit is 120 hours of contact or classroom instruction; given a typical, 180 day school year, a course that met 40 minutes/day for 180 days would provide 120 hours of contact. A unit is then generally viewed as a year long course.

- Art: 2 courses (60 or 120 contacts hours each)
- Music: 2 course (60 or 120 contacts hours each)
- Home Economics: 1 course (60 or 120 contacts hours)
- Industrial Arts: 1 course (60 or 120 contacts hours)
- Reading: 1 course (60 or 120 contacts hours)
- Health: 2 course (60 or 120 contacts hours)
- Environmental Education: 1 course (60 or 120 contacts hours)

Related to the above list of courses which must be taught is a list of courses which must be offered to all secondary students, but which (presumably) do not have to be taught if enrollment is too low:

- Vocational Education
- Business Education
- Consumer Education
- Foreign Languages
- Laboratory Sciences (including Biology, Physics and Chemistry)
- Computer Science
- Industrial Arts
- Home Economics

Finally, districts are required to teach, and secondary students are required to take courses in mathematics, science, and social studies as follows:

1. Mathematics: five courses of which three must be 120 contact hours;
2. Science: five courses of which three must be 120 contact hours; and can include the three Laboratory Science Courses;
3. Social Studies: five courses of which three must be 120 contact hours. Allowable courses include: Anthropology, Economics, Geography, History, Political Science, Psychology, Sociology, American Culture, World Cultures, History and Government of the US and Pennsylvania History.

Table 5.33 summarizes these graduation and course offering requirements and shows their impact by grade level.

Table 5.33: Pennsylvania Secondary Graduation and Curricula Requirements

| Required for H.S. Dipl.: | 4 x 120 | 120 | 3 x 120 | 3 x 120 | 3 x 120 | 2 x 120 | 5 x 120 |
|---|---|---|---|---|---|---|---|
| Required to Offer: | 6 x 120 | 6 x 60 | 3 x 120,2 x 60 | 3 x 120,2 x 60 | | | |
| Grades: | English | Phys Ed | Science | Math | Social Studies | Arts & Humanities | Electives |
| 7 | 120 | 60+ | | | | | |
| 8 | 120 | 60+ | | | | | |
| 9 | 120 | 60+ | 120 | 120 | 120 | 60 | 120 |
| 10 | 120 | 60+ | 120 | 120 | 120 | 60 | 120 |
| 11 | 120 | 60+ | 120 | 120 | 120 | 60 | 120 |
| 12 | 120 | 60+ | 60,60 | 2y,2y | | 60 | 60+,60+ |

x=120 clock hours of instruction (2 semester course/year), 1 Carnegie Unit
y= 60 clock hours of instruction (1 semester course/year), 1/2 Carngie Unit (stated as a minimum in case of physical education).
Source: Author's tabulations

The Pennsylvania Department of Education annually collects data on secondary school course enrollments. Of immediate interest is the extent to which districts offer various courses. Table 5.34 displays for each secondary course the fraction of the 501 Pennsylvania school districts which offer the course.

As Table 5.33 shows, a separate English course is required for students in grades 7-12. On the other hand, as shown in Table 5.35, only 23% of Pennsylvania's public school districts offer Advanced Placement Biology, and only 35% offer Advanced Placement History. Virtually all districts offer Choral Music, General Art, and General Music. Of the various foreign languages that are offered, 96% of the districts offer at least some Spanish, 86% offer some French, 55% offer some German, and 32% offer some Latin. With respect to mathematics, virtually all districts offer Algebra 1 and Algebra 2, but only 36% offer Algebra 3. Virtually all districts offer some form of calculus (69% offer a separate course and 18% offer a combined calculus and analytical geometry course) while 38% offer Advanced Placement calculus. First year biology, chemistry, and physics are offered at better than 97% of the districts; however, only 72% offer Biology 2, 59% offer Chemistry 2, and only 24% offer Physics 2. In the area of social studies, 72% of the districts offer Economics, and virtually all offer Government, U.S. History, and World Culture.

Table 5.34: Percent of Pennsylvania School Districts Offering Various Courses in 1989

| Secondary Course | % of SD W/Course | Secondary Course | % of SD W/Course |
|---|---|---|---|
| AP: Art | 4.2% | For Lang: German 5&6 | 8.6% |
| AP: Biology | 23.8% | For Lang: Italian 1 | 3.2% |
| AP: Chemistry | 25.4% | For Lang: Italian 2 | 3.0% |
| AP: Comp Sci | 13.8% | For Lang: Italian 3 | 2.0% |
| AP: English | 48.4% | For Lang: Italian 4&5 | 1.6% |
| AP: French | 8.8% | For Lang: Latin 1 | 32.2% |
| AP: German | 0.6% | For Lang: Latin 2 | 30.2% |
| AP: Gov | 8.6% | For Lang: Latin 3 | 19.6% |
| AP: History | 35.0% | For Lang: Latin 4 | 12.6% |
| AP: Italian | 0.6% | For Lang: Russian 1 | 6.0% |
| AP: Latin | 2.6% | For Lang: Russian 2 | 3.0% |
| AP: Math | 36.8% | For Lang: Russian 3 | 1.2% |
| AP: Music | 2.2% | For Lang: Russian 4&5 | 0.6% |
| AP: Physics | 13.8% | For Lang: Spanish 1 | 95.8% |
| AP: Spanish | 9.2% | For Lang: Spanish 2 | 95.0% |
| Bus: Accting 1 | 97.6% | For Lang: Spanish 3 | 90.8% |
| Bus: Accting 2 | 85.6% | For Lang: Spanish 4 | 76.2% |
| Bus: Bus English | 55.4% | For Lang: Spanish 5&6 | 18.2% |
| Bus: Bus Law | 60.4% | For Lang: Spanish for | 1.6% |
| Bus: Bus Math | 78.4% | Math: Alg 1 | 99.6% |
| Bus: Data Process | 46.8% | Math: Alg 2 | 98.4% |
| Bus: Intro to Bus | 73.2% | Math: Alg 3 | 35.8% |
| Bus: Shorthand 1 | 74.6% | Math: Anal Geom | 25.2% |
| Bus: Shorthand 2 | 52.2% | Math: Arith | 55.4% |
| Bus: Typing 1 | 98.6% | Math: Calculus | 68.8% |
| Bus: Typing 2 | 91.4% | Math: AP Calculus | 35.0% |
| Comp Sci: Computer Liter | 83.8% | Math: Comb Calc&Ana Geom | 18.4% |
| Comp Sci: Comp Sci 1 | 52.8% | Math: Comb Plane & Solid | 37.6% |
| Comp Sci: Comp Sci 2 | 31.6% | Math: Cons Math | 60.8% |
| Comp Sci: Programming 1 | 63.4% | Math: Fund of Math | 41.0% |
| Comp Sci: Programming 2 | 43.0% | Math: Gen Math 1 | 90.8% |
| Humanity: Music Theorem | 29.6% | Math: Gen Math 2 | 68.0% |
| Humanity: Aesthetics | 2.2% | Math: Gen Math 3 | 39.6% |
| Humanity: Arts Criticism | 0.3% | Math: Intro to College Ma | 23.4% |
| Humanity: Arts History | 14.2% | Math: Plane Geometry | 67.8% |
| Humanity: Choral Music | 94.2% | Math: Prob&Stat | 25.2% |
| Humanity: Dance | 3.6% | Math: SolidGeometry | 4.6% |
| Humanity: Drama | 35.4% | Math: Trig | 89.8% |
| Humanity: Film Studies | 7.2% | Sci: Biology 1 | 98.8% |
| Humanity: Gen Art | 98.6% | Sci: Biology 2 | 72.0% |
| Humanity: Gen Music | 97.4% | Sci: Chemistry 1 | 98.8% |
| Humanity: Humanities | 26.2% | Sci: Chemistry 2 | 59.2% |
| Humanity: Inst Music | 97.0% | Sci: Earth& Space Sci 1 | 83.2% |
| Humanity: Philosophy | 3.4% | Sci: Earth& Space Sci 2 | 13.0% |
| Humanity: Photography | 35.6% | Sci: Gen Sci (JHS) | 54.6% |
| Humanity: Studio Art | 50.6% | Sci: Gen Sci (SHS) | 62.6% |
| English: English | 99.6% | Sci: Life Science | 72.4% |
| English: Literature | 4.8% | Sci: Physical Science | 79.4% |
| English: Speech | 60.2% | Sci: Physics 1 | 97.0% |
| English: Writing | 66.0% | Sci: Physics 2 | 24.4% |
| For Lang: Exploration | 30.2% | Soc Studies: Anthropology | 11.6% |
| For Lang: French 1 | 86.4% | Soc Studies: Economics | 72.4% |
| For Lang: French 2 | 86.2% | Soc Studies: Geography | 75.4% |
| For Lang: French 3 | 77.6% | Soc Studies: Govt/Civics | 91.2% |
| For Lang: French 4 | 67.8% | Soc Studies: Pa History | 45.8% |
| For Lang: French 5&6 | 18.2% | Soc Studies: Psychology | 60.6% |
| For Lang: German 1 | 55.0% | Soc Studies: Sociology | 61.4% |
| For Lang: German 2 | 54.4% | Soc Studies: US History/ | 98.8% |
| For Lang: German 3 | 50.2% | Soc Studies: World Culture | 97.8% |
| For Lang: German 4 | 42.6% | | |

Source: Tabulations of Pennsylvania Department of Education curriculum enrollment data.

To ascertain "best practice", the median enrollment rate for each of the courses show in Table 5.34 for districts which offer the course was tabulated. The results are displayed in Table 5.35. It should be noted that the enrollment rate is the ratio of 1989 enrollment divided by total secondary enrollment in 1989. This broad definition of students potentially eligible was used instead of the number of students per grade level because of the difficulty of determining with certainty the grade level at which a student might take a particular elective. In the case of English, which is required in grades 7 through 12, the total number of students in these grades divided by the total number of secondary students is quite close to 100% (97.9%). A course that might be offered and required in just one grade would have an expected enrollment rate of 1/6 or 16.7% if the grade enrollments are the same at a given moment in time. Since the number of students in a district varies across grades 7-12 due to demographics, this rule of thumb may be inaccurate. Clearly, the best-practice enrollment rates of AP courses reflect, in districts which offer them, college entrance

requirements and differential tastes. AP Physics is typically only available to high school seniors, so the theoretical maximum enrollment rate would be 1/6 or 16.7%. The observed median of .6% is consistent with a senior year enrollment rate of 3.6% (assuming uniform grade enrollment levels) which is still far less than 1/6 or 16.7%.

Table 5.35: Median "Best Practice" Enrollment Rates for Districts Offering a Course in 1989/90

| Secondary Course | Median Rate in % | Secondary Course | Median Rate in % |
|---|---|---|---|
| AP: Art | .4% | For Lang: German 5/6 | .5% |
| AP: Biology | 1.1% | For Lang: Italian 1 | 1.4% |
| AP: Chemistry | .8% | For Lang: Italian 2 | 1.0% |
| AP: Comp Sci | .7% | For Lang: Italian 3 | .7% |
| AP: English | 1.7% | For Lang: Italian 4/5 | .5% |
| AP: French | .4% | For Lang: Latin 1 | .7% |
| AP: German | .4% | For Lang: Latin 2 | .5% |
| AP: Gov | 1.5% | For Lang: Latin 3 | 2.1% |
| AP: History | 1.9% | For Lang: Latin 4 | 1.1% |
| AP: Italian | .1% | For Lang: Russian 1 | .3% |
| AP: Latin | .3% | For Lang: Russian 2 | .5% |
| AP: Math | 1.3% | For Lang: Russian 3 | .1% |
| AP: Music | .2% | For Lang: Russian 4/5 | 0.6% |
| AP: Physics | .6% | For Lang: Spanish 1 | 7.8% |
| AP: Spanish | .5% | For Lang: Spanish 2 | 5.4% |
| Bus: Accting 1 | 3.9% | For Lang: Spanish 3 | 2.3% |
| Bus: Accting 2 | 1.2% | For Lang: Spanish 4 | 1.0% |
| Bus: Bus English | 1.8% | For Lang: Spanish 5/6 | .7% |
| Bus: Bus Law | 2.2% | For Lang: Spanish - Gen | .7% |
| Bus: Bus Math | 3.3% | Math: Alg 1 | 14.6% |
| Bus: Data Process | 2.3% | Math: Alg 2 | 9.6% |
| Bus: Intro to Bus | 3.4% | Math: Alg 3 | 4.2% |
| Bus: Shorthand 1 | 1.0% | Math: Anal Geom | 3.9% |
| Bus: Shorthand 2 | .5% | Math: Arith | 27.2% |
| Bus: Typing 1 | 8.4% | Math: Calculus | 2.1% |
| Bus: Typing 2 | 1.8% | Math: AP Calculus | 1.3% |
| Comp Sci: Computer Liter | 17.7% | Math: Comb Calc&Ana Geom | 2.6% |
| Comp Sci: Comp Sci 1 | 4.8% | Math: Comb Plane & Solid | 8.9% |
| Comp Sci: Comp Sci 2 | 1.5% | Math: Cons Math | 3.7% |
| Comp Sci: Programming 1 | 2.8% | Math: Fund of Math | 6.2% |
| Comp Sci: Programming 2 | 1.1% | Math: Gen Math 1 | 7.0% |
| Humanity: Music Theorem | .6% | Math: Gen Math 2 | 4.3% |
| Humanity: Aesthetics | 3.1 | Math: Gen Math 3 | 3.5% |
| Humanity: Arts Criticism | 3.1% | Math: Intro to College Ma | 2.4% |
| Humanity: Arts History | 2.1% | Math: Plane Geometry | 9.2% |
| Humanity: Choral Music | 14.0% | Math: Prob&Stat | 1.4% |
| Humanity: Dance | 1.9% | Math: SolidGeometry | 6.1% |
| Humanity: Drama | 1.8% | Math: Trig | 5.5% |
| Humanity: Film Studies | 3.0% | Sci: Biology 1 | 16.0% |
| Humanity: Gen Art | 38.8% | Sci: Biology 2 | 2.8% |
| Humanity: Gen Music | 33.1% | Sci: Chemistry 1 | 8.9% |
| Humanity: Humanities | 4.7% | Sci: Chemistry 2 | 1.7% |
| Humanity: Inst Music | 13.3% | Sci: Earth& Space Sci 1 | 15.8% |
| Humanity: Philosophy | 2.0% | Sci: Earth& Space Sci 2 | 3.9% |
| Humanity: Photography | 3.4% | Sci: Gen Sci (JHS) | 28.7% |
| Humanity: Studio Art | 4.9% | Sci: Gen Sci (SHS) | 7.1% |
| English: English | 97.9% | Sci: Life Science | 16.3% |
| English: Literature | 22.6% | Sci: Physical Science | 15.6% |
| English: Speech | 4.1% | Sci: Physics 1 | 4.5% |
| English: Writing | 6.0% | Sci: Physics 2 | 1.0% |
| For Lang: Exploration | 14.4% | Soc Studies: Anthropology | 3.2% |
| For Lang: French 1 | 4.1% | Soc Studies: Economics | 12.9% |
| For Lang: French 2 | 3.1% | Soc Studies: Geography | 17.2% |
| For Lang: French 3 | 1.7% | Soc Studies: Govt/Civics | 17.0% |
| For Lang: French 4 | .8% | Soc Studies: Pa History | 16.4% |
| For Lang: French 5/6 | .4% | Soc Studies: Psychology | 5.9% |
| For Lang: German 1 | 2.7% | Soc Studies: Sociology | 4.7% |
| For Lang: German 2 | 1.8% | Soc Studies: US History | 33.3% |
| For Lang: German 3 | 1.0% | Soc Studies: World Culture | 29.5% |
| For Lang: German 4 | .6% | | |

Source: Tabulations of Pennsylvania Department of Education curriculum enrollment data.

## 5.5 Supply and Demand Interactions

We now examine the overall effects of the training of new teachers in the 1980's, and the actually hiring which took place. We observe first the employment experience of new teachers, and then examine some differential effects that result from teachers entering the market from different certificating institutions.

### 5.5.1 Pennsylvania Teachers Trained and Hired During the 1980's

The number of individuals who graduated with a teaching degree from a Pennsylvania certificating institution varied from a low of 5,987 in 1983/4 to a high of 7,327 in 1988/9. Table 5.36 displays the self-reported training and employment of new teachers, both in Pennsylvania and overall, for this period. Several things are evident from these data. First, the numbers of newly trained teachers were considerably lower each year than the numbers hired. The overall employment rate varied from a low of 34.4% in 1988/9 to a high of 45.3% in 1985/6. Second, the employment rates were relatively constant across broad areas of specialization during the 1980's. In 1983/4, the employment rate was lowest for newly graduated secondary school teachers (35.7%), and highest for special education teachers (46.2%). Variability was greatest in 1988/9 when the employment rate for new secondary school teachers was 29.4% and the rate for kindergarten teachers was 45.8%.

Table 5.36: Employment Rates of Teachers Trained in Pennsylvania:1983/4 through 1988/9

| Subject | New PA Trained 1983-84 | Total Hired 1983-84 | Empl. Rate 1983-84 | New PA Trained 1984-85 | Total Hired 1984-84 | Empl. Rate 1984-85 | New PA Trained 1985-86 | Total Hired 1985-86 | Empl. Rate 1985-86 |
|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| Elementary | 1,838 | 755 | 0.411 | 1,852 | 770 | 0.416 | 2,021 | 940 | 0.465 |
| Kindergarden | 425 | 195 | 0.459 | 532 | 242 | 0.455 | 425 | 214 | 0.504 |
| Secondary | 2,630 | 940 | 0.357 | 2,762 | 1,056 | 0.382 | 2,676 | 1,114 | 0.416 |
| Special Education | 1,094 | 505 | 0.462 | 915 | 462 | 0.505 | 824 | 427 | 0.518 |
| TOTAL TEACHERS | 5,987 | 2,395 | 0.400 | 6,061 | 2,530 | 0.417 | 5,946 | 2,695 | 0.453 |
| | | | | | | | | | |
| Subject | 1986-87 [12] | 1986-87 [13] | 1986-87 [14] | 1987-88 [15] | 1987-88 [16] | 1987-88 [17] | 1988-89 [18] | 1988-89 [19] | 1988-89 [20] |
| Elementary | 2,429 | 1,090 | 0.449 | 2,674 | 1,106 | 0.414 | 2,857 | 1,037 | 0.363 |
| Kindergarden | 504 | 216 | 0.429 | 466 | 224 | 0.481 | 548 | 251 | 0.458 |
| Total Secondary | 3,083 | 1,064 | 0.345 | 2,882 | 1,032 | 0.358 | 3,181 | 934 | 0.294 |
| Special Education | 850 | 401 | 0.472 | 687 | 318 | 0.463 | 741 | 302 | 0.408 |
| TOTAL TEACHERS | 6,866 | 2,771 | 0.404 | 6,709 | 2,680 | 0.399 | 7,327 | 2,524 | 0.344 |

Source: Tabulations of Pennsylvania Department of Education personnel files.

Another way to examine these changes in supply, the demand for teachers implied by overall levels of enrollment, and the level of hires of newly trained teachers, is to graph each of these series over a longer period of time. Figures 5.1 through 5.3 display these series with 1965 indexed as the base year. Figure 5.1 shows these three series for primary school teachers trained, primary students enrolled, and the number of new primary teachers trained and hired in Pennsylvania. It is clear that as the Vietnam War and the draft built up in the late 1960's, the number of new teachers trained grew dramatically. In 1971, the number of teachers trained was 80% higher than in 1965, but by the end of the 1980's it fell below the initial, 1965 level. The number of newly hired primary school teachers peaked in 1968, and then fell to only 40% of the 1965 level in 1989. Student demographics

have changed the least; note that primary student enrollment has fallen systematically since the early 1970's and was still less than 80% of the 1965 level in 1989.

The pattern for secondary teachers is quite similar; however, the peak in teacher production was only 140% of the 1965 level as contrasted to 180+% of the 1965 level of primary school teachers. The hiring of newly trained secondary school teachers has fallen off dramatically and has persisted at 20% of the 1965 level.

The overall pattern of teacher training, hiring, and student enrollment, shown in Figure 5.3, is, of course, an average of the previous two figures. In the case of primary and secondary school teachers graduated over the period 1965-1989, there is consistent evidence that far fewer newly trained teachers were hired than graduated. Furthermore, the vast swings in teachers trained and hired are not mirrored by dramatic changes in student demographics.

It is difficult to envision how the various teacher training institutions have dealt with such large swings in their own enrollment. Obviously, it becomes increasingly difficult to justify a particular education school faculty size when its clientele falls by 50%. There is anecdotal evidence that a number of the larger education schools pursued an aggressive policy of downsizing of their own faculty in the 1980's to cope with falling class size.[11] Another response, besides cutting faculty size, is to encourage and counsel college sophomores to pursue teaching in order to maintain a viable teacher training program. The removal of financial and academic barriers are additional ways to try to maintain such college majors. [12]

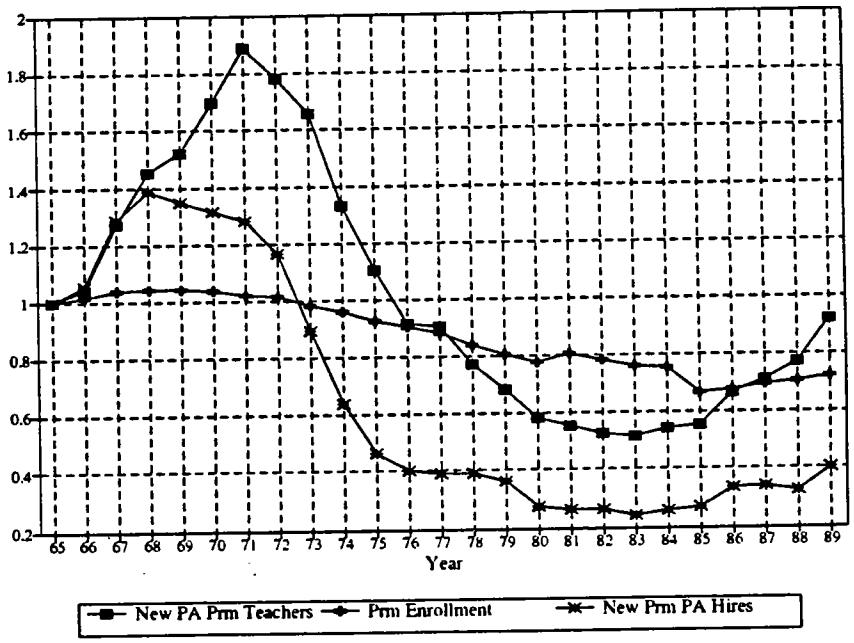



Figure 5.1: Primary Teachers Trained and Hired, and Primary Students Enrolled in Pennsylvania: 1965-1989

[11] In particular, the University of Pittsburgh's School of Education sought to reduce by almost 1/2 the size of its School of Education faculty in the 1980's in response to student's reduced interest in pursuing a teaching career.

[12] Recall also the observations of Schlecty and Vance(1983) on teacher recruitment and selection.

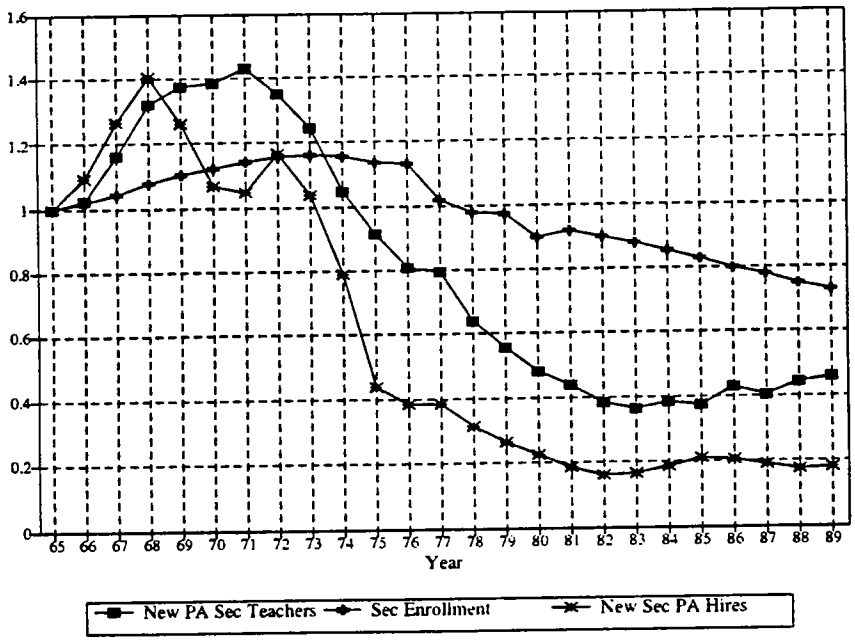



**Figure 5.2: Secondary Teachers Trained and Hired, and Secondary Students Enrolled in Pennsylvania: 1965-1989**

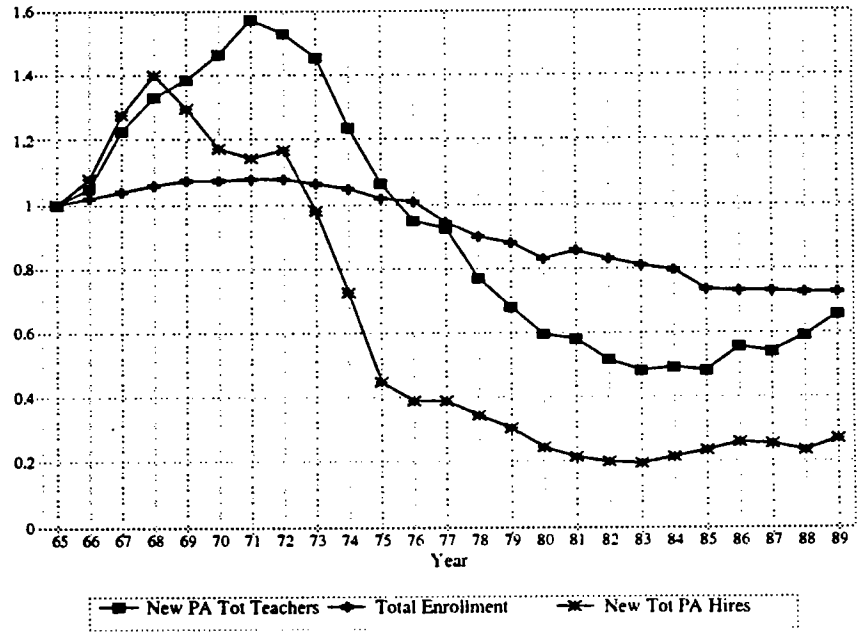



**Figure 5.3: Total Teachers Trained and Hired, and Students Enrolled in Pennsylvania: 1965-1989**

### 5.5.2 Differential Effects of Certificating Institutions

We examine here a few differential effects on employment and student outcomes that are related to the type of teacher training institution. First, we note that the employment experience reflected above in Table 5.36 varies by type of certificating institution. Table 5.37 shows the overall employment rates for the four major types of training institutions from 1988-1990. In 1988/89, 34.1% of the newly trained teachers found jobs either inside or outside of Pennsylvania; in 1989/90, 34.8% found jobs. However, this employment rate varied in 1988/89 from a low of 14% for the state related institutions, to a high of 49.8% for the teachers trained in private colleges and universities. This last group of institutions does not receive any state financial assistance in their teacher training programs, but their graduates enjoyed much better employment rates both within and without Pennsylvania than did the graduates of the 14 public universities; contrast 49.8% and 29.5% employment rates for private vs. public universities in 1988/89 and 57.0% vs. 33.1% in 1989/90.

It should be noted that these generally low employment rates were not always present among the various certificating institutions. In the mid-1960's, employment rates for teachers from all types of institutions were much higher. In 1965, fully 82% of the graduates from public universities obtained teaching positions inside and outside Pennsylvania; however, by 1973, only 45% obtained teaching positions, as reported by the Pennsylvania Department of Education's 1975 *Our Colleges and Universities Today*, XII, 5.

Table 5.37: Employment Rates by Type of Certificating Institution

| Year | Type of Certificating Institution | Total Trained | PA Hired | PA Empl. Rate | Total Hired | Total Empl. Rate | 1983/84 Tuitions |
|---|---|---|---|---|---|---|---|
| | | [3] | [4] | [5] | [6] | [7] | [8] |
| 88/89 | State Universities[14] | 4,116 | 880 | .214 | 1,216 | .295 | $1,644 |
| | State Related Commonwealth Universities[6] | 1,230 | 128 | .104 | 172 | .140 | $2,382 |
| | Private State-Aided Institutions[3] | 97 | 37 | .381 | 53 | .546 | $7,052 |
| | Private Colleges and Universities[60] | 2,649 | 1,057 | .400 | 1,319 | .498 | $5,229 |
| | Total[83] | 8,092 | 2,102 | .260 | 2,760 | .341 | |
| 89/90 | State Universities | 3,804 | 908 | .239 | 1,258 | .331 | $1,644 |
| | State Related Commonwealth Universities | 1,214 | 186 | .153 | 216 | .178 | $2,382 |
| | Private State-Aided Institutions | 81 | 19 | .235 | 34 | .420 | $7,052 |
| | Private Colleges and Universities | 2,819 | 837 | .382 | 1,247 | .570 | $5,229 |
| | Total | 7,918 | 1,950 | .246 | 2,755 | .348 | |

Source: Tabulations of unpublished Pennsylvania Department of Education
reports on employment and graduations at certificate granting institutions for 1988/89 and 1989/90
[8] 1983/84 Tuitions from NCES Education Directory

The second aspect of certificating institutions involves the relationship between type of certificating institution and the post-secondary educational plans of the employment district's high school graduates. Table 5.38 displays the simple correlation for five measures of each district's teacher inventory: i] the percentage of a district's teachers that came from public universities; ii] the percentage of a district's teachers which came from state related universities, iii] the percentage of a district's teachers that came from private/state-related universities; iv] the percentage of a district's teachers that came from private universities; and v] the percentage of a district's teachers that came from other universities. These teacher source measures are correlated with the fraction of high school graduating seniors who planned to go to any post-secondary school.

Table 5.38 shows the simple correlation coefficients between these input and output measures, the significance level, and at the bottom of the table some summary statistics. Most dramatic is the highly significant, **inverse** relationship between the fraction of a districts' teachers from public

universities, and students going on to any post-secondary education; it is -.44 and highly significant. On the other hand, we find a **positive** correlation between the fraction of teachers from private colleges and universities and the fraction of students going on to any post-secondary education; the correlation is +.355 and highly significant.

It is difficult to simply conclude from these correlations that districts which choose to employ relatively more teachers from public universities also relatively choose to encourage far fewer students to any form of post-secondary education. We noted earlier that districts tend to hire teachers within an hour's drive of the MSA within which the district lies, and the inverse correlation may simply be picking up spatial differences in post-secondary education rates which happen to be correlated to the type of institution which is nearby. However, the change in sign in the statistical relationship between the source of teachers and students' post-secondary educational activity certainly deserves further examination. This relationship is explored in Chapter 8 below.

What does seem clear is that the presence of teachers who have graduated from private colleges and universities is associated with students wishing to pursue greater post-secondary education. One would hope that attempts to limit the certificating activities of these institutions would be carefully scrutinized since there is some sort of systematic statistical relationship between student plans and institutional source of teachers.

Table 5.38: Correlation Coefficients: % Source of Teachers Employed by School District and % Post-Secondary Educational Activities of High School Graduates in School District: 1989-90

| | % Teach State U | % Teach State Rel | %Teach Priv-State R | % Teach Private | % Teach Priv/Oth | % HS Grad Any PostS. |
|---|---|---|---|---|---|---|
| % Teachers: State U | 1.00000 | -0.35157 | -0.35915 | -0.63508 | -0.53987 | -0.44886 |
| Probability (R=0) | 0.0 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |
| % Teachers: :State Rel | | 1.00000 | 0.14961 | -0.14327 | -0.11171 | 0.14854 |
| Probability (R=0) | | 0.0 | 0.0008 | 0.0013 | 0.0126 | 0.0009 |
| % Teachers: Priv-State Rel | | | 1.00000 | 0.06357 | 0.23509 | 0.25379 |
| Probability (R=0) | | | 0.0 | 0.1566 | 0.0001 | 0.0001 |
| % Teachers: Private | | | | 1.00000 | -0.04007 | 0.35519 |
| Probability (R=0) | | | | 0.0 | 0.3722 | 0.0001 |
| % Teachers: Private/Other | | | | | 1.00000 | 0.15175 |
| Probability (R=0) | | | | | 0.0 | 0.0007 |
| % HS Grads: Any Post. Sec. | | | | | | 1.00000 |
| Probability (R=0) | | | | | | 0.0 |
| Mean (in %) | 42.6 | 9.7 | 5.8 | 1.3 | 31.4 | 63.1 |
| Minimum (in %) | 9.4 | 0.0 | 0.0 | 0.0 | 10.1 | 18.6 |
| Maximum (in %) | 75.4 | 42.2 | 9.0 | 62.9 | 62.5 | 97.3 |

Source: Tabulations of unpublished Pennsylvania Department of Education reports on employment and graduations in certificate granting institutions for 1989/90; PDE professional personnel file and certification file.

## 5.6 Summary

In this chapter, we have examined the long-term and short-term sources of classroom teacher supply and demand in Pennsylvania. Five sources of teachers may be distinguished: (i) public or state universities; (ii) state-related universities; (iii) private, state-related universities; (iv) private colleges and universities; and (v) non-Pennsylvania colleges and universities.

Relatively few (17), essentially publicly supported institutions account for the vast bulk (70%) of teachers trained and certificates issued in Pennsylvania. Far more teaching certificates, on the order of 324,000, have been issued since 1950, than are currently employed in the classroom (about 98,000).

Pennsylvania's metropolitan areas vary in the types of institutional teacher training sources available. Some areas such as Philadelphia have institutions from all five types, while others

are much more concentrated. The market for newly hired teachers seems to be quite limited geographically. Better than 60% of all newly hired teachers in 1990/1 were hired from areas within 70 miles of the hiring district.

Juxtaposition of the latent supplies (e.g. retirees and and certificated non-teachers) of teachers against the current stock of teachers indicates that there are far more individuals not teaching in any certification area than are teaching. While the median ages varies considerably by certification and assignment area among those currently teaching, it is difficult to conclude that there will be an imminent "shortage" of public school teachers.

Student enrollment has recently begun to grow, and will continue to grow through the balance of the 1990's. This enrollment growth will occur in the upper grades. Given that secondary school teachers are older than their primary school counterparts, it seems likely that this will lead to greater hiring of secondary teachers in the balance of the decade. There are, however, wide variations in the spatial distribution of such growth. Some parts of the Commonwealth such as Johnstown will experience absolute enrollment declines, while others, such as Chester Count will experience an enrollment increase in excess of 20%.

Overall, the student teacher ratio fell from 19 to 16 during the 1980's. This was due both to declining student enrollments and the hiring of additional, primarily special education teachers.

Examination of enrollment in secondary level courses, indicates wide variation in the fraction of districts which offer courses. While all districts offer various languages and social studies, there is significant variation in the extent to which advanced science and mathematics are offered, and the the extent to which advanced placement courses are offered.

During the 1980's, the employment experience of newly trained teachers was not strong; no more than 45% of newly trained teachers were hired in the 1980's. Teachers trained at public universities faced systematically worse employment opportunities than teachers trained at private colleges and universities. Also, it was found that students in districts with a high proportion of teachers from public universities were far less likely to pursue post-secondary education. By contrast, students in districts with a high proportion of teachers from private universities were more likely to pursue post-secondary education. Whether or not these relationships are causal or coincidental is explored further in Chapter 8.

Overall, there is little evidence from the 1980's to support the conjecture that there was a teacher shortage. During this period, student-teacher ratios generally fell from 19.3 to 16.3 or by 15.5%. The number of employed teachers grew over the decade of the 1980's, and real incomes also grew. The rising age of first ever hired teachers coupled with generally low employment rates of newly graduated teachers in the 1980's are consistent with a situation of excess supply rather than shortage. Given the generally aging of the teacher force in the 1980's and the projected enrollment growth in the balance of the decade, it is not clear whether or not the historical relationships of excess supply found in the 1980's will continue into the 1990's.

# Chapter 6

# Teacher Supply and Demand through the Year 2000: Demographic Model Results

We present in this chapter the results of making projections with the teacher and student demographic models developed in Chapter 4. Three retirement scenarios are analyzed below, each of which takes into account the changing age distribution of teachers through the end of the decade:

1. Retirement at age 65; $H^a$ denotes the number of teachers needed to replace retiring teachers under this assumption
2. Retirement with 30 Years of Experience; $H^e$ denotes the number of teachers needed to replace retiring teachers under this assumption
3. Retirement with 27 Years of Experience [the impact of Senator Robert Mellow's early retirement legislation]: $H^m$ denotes the number of teachers needed to replace retiring teachers under this assumption

All three retirement scenarios assume persistence of observed curricula in 1989 into the forecast period in accordance with equations 4.7 and 4.8. Also, the staffing implications of applying "best practice" curricula are reported. In each instance, the number of teachers who will need to be hired during the balance of the decade is reported in total numbers and also as a percentage of the 1990/1 stock of teachers according to the model developed in Chapter 4. This percentage is called the *replacement rate*, and will be compared to the historical replacement rate: the number of new hires in the 1980's divided by the 1982/3 stock of teachers.

Two concepts of quits for reasons other than retirement are used to complete the simulation process:

- Historical, state-level differential quit rates by assignment area; and,
- Total historical quits observed at the school district level

These two different concepts are used because at the school district level, historical quit rates by assignment areas, even over an eight year period, are quite statistically "noisy". Such quit rates by assignment area simply do not permit the prediction of individual withdrawals for non-retirement reasons. This is because the cumulative probabilities, across time and assignment areas are still quite small, especially for smaller districts. At the state level, however, the cumulative probabilities, due to aggregation, become meaningful, and can be applied with confidence to the larger stock of teachers by assignment areas.

## 6.1 Overall Demographic Model Results

Table 6.1 shows the overall simulation results. In 1990/1, there were 97,867 classroom teachers across the state. Irrespective of retirements and student demographics, we predict that 27,265 teachers will need to be hired during the balance of the decade to replace teachers who withdraw from a district for reasons other than retirement. This forecast is based on differential quit rates by assignment area observed in the 1980's (See Column [4] of Table 6.1).

If Pennsylvania's classroom teachers simply retire at age 65 during the balance of the decade, then 21,693 teachers will need to be hired during this period to maintain annually current student-teacher ratios, respond to projected enrollment growth and maintain current curricula patterns. Should Pennsylvania's classroom teachers retire with 30 years of experience, then essentially twice as many teachers, 43,045, will need to be hired during the balance of the decade to maintain current student-teacher ratios and to respond to projected enrollment growth. Finally, if Pennsylvania's classroom teachers retire with 27 years of experience, as essentially provided for in the Mellow Bill, then 53,565 teachers will need to be hired during this time period. [1]

Combining the projected quits with the forecasted hire rates, we project total hiring needs of:

1. 27,265 + 21,693 = 48,958 under retirement at age 65 assumption or a 50.0% (48,958/97,867) replacement rate;
2. 27,265 + 43,045 = 70,031 under retirement with 30 years experience assumption or a 71.6% (70,031/97,867) replacement rate;
3. 27,265 + 53,565 = 80,830 under retirement with 27 years experience assumption or a 82.6% (80,830/97867) replacement rate.

[1] The reader will note small differences in projected totals depending on whether teacher assignment area or school district/county is the tabulating variable. The differences are due to the small number of teachers in the base year who did not report a school district of employment but did report an assignment area. The 1990/1 base case shows 97,868 teachers with known assignments, but 97,818 teachers with known school districts of employment.

Table 6.1: Hiring Needs based on Historical Quits and Demographic Models of Teacher Retirement and Student Demographics

| Primary Assignment | 1990/1 Teachers | Quit Rate | Pred. Quits | Pred. $H^a$ | Pred. $H^e$ | Pred. $H^m$ | Pred. % $H^a$ | Pred. % $H^e$ | Pred. % $H^m$ | Pred. % Tot $H^a$ | Pred. % Tot $H^e$ | Pred. % Tot $H^e$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] | [14] |
| Agriculture | 188 | 60.2 | 113 | 25 | 43 | 48 | 13.3% | 22.9% | 25.5% | 73.5% | 83.1% | 85.7% |
| Art | 3,058 | 36.1 | 1,105 | 343 | 517 | 572 | 11.2% | 16.9% | 18.7% | 47.4% | 53.0% | 54.8% |
| Biology | 1,835 | 26.2 | 481 | 543 | 986 | 1,029 | 29.6% | 53.7% | 56.1% | 55.8% | 79.9% | 82.3% |
| Business Ed | 2,443 | 35.9 | 877 | 623 | 869 | 959 | 25.5% | 35.6% | 39.3% | 61.4% | 71.5% | 75.2% |
| Chemistry | 935 | 30.1 | 282 | 264 | 373 | 367 | 28.2% | 39.9% | 39.3% | 58.4% | 70.0% | 69.4% |
| Driver Ed | 397 | 15.1 | 60 | 84 | 73 | 63 | 21.2% | 18.4% | 15.9% | 36.3% | 33.5% | 31.0% |
| Earth/Space | 697 | 32.9 | 229 | 125 | 217 | 204 | 17.9% | 31.1% | 29.3% | 50.8% | 64.0% | 62.1% |
| English | 7,157 | 29.7 | 2,124 | 2,323 | 4,419 | 5,393 | 32.5% | 61.7% | 75.4% | 62.1% | 91.4% | 105.0% |
| French | 886 | 44.5 | 394 | 233 | 373 | 407 | 26.3% | 42.1% | 45.9% | 70.8% | 86.6% | 90.4% |
| Gen Elem./Ear.Ch. | 39,554 | 20.9 | 8,267 | 6,344 | 16,646 | 23,279 | 16.0% | 42.1% | 58.9% | 36.9% | 63.0% | 79.8% |
| General Science | 2,227 | 26.3 | 585 | 721 | 1,236 | 1,347 | 32.4% | 55.5% | 60.5% | 58.6% | 81.8% | 86.7% |
| German | 430 | 39.1 | 168 | 119 | 157 | 158 | 27.7% | 36.5% | 36.7% | 66.8% | 75.6% | 75.8% |
| Gifted | 619 | 32.9 | 204 | 56 | 90 | 88 | 9.0% | 14.5% | 14.2% | 42.0% | 47.5% | 47.1% |
| Health/Phys Ed | 5,908 | 24.8 | 1,463 | 1,306 | 2,718 | 3,085 | 22.1% | 46.0% | 52.2% | 46.9% | 70.8% | 77.0% |
| Hearing Impaired | 77 | 13.1 | 10 | 28 | 29 | 39 | 36.4% | 37.7% | 50.6% | 49.5% | 50.8% | 63.7% |
| Home Economics | 1,981 | 45.7 | 906 | 619 | 811 | 1,013 | 31.2% | 40.9% | 51.1% | 77.0% | 86.7% | 96.9% |
| Industrial Arts | 2,345 | 27.4 | 641 | 588 | 879 | 984 | 25.1% | 37.5% | 42.0% | 52.4% | 64.8% | 69.3% |
| Mathematics | 6,388 | 27.1 | 1,732 | 1,890 | 4,118 | 4,819 | 29.6% | 64.5% | 75.4% | 56.7% | 91.6% | 102.6% |
| Mental/Phys Hand | 6,718 | 38.5 | 2,588 | 1,571 | 1,941 | 2,548 | 23.4% | 28.9% | 37.9% | 61.9% | 67.4% | 76.4% |
| Music | 4,254 | 39.6 | 1,686 | 865 | 1,452 | 1,668 | 20.3% | 34.1% | 39.2% | 60.0% | 73.8% | 78.9% |
| Other Languages | 229 | 80.1 | 183 | 53 | 53 | 68 | 23.1% | 23.1% | 29.7% | 103.3% | 103.3% | 109.8% |
| Other Science | 45 | 49.5 | 22 | 8 | 13 | 17 | 17.8% | 28.9% | 37.8% | 67.3% | 78.4% | 87.3% |
| Physics | 496 | 14.8 | 73 | 111 | 139 | 147 | 22.4% | 28.0% | 29.6% | 37.1% | 42.8% | 44.4% |
| Social Studies | 6,256 | 37.4 | 2,337 | 2,119 | 3,905 | 4,151 | 33.9% | 62.4% | 66.4% | 71.2% | 99.8% | 103.7% |
| Spanish | 1,342 | 22.3 | 299 | 361 | 567 | 652 | 26.9% | 42.3% | 48.6% | 49.2% | 64.5% | 70.9% |
| Speech/Lang Imp | 394 | 38.2 | 151 | 79 | 106 | 135 | 20.1% | 26.9% | 34.3% | 58.3% | 65.1% | 72.5% |
| Visually Impair | 37 | 35.7 | 13 | 10 | 13 | 17 | 27.0% | 35.1% | 45.9% | 62.7% | 70.8% | 81.6% |
| Vocational Ed | 746 | 24.9 | 186 | 246 | 232 | 259 | 33.0% | 31.1% | 34.7% | 57.9% | 56.0% | 59.6% |
| Vocational Health | 36 | 35.4 | 13 | 13 | 6 | 10 | 36.1% | 16.7% | 27.8% | 71.5% | 52.1% | 63.2% |
| Vocational Tech. | 123 | 38.9 | 48 | 14 | 25 | 30 | 11.4% | 20.3% | 24.4% | 50.3% | 59.3% | 63.3% |
| Not Listed Else | 66 | 35.6 | 23 | 9 | 9 | 9 | 13.6% | 13.6% | 13.6% | 49.2% | 49.2% | 49.2% |
| Total | 97,867 | 27.9 | 27,265 | 21,693 | 43,045 | 53,565 | | | | | | |

Source: Tabulations of historical quit data and supply and demand model results.
Definitions:
[4] Sum of non-retirement withdrawal rates, in percent, for 1982/3 through and including 1989/90 by assignment area.
[5] Predicted quits; column [3] * [4].
[6] $H^a$: replacement hires due to retirements at age 65 and student demographics, 1991/2-2000/1
[7] $H^e$: replacement hires due to retirements at 30 years of service and student demographics, 1991/2-2000/1
[8] $H^m$: replacement hires due to retirements at 27 years of service and student demographics, 1991/2-2000
[9] % $H^a$: $H^a$/1990/1 Teachers
[10] % $H^e$: $H^e$/1990/1 Teachers
[11] % $H^m$: $H^m$/1990/1 Teachers
[12] % Tot $H^a$: [$H^a$ + Quits]/ 1990/1 Teachers
[13] % Tot $H^e$: [$H^e$ + Quits]/ 1990/1 Teachers
[14] % Tot $H^m$: [$H^m$ + Quits]/ 1990/1 Teachers

These projected hires of between 48,958 to 80,830 compare with historical quits (other than for retirement) during the 1980's of 25,269, and historical hires of 34,604, or a total of 59,873 total hires during the 1980's. The replacement projections based on 30 and 27 years of experience respectively suggest that districts may have to hire between 24% (43,045/34,604 ) and 54% (53,565/34,604) more teachers in the balance of the decade than they did during the 1980's. (See Table 6.9 which displays historical quits during the 1980's (other than for retirement) and historical hires during the 1980's). While we noted that there are many more certificated individuals currently not teaching than needed, these state level demographic projections indicate that school districts will be searching increasingly for replacement teachers during the balance of the decade.

We may examine the projected hiring problem by comparing projected hires by MSA. Table 6.2 shows the inventory of 1990/1 teachers, actual hires during the 1980's (34,631), *actual* quits aggregated from the district level during the 1980's (rather than historical quits by assignment area), and the various hires under the three retirement assumptions. It is evident that the Philadelphia MSA will need to hire as many as 24,000 new teachers during the balance of the decade, while other areas such as Altoona, will be hiring less than 1,000 new teachers.

Table 6.2: Predicted Hires based on Teacher and Student Demographics, Actual Quits: 1992/3-1999/2000 Comparison to Past Hires in 1980's by MSA

| MSA | 1990/1 Teachers | Act. Hires 1982/9 | Pred. $H^a$ | Actual Quits 82-9 | Pred. Tot. $H^a$ | Pred. $H^e$ | Pred. Tot. $H^e$ | Pred. $H^m$ | Pred. Tot. $H^m$ |
|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] |
| Allentown | 4,648 | 1,763 | 1,302 | 1,108 | 2,410 | 2,385 | 3,493 | 2,899 | 4,007 |
| Altoona | 1,097 | 389 | 194 | 286 | 480 | 446 | 732 | 570 | 856 |
| Erie | 2,318 | 869 | 443 | 629 | 1,072 | 900 | 1,529 | 1,173 | 1,802 |
| Harrisburg | 5,866 | 2,246 | 1,171 | 1,799 | 2,970 | 2,380 | 4,179 | 2,974 | 4,773 |
| Johnstown | 1,988 | 632 | 124 | 513 | 637 | 474 | 987 | 660 | 1,173 |
| Lancaster | 3,544 | 1,590 | 1,143 | 1,084 | 2,227 | 1,879 | 2,963 | 2,127 | 3,211 |
| Scranton | 5,727 | 1,593 | 1,556 | 1,305 | 2,861 | 2,947 | 4,252 | 3,712 | 5,017 |
| Philadelphi | 28,797 | 12,578 | 8,276 | 7,249 | 15,525 | 13,810 | 21,059 | 16,937 | 24,186 |
| Pittsburgh | 15,930 | 2,867 | 2,520 | 3,486 | 6,006 | 7,010 | 10,496 | 8,891 | 12,377 |
| Readin | 2,965 | 1,051 | 985 | 734 | 1,719 | 1,639 | 2,373 | 1,892 | 2,626 |
| Sharon | 1,138 | 381 | 100 | 325 | 425 | 328 | 653 | 405 | 730 |
| State Colle | 815 | 352 | 196 | 274 | 470 | 320 | 594 | 403 | 677 |
| Williamspor | 1,152 | 423 | 164 | 263 | 427 | 444 | 707 | 540 | 803 |
| York | 3,563 | 1,643 | 1,081 | 1,111 | 2,192 | 1,785 | 2,896 | 2,111 | 3,222 |
| Beaver | 1,519 | 412 | 195 | 365 | 560 | 544 | 909 | 664 | 1,029 |
| NonMSA | 16,751 | 5,842 | 2,243 | 4,716 | 6,959 | 5,716 | 10,432 | 7,592 | 12,308 |
| Total | 97,818 | 34,631 | 21,693 | 25,247 | 46,940 | 43,007 | 68,254 | 53,550 | 78,797 |

Source: Tabulations of PED files.
Definitions:
[4] $H^a$: replacement hires due to retirements at age 65 and student demographics, 1991/2-2000/1
[5] Actual non-retirement withdrawals, 1982/3-1989/90, by MSA.
[6] Columns [4] + [5]
[7] $H^e$: replacement hires due to retirements at 30 years of service and student demographics, 1991/2-2000/1
[8] Columns [7] + [5]
[9] $H^m$: replacement hires due to retirements at 27 years of service and student demographics, 1991/2-2000/1
[10] Columns [9] + [5]

### 6.1.1 Results by Assignment Area

Assignment areas with replacement rates of more than 5% above the overall average under all three retirement assumptions are:[2]

- Biology
- English
- General Science
- Mathematics
- Social Studies

Assignment areas with replacement rates of more than 5% below the overall average under all three retirement assumptions are;[3]

- Agriculture
- Art
- Earth/Space
- General Elementary and Early Childhood
- Gifted
- Other Science
- Vocational Technical

[2]See Columns [7], [8] and [9] of Table 6.1.
[3]See Columns [7], [8] and [9] of Table 6.1.

### 6.1.2 Sources of Hiring: Teacher vs. Student Demographics

The overall results show the effects of several factors: teacher retirements, changes in student demographics and historical quits. The two demographic effects can be decomposed into replacement hires due solely to teacher retirements, $\hat{H}_r$, and hires due to student enrollment growth, $\hat{H}_e$. Total hires without regard to quits are $\hat{H}_r + \hat{H}_e$. Of the 21,693 replacement hires projected under the age 65 retirement assumptions, 11,832 or 54.5% are due to overall enrollment growth (see Table 6.3). Under the assumption of retirement after 30 years of service, enrollment growth is far less important; its overall effect is only 24.6% (See Table 6.4). Of course, the differential effect of enrollment growth follows the relative increase in the number of secondary students which was discussed in Chapter 5. Retirement of secondary school teachers requires 35% of the replacements of secondary school teachers under the age 65 retirement assumption; this implies that 65% must be due to enrollment growth.[4]

Table 6.3: Sources of Projected Hires: Teacher Retirement vs. Student Enrollment Growth

| | Retire at Age 65 | | | Retire with 30 Years Exp. | | |
|---|---|---|---|---|---|---|
| Teacher Assignment | Total "Needs" | Hires due to Retire. | Hires due to Enroll. | Total "Needs" | Hires due to Retire. | Hires due to Enroll. |
| | [2] | [3] | [4] | [5] | [6] | [7] |
| Kindergarden | 171 | 90 | 81 | 347 | 284 | 63 |
| Primary | 6,172 | 4,416 | 1,756 | 16,298 | 14,874 | 1,424 |
| Secondary | 10,879 | 3,854 | 7,025 | 19,686 | 13,393 | 6,293 |
| Other Secondary | 4,470 | 1,500 | 2,970 | 6,681 | 3,876 | 2,805 |
| Total | 21,692 | 9,860 | 11,832 | 43,012 | 32,427 | 10,585 |

Source: Analysis of supply and demand model results.
Definitions:
[2] "Total Needs": $H^a$: replacement hires due to retirements at age 65 and student demographics, 1991/2-2000/1
[3] Hires to replace retiring teachers due to retirements at age 65, 1991/2-2000/1.
[4] Hires to deal with expanding student enrollment, 1991/2-2000/1
[5] "Total Needs": $H^e$: replacement hires due to retirements at 30 years of service & student demographics, 1991/2-2000/1
[6] Hires to replace retiring teachers due to retirements at 30 years of experience.
[7] Hires to deal with expanding student enrollment, 1991/2-2000/1

[4]It should be noted that we focus on the implications for recruitment of projected net new hires due to retirement and/or enrollment growth. There are circumstances when retirements are matched by enrollment declines so that no net new hires are projected. Also, there are circumstances when there are *more* projected retirements than enrollment declines, which implies net hires due to retirement. The projections in Table 6.3 and 6.4 are based on this net concept.

Table 6.4: % Sources of Projected Hires: Teacher Retirement vs. Student Enrollment Growth

| | Retire at Age 65 | | | Retire with 30 Years Exp. | | |
|---|---|---|---|---|---|---|
| Teacher Assignment | % Total "Needs" | % Hires due to Retire. | % Hires due to Enroll. | % Total "Needs" | % Hires due to Retire. | % Hires due to Enroll. |
| | [2] | [3] | [4] | [5] | [6] | [7] |
| Kindergarden | 100.0% | 52.6% | 47.4% | 100.0% | 81.8% | 18.2% |
| Primary | 100.0% | 71.5% | 28.5% | 100.0% | 91.3% | 8.7% |
| Secondary | 100.0% | 35.4% | 64.6% | 100.0% | 68.0% | 32.0% |
| Other Secondary | 100.0% | 33.6% | 66.4% | 100.0% | 58.0% | 42.0% |
| Total | 100.0% | 45.5% | 54.5% | 100.0% | 75.4% | 24.6% |

Source: See Table 6.3
Definitions:
[3] Column [3]/[2] of Table 6.3
[4] Column [4]/[2] of Table 6.3
[6] Column [6]/[5] of Table 6.3
[7] Column [7]/[5] of Table 6.3

## 6.2 Results by Assignment Area and MSA

We now disaggregate geographically the overall hiring projections presented above. Table 6.5 displays the 1990/1 inventory of assigned teachers by Metropolitan Statistical Area; they total 97,817 in known school districts. Tables 6.6, 6.7, and 6.8 display, respectively, the fraction of the 1990/1 inventory of teachers needed to replace retiring teachers under the retirement at age 65, the retirement with 30 years of experience and the retirement with 27 years of experience assumptions. They also take into account projected hiring needs due to changes in student enrollment and curricula, but not quits.

It is evident that there are very large differentials among MSA's in their projected hiring patterns. For example, Biology was an area identified at the state level that would require an above-average rate of replacement under all three retirement assumptions. Statewide, under the age 65 retirement assumption, 29.6% of the 1990/1 state-wide inventory of teachers are projected to be replaced during the balance of the decade.[5] In the Allentown MSA, 43% of the 1990/1 inventory of Biology teachers will need to be replaced while in Altoona, only 7% will need to be replaced.

MSA's that will need to replace *less* than 20% of their Biology teachers in the balance of the decade are: Altoona, Johnstown, Sharon, State College and Non-MSAs. MSA's that will need to replace *more* than 35% of their Biology teachers in the balance of the decade are: Allentown, Erie, Lancaster, Scranton, Philadelphia, Reading, York and Beaver. There are numerous instances of replacement rates in excess of 40% in particular parts of the state, and a few instances of replacement rates of 50% or more: Reading will need to replace 50.9% of its 1990/1 English teachers, and 52.9% of its French teachers. Generally, Lancaster, Philadelphia and Reading MSA's display the highest replacement rates. It should be noted that these figures *do not* reflect any replacements needed for quits.

The stronger retirement assumption of 30 years of service leads to much higher replacement rates. Recall that overall, 44% of the 1990/1 inventory of teachers state-wide will need to be replaced due to teacher and student demographics. In the Allentown MSA, 84% of the English teachers will need to be replaced along with 85% of the Mathematics teachers, and 78% of the Social Studies instructors. Other MSA's that will need to replace more than 70% of their English teachers

[5] See Table 6.1.

are: Lancaster, Scranton, Philadelphia, Pittsburgh, Reading, York and Beaver. In Mathematics, Allentown, Altoona, Erie, Lancaster, Philadelphia Pittsburgh, Reading, Williamsport and York MSA's will have to replace more than 70% of their 1990/1 teacher inventory. Again, it should be noted that these figures *do not* reflect any replacements needed for quits.

## Table 6.5: 1990/1 Teachers by Assignment Area and MSA

| [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
|---|---|---|---|---|---|---|---|---|
| Assignment Area | Allentown | Altoona | Erie | Harrisburg | Johnstown | Lancaster | Scranton | Philadelphia |
| Agriculture | 1 | 5 | 4 | 16 | 7 | 19 | 5 | 23 |
| Art | 156 | 26 | 73 | 186 | 62 | 122 | 176 | 840 |
| Biology | 107 | 28 | 40 | 111 | 33 | 64 | 117 | 479 |
| Business Educatio | 130 | 28 | 53 | 150 | 63 | 82 | 169 | 585 |
| Chemistry | 40 | 11 | 22 | 54 | 27 | 28 | 60 | 222 |
| Driver Education | 17 | 7 | 10 | 37 | 15 | 24 | 27 | 44 |
| Early Childhood | 26 | 6 | 14 | 29 | 18 | 75 | 26 | 502 |
| Earth/Space | 39 | 15 | 18 | 56 | 21 | 34 | 51 | 116 |
| English | 353 | 85 | 180 | 445 | 151 | 251 | 463 | 1,874 |
| French | 37 | 9 | 10 | 49 | 18 | 24 | 50 | 270 |
| General Elementar | 1,857 | 434 | 903 | 2,295 | 798 | 1,415 | 2,239 | 11,206 |
| General Science | 103 | 17 | 63 | 102 | 39 | 76 | 144 | 693 |
| German | 43 | 5 | 5 | 26 | 4 | 24 | 24 | 94 |
| Gifted | 19 | 14 | 24 | 41 | 6 | 14 | 44 | 186 |
| Health/Phys Educ | 282 | 55 | 130 | 342 | 107 | 206 | 361 | 1,687 |
| Hearing Impaired | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 59 |
| Home Economics | 97 | 27 | 47 | 123 | 42 | 82 | 111 | 477 |
| Industrial Arts | 112 | 23 | 58 | 141 | 56 | 99 | 133 | 545 |
| Mathematics | 296 | 77 | 154 | 377 | 143 | 227 | 426 | 1,735 |
| Mental/Phys Handi | 249 | 56 | 183 | 436 | 74 | 178 | 243 | 3,238 |
| Music | 203 | 46 | 77 | 270 | 94 | 168 | 244 | 1,135 |
| Not Listed Elsewh | 5 | 1 | 0 | 12 | 0 | 11 | 3 | 6 |
| Other Languages | 9 | 2 | 3 | 26 | 0 | 4 | 12 | 91 |
| Other Science | 3 | 0 | 0 | 13 | 1 | 1 | 3 | 7 |
| Physics | 28 | 7 | 10 | 24 | 11 | 14 | 30 | 124 |
| Social Studies | 341 | 84 | 161 | 396 | 154 | 236 | 418 | 1,449 |
| Spanish | 73 | 9 | 21 | 76 | 34 | 50 | 75 | 442 |
| Speech/Lang Impai | 14 | 6 | 17 | 0 | 0 | 9 | 21 | 193 |
| Visually Impaired | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| Vocational Educat | 4 | 10 | 28 | 29 | 6 | 7 | 37 | 388 |
| Vocational Health | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 23 |
| Vocational Tech E | 3 | 4 | 3 | 4 | 4 | 0 | 12 | 39 |

| Assignment Area | Pittsburgh | Reading | Sharon | State Coll. | Williamsport | York | Beaver | Non-MSA |
|---|---|---|---|---|---|---|---|---|
| Agriculture | 4 | 10 | 2 | 4 | 2 | 15 | 1 | 70 |
| Art | 531 | 98 | 38 | 30 | 42 | 107 | 52 | 518 |
| Biology | 320 | 61 | 21 | 11 | 24 | 67 | 41 | 311 |
| Business Educatio | 398 | 71 | 30 | 21 | 30 | 87 | 45 | 501 |
| Chemistry | 188 | 27 | 12 | 10 | 9 | 34 | 16 | 175 |
| Driver Education | 43 | 15 | 4 | 6 | 5 | 27 | 6 | 110 |
| Early Childhood | 143 | 39 | 11 | 25 | 8 | 36 | 9 | 285 |
| Earth/Space | 137 | 24 | 6 | 7 | 7 | 32 | 14 | 120 |
| English | 1,237 | 224 | 79 | 60 | 91 | 260 | 121 | 1,281 |
| French | 191 | 17 | 6 | 8 | 9 | 30 | 17 | 141 |
| General Elementar | 6,148 | 1,210 | 413 | 297 | 423 | 1,432 | 634 | 6,566 |
| General Science | 332 | 61 | 32 | 19 | 37 | 79 | 33 | 396 |
| German | 72 | 30 | 4 | 3 | 6 | 15 | 8 | 67 |
| Gifted | 132 | 8 | 7 | 9 | 4 | 8 | 10 | 93 |
| Health/Phys Educ | 1,053 | 185 | 60 | 49 | 77 | 213 | 92 | 1,005 |
| Hearing Impaired | 11 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| Home Economics | 344 | 75 | 21 | 19 | 27 | 82 | 33 | 373 |
| Industrial Arts | 429 | 89 | 29 | 21 | 35 | 106 | 39 | 429 |
| Mathematics | 1,079 | 191 | 74 | 61 | 84 | 225 | 98 | 1,138 |
| Mental/Phys Handi | 724 | 88 | 122 | 14 | 60 | 209 | 34 | 810 |
| Music | 717 | 151 | 44 | 42 | 63 | 164 | 67 | 768 |
| Not Listed Elsewh | 13 | 0 | 1 | 1 | 0 | 6 | 1 | 6 |
| Other Languages | 29 | 9 | 4 | 1 | 0 | 7 | 7 | 25 |
| Other Science | 5 | 0 | 0 | 1 | 1 | 4 | 0 | 6 |
| Physics | 106 | 16 | 6 | 6 | 7 | 18 | 4 | 85 |
| Social Studies | 1,069 | 219 | 76 | 58 | 87 | 237 | 108 | 1,160 |
| Spanish | 236 | 39 | 15 | 13 | 12 | 40 | 16 | 191 |
| Speech/Lang Impai | 75 | 0 | 12 | 7 | 0 | 0 | 1 | 39 |
| Visually Impaired | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Vocational Educat | 124 | 7 | 3 | 11 | 2 | 20 | 6 | 64 |
| Vocational Health | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Vocational Tech E | 25 | 1 | 3 | 1 | 0 | 3 | 6 | 15 |

Source: Analysis of model results

Table 6.6: 1992-2000 Teacher Replacement Rates by Assignment Area and MSA: Age 65 Retirement and Student Demographics

| [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
|---|---|---|---|---|---|---|---|---|
| Assignment Area | Allentown | Altoona | Erie | Harrisburg | Johnstown | Lancaster | Scranton | Philadelphia |
| Agriculture | 0.0% | 0.0% | 0.0% | 18.8% | 14.3% | 42.1% | 0.0% | 21.7% |
| Art | 12.8% | 7.7% | 12.3% | 9.7% | 0.0% | 9.0% | 13.1% | 17.9% |
| Biology | 43.0% | 7.1% | 35.0% | 23.4% | 9.1% | 42.2% | 40.2% | 34.9% |
| Business Education | 36.2% | 21.4% | 15.1% | 25.3% | 14.3% | 29.3% | 29.0% | 36.9% |
| Chemistry | 32.5% | 27.3% | 22.7% | 18.5% | 3.7% | 35.7% | 46.7% | 39.6% |
| Driver Education | 23.5% | 71.4% | 10.0% | 32.4% | 0.0% | 29.2% | 51.9% | 20.5% |
| Early Childhood | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Earth/Space | 15.4% | 13.3% | 27.8% | 16.1% | 0.0% | 38.2% | 25.5% | 21.6% |
| English | 37.7% | 23.5% | 34.4% | 29.4% | 13.2% | 43.8% | 39.3% | 40.9% |
| French | 35.1% | 11.1% | 0.0% | 18.4% | 11.1% | 45.8% | 30.0% | 36.3% |
| General Elementar | 20.5% | 15.0% | 13.3% | 17.6% | 3.9% | 28.8% | 19.4% | 19.9% |
| General Science | 42.7% | 17.6% | 28.6% | 22.5% | 5.1% | 40.8% | 45.8% | 43.9% |
| German | 39.5% | 20.0% | 20.0% | 7.7% | 0.0% | 29.2% | 29.2% | 41.5% |
| Gifted | 0.0% | 0.0% | 8.3% | 0.0% | 0.0% | 21.4% | 0.0% | 17.7% |
| Health/Phys Educ | 27.3% | 18.2% | 15.4% | 17.8% | 5.6% | 35.4% | 22.7% | 33.3% |
| Hearing Impaired | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 39.0% |
| Home Economics | 42.3% | 25.9% | 27.7% | 26.8% | 9.5% | 46.3% | 31.5% | 47.6% |
| Industrial Arts | 30.4% | 13.0% | 15.5% | 19.1% | 7.1% | 35.4% | 31.6% | 43.5% |
| Mathematics | 37.8% | 26.0% | 28.6% | 28.4% | 4.9% | 40.1% | 40.6% | 35.5% |
| Mental/Phys Handi | 32.9% | 8.9% | 13.7% | 16.7% | 0.0% | 32.0% | 30.9% | 31.0% |
| Music | 24.1% | 17.4% | 15.6% | 15.9% | 3.2% | 26.2% | 29.1% | 28.0% |
| Not Listed Elsewh | 40.0% | 0.0% | 0.0% | 8.3% | 0.0% | 18.2% | 0.0% | 50.0% |
| Other Languages | 0.0% | 0.0% | 66.7% | 19.2% | 0.0% | 25.0% | 33.3% | 35.2% |
| Other Science | 33.3% | 0.0% | 0.0% | 30.8% | 0.0% | 100% | 0.0% | 14.3% |
| Physics | 25.0% | 14.3% | 10.0% | 20.8% | 9.1% | 35.7% | 30.0% | 35.5% |
| Social Studies | 42.5% | 31.0% | 36.6% | 27.5% | 17.5% | 45.3% | 36.6% | 46.4% |
| Spanish | 31.5% | 22.2% | 28.6% | 21.1% | 8.8% | 34.0% | 34.7% | 32.6% |
| Speech/Lang Impai | 35.7% | 16.7% | 17.6% | 0.0% | 0.0% | 33.3% | 9.5% | 25.9% |
| Visually Impaired | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 32.0% |
| Vocational Educat | 0.0% | 0.0% | 14.3% | 10.3% | 0.0% | 0.0% | 10.8% | 48.2% |
| Vocational Health | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 33.3% | 47.8% |
| Vocational Tech E | 0.0% | 25.0% | 0.0% | 0.0% | 0.0% | 0.0% | 8.3% | 23.1% |

| Assignment Area | Pittsburgh | Reading | Sharon | State Coll. | Williamsport | York | Beaver | Non-MSA |
|---|---|---|---|---|---|---|---|---|
| Agriculture | 0.0% | 20.0% | 0.0% | 0.0% | 0.0% | 33.3% | 0.0% | 1.4% |
| Art | 8.7% | 15.3% | 10.5% | 6.7% | 4.8% | 11.2% | 11.5% | 4.4% |
| Biology | 25.9% | 47.5% | 14.3% | 18.2% | 25.0% | 41.8% | 36.6% | 14.5% |
| Business Education | 24.1% | 32.4% | 10.0% | 28.6% | 23.3% | 33.3% | 4.4% | 12.0% |
| Chemistry | 27.1% | 48.1% | 0.0% | 40.0% | 11.1% | 41.2% | 6.3% | 12.6% |
| Driver Education | 11.6% | 13.3% | 0.0% | 33.3% | 0.0% | 37.0% | 16.7% | 10.9% |
| Early Childhood | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Earth/Space | 15.3% | 29.2% | 0.0% | 28.6% | 28.6% | 34.4% | 14.3% | 5.8% |
| English | 28.5% | 50.9% | 12.7% | 28.3% | 25.3% | 42.7% | 31.4% | 18.3% |
| French . | 23.6% | 52.9% | 0.0% | 25.0% | 11.1% | 36.7% | 11.8% | 9.9% |
| General Elementar | 8.3% | 26.9% | 5.6% | 23.2% | 5.7% | 24.2% | 5.4% | 14.3% |
| General Science | 22.9% | 41.0% | 21.9% | 31.6% | 21.6% | 40.5% | 15.2% | 17.9% |
| German | 27.8% | 36.7% | 0.0% | 66.7% | 16.7% | 20.0% | 0.0% | 11.9% |
| Gifted | 9.8% | 0.0% | 0.0% | 44.4% | 0.0% | 0.0% | 0.0% | 1.1% |
| Health/Phys Educ | 14.3% | 35.1% | 3.3% | 30.6% | 13.0% | 31.0% | 6.5% | 10.0% |
| Hearing Impaired | 36.4% | 0.0% | 33.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Home Economics | 25.9% | 40.0% | 14.3% | 21.1% | 14.8% | 43.9% | 9.1% | 13.9% |
| Industrial Arts | 19.3% | 34.8% | 3.4% | 33.3% | 2.9% | 33.0% | 2.6% | 8.9% |
| Mathematics | 23.0% | 48.2% | 23.0% | 23.0% | 26.2% | 43.1% | 30.6% | 17.6% |
| Mental/Phys Handi | 14.4% | 27.3% | 0.8% | 21.4% | 15.0% | 30.6% | 0.0% | 5.4% |
| Music | 15.2% | 24.5% | 9.1% | 21.4% | 20.6% | 28.0% | 19.4% | 11.2% |
| Not Listed Elsewh | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 16.7% | 0.0% | 0.0% |
| Other Languages | 10.3% | 33.3% | 0.0% | 0.0% | 0.0% | 14.3% | 14.3% | 4.0% |
| Other Science | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 25.0% | 0.0% | 0.0% |
| Physics | 20.8% | 25.0% | 33.3% | 16.7% | 0.0% | 33.3% | 0.0% | 3.5% |
| Social Studies | 26.4% | 49.8% | 22.4% | 29.3% | 32.2% | 40.1% | 31.5% | 20.6% |
| Spanish | 24.6% | 35.9% | 13.3% | 23.1% | 16.7% | 42.5% | 6.3% | 14.1% |
| Speech/Lang Impai | 16.0% | 0.0% | 0.0% | 28.6% | 0.0% | 0.0% | 0.0% | 2.6% |
| Visually Impaired | 18.2% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Vocational Educat | 25.0% | 0.0% | 0.0% | 27.3% | 0.0% | 15.0% | 0.0% | 17.2% |
| Vocational Health | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 33.3% |
| Vocational Tech E | 8.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 6.7% |

Source: Analysis of model results.
Table entries are ratios of replacement needs, 1992-2000 to 1990/1 teachers for MSA and assignment areas.

Table 6.7: 1992-99 Teacher Replacement Rates by Assignment Area and MSA: 30 Years Experience and Student Demographics

| [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
|---|---|---|---|---|---|---|---|---|
| Assignment Area | Allentown | Altoona | Erie | Harrisburg | Johnstown | Lancaster | Scranton | Philadelphia |
| Agriculture | 0.0% | 0.0% | 25.0% | 25.0% | 14.3% | 63.2% | 0.0% | 34.8% |
| Art | 21.2% | 19.2% | 20.5% | 9.7% | 3.2% | 18.0% | 17.0% | 24.6% |
| Biology | 57.9% | 53.6% | 52.5% | 52.3% | 12.1% | 71.9% | 67.5% | 63.7% |
| Business Educatio | 53.1% | 32.1% | 18.9% | 35.3% | 14.3% | 35.4% | 41.4% | 54.5% |
| Chemistry | 55.0% | 36.4% | 9.1% | 33.3% | 3.7% | 53.6% | 55.0% | 51.8% |
| Driver Education | 17.6% | 71.4% | 0.0% | 37.8% | 0.0% | 41.7% | 37.0% | 15.9% |
| Early Childhood | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Earth/Space | 23.1% | 33.3% | 44.4% | 32.1% | 9.5% | 67.6% | 39.2% | 32.8% |
| English | 69.4% | 48.2% | 57.8% | 52.4% | 36.4% | 65.7% | 71.5% | 70.9% |
| French | 54.1% | 0.0% | 20.0% | 36.7% | 5.6% | 54.2% | 34.0% | 61.5% |
| General Elementar | 47.8% | 42.9% | 40.1% | 42.6% | 28.2% | 52.4% | 49.4% | 42.0% |
| General Science | 68.0% | 41.2% | 57.1% | 49.0% | 12.8% | 60.5% | 67.4% | 68.3% |
| German | 55.8% | 20.0% | 0.0% | 19.2% | 0.0% | 50.0% | 29.2% | 50.0% |
| Gifted | 0.0% | 0.0% | 25.0% | 2.4% | 0.0% | 28.6% | 0.0% | 24.7% |
| Health/Phys Educ | 52.5% | 47.3% | 28.5% | 45.0% | 24.3% | 60.7% | 46.8% | 59.5% |
| Hearing Impaired | 0.0% | 0.0% | 25.0% | 0.0% | 0.0% | 0.0% | 0.0% | 35.6% |
| Home Economics | 42.3% | 37.0% | 27.7% | 39.0% | 14.3% | 51.2% | 46.8% | 52.8% |
| Industrial Arts | 50.9% | 26.1% | 36.2% | 38.3% | 14.3% | 49.5% | 40.6% | 49.4% |
| Mathematics | 72.3% | 59.7% | 61.7% | 59.4% | 38.5% | 70.0% | 75.4% | 67.7% |
| Mental/Phys Handi | 41.8% | 28.6% | 17.5% | 22.0% | 1.4% | 42.1% | 38.7% | 33.1% |
| Music | 36.9% | 21.7% | 32.5% | 29.3% | 16.0% | 39.3% | 41.4% | 43.0% |
| Not Listed Elsewh | 40.0% | 0.0% | 0.0% | 16.7% | 0.0% | 18.2% | 0.0% | 16.7% |
| Other Languages | 22.2% | 0.0% | 33.3% | 19.2% | 0.0% | 25.0% | 25.0% | 35.2% |
| Other Science | 33.3% | 0.0% | 0.0% | 69.2% | 0.0% | 100% | 0.0% | 14.3% |
| Physics | 28.6% | 28.6% | 0.0% | 16.7% | 9.1% | 35.7% | 30.0% | 46.0% |
| Social Studies | 72.1% | 52.4% | 55.9% | 53.0% | 33.1% | 79.7% | 71.5% | 81.8% |
| Spanish | 47.9% | 44.4% | 38.1% | 34.2% | 14.7% | 48.0% | 46.7% | 52.3% |
| Speech/Lang Impai | 50.0% | 33.3% | 29.4% | 0.0% | 0.0% | 33.3% | 23.8% | 28.5% |
| Visually Impaired | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 36.0% |
| Vocational Educat | 0.0% | 0.0% | 17.9% | 3.4% | 0.0% | 0.0% | 10.8% | 45.1% |
| Vocational Health | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 21.7% |
| Vocational Tech E | 0.0% | 50.0% | 0.0% | 25.0% | 25.0% | 0.0% | 8.3% | 30.8% |

| Assignment Area | Pittsburgh | Reading | Sharon | State Coll. | Williamsport | York | Beaver | Non-MSA |
|---|---|---|---|---|---|---|---|---|
| Agriculture | 0.0% | 30.0% | 0.0% | 25.0% | 0.0% | 40.0% | 0.0% | 10.0% |
| Art | 16.8% | 15.3% | 18.4% | 6.7% | 4.8% | 19.6% | 15.4% | 7.9% |
| Biology | 52.2% | 52.5% | 28.6% | 36.4% | 50.0% | 59.7% | 51.2% | 36.7% |
| Business Educatio | 29.9% | 26.8% | 13.3% | 23.8% | 26.7% | 36.8% | 4.4% | 22.4% |
| Chemistry | 46.8% | 51.9% | 0.0% | 30.0% | 33.3% | 50.0% | 6.3% | 21.1% |
| Driver Education | 2.3% | 13.3% | 0.0% | 16.7% | 0.0% | 22.2% | 33.3% | 10.9% |
| Early Childhood | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Earth/Space | 35.8% | 50.0% | 0.0% | 57.1% | 28.6% | 40.6% | 7.1% | 10.8% |
| English | 66.6% | 74.1% | 34.2% | 36.7% | 52.7% | 73.1% | 62.8% | 44.0% |
| French | 40.8% | 52.9% | 0.0% | 25.0% | 33.3% | 30.0% | 23.5% | 22.0% |
| General Elementar | 43.8% | 55.4% | 34.6% | 44.1% | 34.3% | 49.2% | 36.9% | 41.5% |
| General Science | 46.4% | 77.0% | 34.4% | 57.9% | 48.6% | 64.6% | 33.3% | 37.6% |
| German | 38.9% | 46.7% | 0.0% | 66.7% | 16.7% | 20.0% | 12.5% | 17.9% |
| Gifted | 15.9% | 0.0% | 0.0% | 77.8% | 0.0% | 0.0% | 0.0% | 5.4% |
| Health/Phys Educ | 38.8% | 53.0% | 25.0% | 61.2% | 45.5% | 48.4% | 30.4% | 30.9% |
| Hearing Impaired | 54.5% | 0.0% | 33.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Home Economics | 42.4% | 57.3% | 14.3% | 15.8% | 33.3% | 48.8% | 27.3% | 25.2% |
| Industrial Arts | 37.8% | 56.2% | 13.8% | 33.3% | 25.7% | 47.2% | 15.4% | 17.0% |
| Mathematics | 70.5% | 82.2% | 60.8% | 42.6% | 60.7% | 74.7% | 64.3% | 49.1% |
| Mental/Phys Handi | 28.5% | 43.2% | 9.0% | 28.6% | 25.0% | 35.4% | 8.8% | 12.2% |
| Music | 32.1% | 35.1% | 18.2% | 31.0% | 42.9% | 42.1% | 32.8% | 22.3% |
| Not Listed Elsewh | 7.7% | 0.0% | 0.0% | 0.0% | 0.0% | 16.7% | 0.0% | 0.0% |
| Other Languages | 10.3% | 22.2% | 0.0% | 0.0% | 0.0% | 0.0% | 28.6% | 8.0% |
| Other Science | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 25.0% | 0.0% | 0.0% |
| Physics | 32.1% | 18.8% | 33.3% | 33.3% | 14.3% | 38.9% | 0.0% | 4.7% |
| Social Studies | 54.3% | 79.9% | 48.7% | 51.7% | 58.6% | 64.1% | 42.6% | 44.9% |
| Spanish | 41.9% | 43.6% | 20.0% | 38.5% | 33.3% | 60.0% | 18.8% | 23.0% |
| Speech/Lang Impai | 29.3% | 0.0% | 8.3% | 42.9% | 0.0% | 0.0% | 0.0% | 7.7% |
| Visually Impaired | 36.4% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Vocational Educat | 25.0% | 0.0% | 0.0% | 18.2% | 0.0% | 15.0% | 0.0% | 17.2% |
| Vocational Health | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 33.3% |
| Vocational Tech E | 28.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 16.7% | 0.0% |

Source: Tabulations of supply and demand simulation model results by assignment area and MSA.

Table 6.8: 1992-99 Teacher Replacement Rates by Assignment Area and MSA: 27 Years Experience and Student Demographics

| [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
|---|---|---|---|---|---|---|---|---|
| Assignment Area | Allentown | Altoona | Erie | Harrisburg | Johnstown | Lancaster | Scranton | Philadelphia |
| Agriculture | 0.0% | 0.0% | 25.0% | 18.8% | 14.3% | 68.4% | 0.0% | 39.1% |
| Art | 14.7% | 34.6% | 24.7% | 12.4% | 3.2% | 18.9% | 18.2% | 29.9% |
| Biology | 69.2% | 25.0% | 55.0% | 54.1% | 15.2% | 75.0% | 78.6% | 69.7% |
| Business Educatio | 50.0% | 39.3% | 17.0% | 37.3% | 12.7% | 34.1% | 43.2% | 65.3% |
| Chemistry | 45.0% | 36.4% | 9.1% | 35.2% | 3.7% | 50.0% | 56.7% | 55.4% |
| Driver Education | 0.0% | 42.9% | 0.0% | 35.1% | 6.7% | 33.3% | 37.0% | 20.5% |
| Early Childhood | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Earth/Space | 30.8% | 0.0% | 61.1% | 30.4% | 9.5% | 67.6% | 29.4% | 37.9% |
| English | 83.6% | 62.4% | 67.2% | 66.1% | 43.0% | 76.1% | 84.9% | 89.4% |
| French | 56.8% | 0.0% | 0.0% | 40.8% | 11.1% | 58.3% | 34.0% | 70.0% |
| General Elementar | 65.8% | 63.6% | 58.1% | 58.2% | 48.6% | 63.5% | 72.1% | 55.2% |
| General Science | 72.8% | 47.1% | 65.1% | 52.9% | 23.1% | 59.2% | 82.6% | 76.5% |
| German | 51.2% | 40.0% | 0.0% | 15.4% | 0.0% | 50.0% | 37.5% | 55.3% |
| Gifted | 0.0% | 0.0% | 25.0% | 7.3% | 0.0% | 28.6% | 0.0% | 24.2% |
| Health/Phys Educ | 59.9% | 49.1% | 41.5% | 51.8% | 29.9% | 60.7% | 56.8% | 67.8% |
| Hearing Impaired | 0.0% | 0.0% | 25.0% | 0.0% | 0.0% | 0.0% | 0.0% | 49.2% |
| Home Economics | 57.7% | 48.1% | 34.0% | 55.3% | 14.3% | 68.3% | 59.5% | 66.5% |
| Industrial Arts | 59.8% | 30.4% | 41.4% | 44.0% | 10.7% | 46.5% | 45.1% | 60.0% |
| Mathematics | 84.5% | 70.1% | 75.3% | 67.6% | 33.6% | 80.6% | 85.2% | 82.9% |
| Mental/Phys Handi | 47.4% | 35.7% | 26.8% | 29.1% | 4.1% | 47.8% | 47.3% | 41.8% |
| Music | 39.4% | 32.6% | 36.4% | 35.9% | 22.3% | 43.5% | 48.8% | 49.7% |
| Not Listed Elsewh | 40.0% | 0.0% | 0.0% | 16.7% | 0.0% | 18.2% | 0.0% | 16.7% |
| Other Languages | 22.2% | 0.0% | 33.3% | 23.1% | 0.0% | 25.0% | 25.0% | 50.5% |
| Other Science | 100% | 0.0% | 0.0% | 76.9% | 0.0% | 100% | 0.0% | 14.3% |
| Physics | 32.1% | 28.6% | 0.0% | 12.5% | 9.1% | 35.7% | 23.3% | 49.2% |
| Social Studies | 78.6% | 61.9% | 64.6% | 58.3% | 33.1% | 83.9% | 76.8% | 86.8% |
| Spanish | 54.8% | 33.3% | 42.9% | 43.4% | 17.6% | 52.0% | 42.7% | 61.8% |
| Speech/Lang Impai | 57.1% | 33.3% | 52.9% | 0.0% | 0.0% | 55.6% | 38.1% | 31.1% |
| Visually Impaired | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 52.0% |
| Vocational Educat | 0.0% | 0.0% | 17.9% | 6.9% | 0.0% | 0.0% | 10.8% | 50.3% |
| Vocational Health | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 33.3% | 34.8% |
| Vocational Tech E | 0.0% | 50.0% | 33.3% | 0.0% | 50.0% | 0.0% | 0.0% | 38.5% |

| Assignment Area | Pittsburgh | Reading | Sharon | State Coll. | Williamsport | York | Beaver | Non-MSA |
|---|---|---|---|---|---|---|---|---|
| Agriculture | 0.0% | 40.0% | 0.0% | 25.0% | 0.0% | 40.0% | 0.0% | 14.3% |
| Art | 17.7% | 18.4% | 7.9% | 6.7% | 0.0% | 23.4% | 9.6% | 8.5% |
| Biology | 55.0% | 49.2% | 28.6% | 54.5% | 45.8% | 53.7% | 39.0% | 34.1% |
| Business Educatio | 32.9% | 32.4% | 13.3% | 28.6% | 13.3% | 39.1% | 6.7% | 24.4% |
| Chemistry | 40.4% | 51.9% | 0.0% | 60.0% | 11.1% | 44.1% | 6.3% | 22.3% |
| Driver Education | 0.0% | 20.0% | 0.0% | 16.7% | 0.0% | 14.8% | 0.0% | 10.0% |
| Early Childhood | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Earth/Space | 26.3% | 33.3% | 0.0% | 57.1% | 28.6% | 40.6% | 14.3% | 12.5% |
| English | 77.4% | 90.6% | 39.2% | 50.0% | 69.2% | 84.2% | 71.9% | 55.8% |
| French | 46.1% | 41.2% | 0.0% | 50.0% | 0.0% | 33.3% | 23.5% | 22.0% |
| General Elementar | 65.3% | 71.6% | 54.0% | 55.6% | 48.0% | 65.1% | 55.2% | 61.9% |
| General Science | 44.3% | 62.3% | 21.9% | 73.7% | 62.2% | 75.9% | 24.2% | 42.7% |
| German | 37.5% | 26.7% | 0.0% | 66.7% | 33.3% | 20.0% | 12.5% | 20.9% |
| Gifted | 13.6% | 0.0% | 0.0% | 88.9% | 0.0% | 0.0% | 0.0% | 4.3% |
| Health/Phys Educ | 45.2% | 58.9% | 28.3% | 71.4% | 40.3% | 53.1% | 27.2% | 34.4% |
| Hearing Impaired | 72.7% | 0.0% | 33.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Home Economics | 49.7% | 66.7% | 19.0% | 26.3% | 44.4% | 59.8% | 36.4% | 30.0% |
| Industrial Arts | 40.8% | 57.3% | 13.8% | 52.4% | 34.3% | 32.1% | 10.3% | 21.9% |
| Mathematics | 79.0% | 94.8% | 50.0% | 52.5% | 76.2% | 81.3% | 65.3% | 61.3% |
| Mental/Phys Handi | 44.8% | 47.7% | 19.7% | 28.6% | 31.7% | 45.0% | 14.7% | 20.5% |
| Music | 36.0% | 37.1% | 18.2% | 38.1% | 54.0% | 47.6% | 32.8% | 25.9% |
| Not Listed Elsewh | 7.7% | 0.0% | 0.0% | 0.0% | 0.0% | 16.7% | 0.0% | 0.0% |
| Other Languages | 13.8% | 22.2% | 0.0% | 0.0% | 0.0% | 0.0% | 14.3% | 8.0% |
| Other Science | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 50.0% | 0.0% | 0.0% |
| Physics | 35.8% | 18.8% | 33.3% | 16.7% | 14.3% | 38.9% | 0.0% | 8.2% |
| Social Studies | 57.6% | 71.7% | 38.2% | 63.8% | 60.9% | 70.0% | 46.3% | 48.3% |
| Spanish | 50.8% | 48.7% | 20.0% | 53.8% | 41.7% | 62.5% | 18.8% | 25.1% |
| Speech/Lang Impai | 40.0% | 0.0% | 16.7% | 57.1% | 0.0% | 0.0% | 0.0% | 17.9% |
| Visually Impaired | 36.4% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Vocational Educat | 33.1% | 0.0% | 0.0% | 18.2% | 0.0% | 10.0% | 0.0% | 12.5% |
| Vocational Health | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 33.3% |
| Vocational Tech E | 28.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 16.7% | 13.3% |

Source: Source: Tabulations of supply and demand simulation model results by assignment area and MSA.

It was noted above that in the aggregate, districts will be doing much more hiring in the 1990's than in the 1980's to maintain current student-teacher ratios and to continue to offer current curricula. If we take into account actual quits, the range of total hires varies from 46,940 (age 65 assumption + quits) to 78,797 (27 years of experience + quits) [6] which contrasts with total historical hires in the 1980's of 34,631. Table 6.9 displays by MSA and county the historical hiring rates (Column [10]), and compares them to the projected hires under the age 65 retirement

[6] See Columns [6], [8] and [10] of Table 6.2.

assumption and the 30 years of experience retirement assumption. Column [11] of Table 6.9, and Column [14] display the projected replacement rates, taking into account the *actual quits* observed in the 1980's. Of Pennsylvania's 67 counties, only 8 are projected to experience lower replacement rates than their actual hiring rates during the 1980's. These counties are: Somerset, Philadelphia, Fulton, Greene, Jefferson, Potter, Sullivan and Warren counties.[7] None of these counties are projected to experience lower replacement rates under the 30 years of experience retirement assumption than they actually experienced in the 1980's.

If we define as a potentially significant hiring problem a projected replacement rate which is 20 percentage points higher than the actual one experienced in the 1980's, we find that districts in eight counties will have such a hiring problem under the first retirement assumption. The districts in Monroe, Chester, Delaware, Montgomery, Berks, Adams, Pike and Wayne counties will, under the age 65 retirement assumption, be facing significant personnel shortages. [8] Furthermore, virtually all counties will have a significant hiring problem under the second retirement assumption. It should also be noted that the quit data used in these calculations are more conservative, i.e. smaller, than those used in the state-wide calculations, since they are based on actual quits in 1982-9 by district. The actual quits total 25,247, while the state-wide predicted quits used total 27,265.

[7] Compare Column [11] against Column [10] of Table 6.9.
[8] Compare Column [11] with Column [10] of Table 6.9.

Table 6.9: Pennsylvania Classroom Teachers Current Inventory and Projected New Hires Under Alternative Retirement Assumptions

| Area | P90 | 91/2 Enr | YP89 | 91/2 Teach. | New Hire[a] | Hist. Quits | Tot. Hire[a] | Hist. Hires | Hist. Rt. | Hire Rt.[a] | New Hire[e] | Tot. Hire[e] | Hire Rt.[e] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] | [14] |
| Allentown MSA | | | | | | | | | | | | | |
| Carbon | 56,907 | 8,069 | $9,057 | 424 | 132 | 101 | 233 | 143 | 34% | 55% | 203 | 304 | 72% |
| Lehigh | 272,548 | 38,165 | $12,794 | 2,229 | 539 | 597 | 1,136 | 899 | 40% | 51% | 1,109 | 1,706 | 77% |
| Northampton | 266,599 | 35,238 | $11,574 | 1,995 | 631 | 410 | 1,041 | 721 | 36% | 52% | 1,073 | 1,483 | 74% |
| Altoona MSA | | | | | | | | | | | | | |
| Blair | 134,811 | 21,043 | $8,232 | 1,097 | 194 | 286 | 480 | 389 | 35% | 44% | 446 | 732 | 67% |
| Erie | | | | | | | | | | | | | |
| Erie | 281,987 | 41,726 | $9,500 | 2,318 | 443 | 629 | 1,072 | 869 | 37% | 46% | 900 | 1,529 | 66% |
| Harrisburg MSA | | | | | | | | | | | | | |
| Cumberland | 224,801 | 32,930 | $12,737 | 2,082 | 438 | 654 | 1,092 | 780 | 37% | 52% | 921 | 1,575 | 76% |
| Dauphin | 233,326 | 33,713 | $11,630 | 2,359 | 466 | 683 | 1,149 | 875 | 37% | 49% | 896 | 1,579 | 67% |
| Lebanon | 113,744 | 17,084 | $10,802 | 985 | 184 | 294 | 478 | 367 | 37% | 49% | 411 | 705 | 72% |
| Perry | 41,924 | 7,460 | $9,717 | 440 | 83 | 168 | 251 | 224 | 51% | 57% | 152 | 320 | 73% |
| Johnstown MSA | | | | | | | | | | | | | |
| Cambria | 159,602 | 22,338 | $7,764 | 1,210 | 83 | 259 | 342 | 276 | 23% | 28% | 323 | 582 | 48% |
| Somerset | 79,376 | 13,478 | $7,745 | 778 | 41 | 254 | 295 | 356 | 46% | 38% | 151 | 405 | 52% |
| Lancaster MSA | | | | | | | | | | | | | |
| Lancaster | 419,065 | 58,907 | $12,213 | 3,544 | 1,143 | 1,083 | 2,226 | 1,590 | 45% | 63% | 1,879 | 2,962 | 84% |
| Scranton MSA | | | | | | | | | | | | | |
| Columbia | 74,147 | 10,519 | $8,864 | 649 | 190 | 174 | 364 | 254 | 39% | 56% | 304 | 478 | 74% |
| Lackawanna | 215,410 | 26,429 | $9,363 | 1,564 | 188 | 325 | 513 | 259 | 17% | 33% | 597 | 922 | 59% |
| Luzerne | 330,600 | 39,249 | $9,262 | 2,279 | 262 | 415 | 677 | 394 | 17% | 30% | 953 | 1,368 | 60% |
| Monroe | 98,927 | 15,931 | $10,143 | 958 | 882 | 304 | 1,186 | 601 | 63% | 124% | 979 | 1,283 | 134% |
| Wyoming | 28,297 | 4,952 | $9,555 | 277 | 34 | 86 | 120 | 85 | 31% | 43% | 114 | 200 | 72% |
| Philadelphia MSA | | | | | | | | | | | | | |
| Bucks | 538,589 | 74,856 | $14,051 | 4,734 | 1,518 | 1,175 | 2,693 | 2,129 | 45% | 57% | 2,688 | 3,863 | 82% |
| Chester | 375,833 | 51,018 | $17,005 | 3,276 | 997 | 1,080 | 2,077 | 1,129 | 34% | 63% | 1,663 | 2,743 | 84% |
| Delaware | 539,477 | 57,484 | $12,926 | 3,808 | 1,093 | 1,229 | 2,322 | 1,419 | 37% | 61% | 1,899 | 3,128 | 82% |
| Montgomery | 669,993 | 75,701 | $18,155 | 5,148 | 1,700 | 1,662 | 3,362 | 2,042 | 40% | 65% | 2,861 | 4,523 | 88% |
| Philadelphia | 1,585,577 | 191,632 | $6,842 | 11,831 | 2,968 | 2,103 | 5,071 | 5,859 | 50% | 43% | 4,699 | 6,802 | 57% |
| Pittsburgh MSA | | | | | | | | | | | | | |
| Allegheny | 1,335,916 | 158,313 | $11,501 | 10,100 | 1,954 | 2,299 | 4,253 | 1,713 | 17% | 42% | 4,897 | 7,196 | 71% |
| Fayette | 137,048 | 22,367 | $6,883 | 1,128 | 80 | 167 | 247 | 180 | 16% | 22% | 405 | 572 | 51% |
| Washington | 203,857 | 30,365 | $9,519 | 1,790 | 129 | 445 | 574 | 540 | 30% | 32% | 524 | 969 | 54% |
| Westmoreland | 379,093 | 54,921 | $9,984 | 2,912 | 357 | 575 | 932 | 434 | 15% | 32% | 1,184 | 1,759 | 60% |
| Reading MSA | | | | | | | | | | | | | |
| Berks | 357,727 | 51,125 | $12,143 | 2,965 | 985 | 733 | 1,718 | 1,051 | 35% | 58% | 1,639 | 2,372 | 80% |
| Sharon MSA | | | | | | | | | | | | | |
| Mercer | 121,093 | 18,844 | $8,388 | 1,138 | 100 | 326 | 426 | 381 | 33% | 37% | 328 | 654 | 57% |
| State College MSA | | | | | | | | | | | | | |
| Centre | 113,912 | 12,576 | $9,341 | 815 | 196 | 274 | 470 | 352 | 43% | 58% | 320 | 594 | 73% |
| Williamsport MSA | | | | | | | | | | | | | |
| Lycoming | 119,904 | 19,622 | $9,346 | 1,152 | 164 | 264 | 428 | 423 | 37% | 37% | 444 | 708 | 61% |
| York MSA | | | | | | | | | | | | | |
| Adams | 78,274 | 12,118 | $10,400 | 708 | 273 | 254 | 527 | 380 | 54% | 74% | 382 | 636 | 90% |
| York | 316,737 | 47,215 | $12,581 | 2,855 | 808 | 857 | 1,665 | 1,263 | 44% | 58% | 1,403 | 2,260 | 79% |
| Beaver MSA | | | | | | | | | | | | | |
| Beaver | 183,127 | 27,955 | $8,445 | 1,519 | 195 | 387 | 582 | 412 | 27% | 38% | 544 | 931 | 61% |
| NonMSA | | | | | | | | | | | | | |
| Armstrong | 77,286 | 12,520 | $8,478 | 756 | 67 | 143 | 210 | 194 | 26% | 28% | 269 | 412 | 54% |
| Bedford | 49,580 | 8,562 | $6,988 | 484 | 55 | 131 | 186 | 175 | 36% | 38% | 147 | 278 | 57% |
| Bradford | 63,587 | 12,191 | $8,660 | 724 | 84 | 229 | 313 | 245 | 34% | 43% | 257 | 486 | 67% |
| Butler | 145,514 | 23,822 | $10,163 | 1,328 | 241 | 352 | 593 | 453 | 34% | 45% | 529 | 881 | 66% |
| Cameron | 5,913 | 1,094 | $8,657 | 68 | 5 | 31 | 36 | 30 | 44% | 53% | 15 | 46 | 68% |
| Clarion | 49,354 | 8,167 | $7,614 | 447 | 62 | 131 | 193 | 161 | 36% | 43% | 125 | 256 | 57% |
| Clearfield | 93,681 | 15,996 | $8,169 | 882 | 70 | 247 | 317 | 256 | 29% | 36% | 242 | 489 | 55% |
| Clinton | 35,977 | 5,840 | $7,817 | 364 | 74 | 79 | 153 | 131 | 36% | 42% | 173 | 252 | 69% |

[continued on next page]

| Area | P90 | 91/2 Enr | YP89 | 91/2 Teach. | New Hire[a] | Hist. Quits | Tot. Hire[a] | Hist. Hires | Hist. Rt. | Hire Rt.[a] | New Hire[e] | Tot. Hire[e] | Hire Rt.[e] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] | [14] |
| Crawford | 71,213 | 12,059 | $8,544 | 748 | 59 | 207 | 266 | 217 | 29% | 36% | 234 | 441 | 59% |
| Elk | 34,132 | 4,494 | $10,074 | 253 | 25 | 94 | 119 | 81 | 32% | 47% | 75 | 169 | 67% |
| Forest | 5,388 | 782 | $6,532 | 58 | . | 24 | 24 | 22 | 38% | 41% | 12 | 36 | 62% |
| Franklin | 114,375 | 17,660 | $10,358 | 1,021 | 141 | 314 | 455 | 386 | 38% | 45% | 370 | 684 | 67% |
| Fulton | 13,837 | 2,521 | $8,261 | 149 | 10 | 48 | 58 | 62 | 42% | 39% | 35 | 83 | 56% |
| Greene | 39,550 | 7,164 | $6,596 | 433 | 25 | 126 | 151 | 180 | 42% | 35% | 77 | 203 | 47% |
| Huntingdon | 42,070 | 6,712 | $7,156 | 425 | 49 | 149 | 198 | 181 | 43% | 47% | 139 | 288 | 68% |
| Indiana | 87,235 | 14,041 | $7,936 | 818 | 117 | 240 | 357 | 325 | 40% | 44% | 267 | 507 | 62% |
| Jefferson | 40,557 | 7,149 | $8,484 | 403 | 33 | 110 | 143 | 160 | 40% | 35% | 113 | 223 | 55% |
| Juniata | 20,132 | 3,371 | $8,885 | 174 | 18 | 45 | 63 | 56 | 32% | 36% | 56 | 101 | 58% |
| Lawrence | 97,068 | 15,013 | $8,145 | 848 | 139 | 254 | 393 | 263 | 31% | 46% | 333 | 587 | 69% |
| Mckean | 48,155 | 8,141 | $8,159 | 504 | 46 | 166 | 212 | 172 | 34% | 42% | 161 | 327 | 65% |
| Mifflin | 43,075 | 6,286 | $8,087 | 419 | 37 | 98 | 135 | 99 | 24% | 32% | 150 | 248 | 59% |
| Montour | 18,749 | 2,591 | $11,301 | 161 | 28 | 47 | 75 | 59 | 37% | 47% | 59 | 106 | 66% |
| Northumberland | 97,267 | 14,346 | $8,261 | 842 | 82 | 222 | 304 | 270 | 32% | 36% | 278 | 500 | 59% |
| Pike | 15,821 | 2,773 | $9,951 | 167 | 183 | 63 | 246 | 102 | 61% | 147% | 194 | 257 | 154% |
| Potter | 16,931 | 3,311 | $7,507 | 209 | 6 | 107 | 113 | 119 | 57% | 54% | 31 | 138 | 66% |
| Schuylkill | 148,625 | 19,675 | $8,670 | 1,078 | 111 | 285 | 396 | 327 | 30% | 37% | 287 | 572 | 53% |
| Snyder | 36,680 | 5,346 | $9,012 | 331 | 76 | 65 | 141 | 120 | 36% | 43% | 150 | 215 | 65% |
| Sullivan | 6,104 | 987 | $7,916 | 63 | 3 | 25 | 28 | 31 | 49% | 44% | 16 | 41 | 65% |
| Susquehanna | 44,338 | 8,208 | $7,932 | 461 | 59 | 105 | 164 | 138 | 30% | 36% | 129 | 234 | 51% |
| Tioga | 41,070 | 6,981 | $7,894 | 391 | 45 | 137 | 182 | 142 | 36% | 47% | 127 | 264 | 68% |
| Union | 31,104 | 3,965 | $9,463 | 236 | 44 | 103 | 147 | 121 | 51% | 62% | 85 | 188 | 80% |
| Venango | 67,127 | 11,623 | $8,303 | 623 | 26 | 173 | 199 | 201 | 32% | 32% | 181 | 354 | 57% |
| Warren | 41,805 | 6,977 | $9,739 | 424 | 16 | 71 | 87 | 134 | 32% | 21% | 127 | 198 | 47% |
| Wayne | 45,713 | 7,560 | $8,896 | 459 | 207 | 96 | 303 | 202 | 44% | 66% | 273 | 369 | 80% |

Source: Supply and demand simulation model of Pennsylvania classroom teachers.
Definitions:
[2]: 1990 census of population
[3]: 1989 money income/1990 census of population
[4]: 1991 total school enrollment/1990 census of population
[5]: total # of classroom teachers by county in 1991/2
[6]: predicted new hires under age 65 retirement assumption through school year 2000
[7]: historical voluntary quits during 1982/89
[8]: total predicted new hires under age 65 retirement assumption: new *hires*[a] + historical quits
[9]: historical hires in county during 1982/89
[10]: ratio of historical hires to 1982 teacher inventory
[11]: ratio of projected hires uder age 65 retirement assuption to 1991/2 teacher inventory
[12]: projected new hires under 30 years of experience retirement assumption
[13]: new hires under 30 years of experience assumption + historical quits
[14]: ratio of predicted total hires under 30 year experience assumption to 1991/2 teacher inventory
*Hires*[a]: due to retirements at age 65 and student demographics
*Hires*[e]: due to retirements at 30 years of service and student demographics

Some indication of the type of teachers who will be hired at the county level is displayed in Table 6.10. Replacement rates are reported in terms of primary vs. secondary teachers compared to the 1990/1 inventories. Primary school teachers are defined here as those with a general and elementary school or early childhood assignment, all other teachers are treated as secondary school teachers. It should be noted that these replacement rates do not reflect the quits in Table 6.9, and are accordingly systematically lower than the total replacement rates in that table. However, there are many high replacement rates, essentially in the same counties noted previously, which confirm the forecast that these counties will be actively recruiting teachers in the balance of the decade.

## Table 6.10: Primary and Secondary Teacher Hiring Needs by Metropolitan Statistical Area

| Area | P90 | YP89 | 1990/1 PrimTch | New $Prim_a$ | New $Prim_e$ | 1991 SecTch | New $SecTch_a$ | New $SecTch_e$ | Replacement Hiring % $Prim_a$ | $Prim_e$ | $SecTch_a$ | $SecTch_e$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Allentown MSA | | | | | | | | | | | | |
| Carbon | 56,907 | $9,057 | 172 | 22 | 65 | 252 | 110 | 138 | 13% | 38% | 44% | 55% |
| Lehigh | 272,548 | $12,794 | 872 | 169 | 416 | 1,357 | 370 | 693 | 19% | 48% | 27% | 51% |
| Northampton | 266,599 | $11,574 | 813 | 190 | 407 | 1,182 | 441 | 666 | 23% | 50% | 37% | 56% |
| MSA Total | 596,054 | | 1,857 | 381 | 888 | 2,791 | 921 | 1,497 | | | | |
| Altoona MSA | | | | | | | | | | | | |
| Blair | 134,811 | $8,232 | 434 | 65 | 186 | 663 | 129 | 260 | 15% | 43% | 19% | 39% |
| Erie MSA | | | | | | | | | | | | |
| Erie | 281,987 | $9,500 | 903 | 120 | 362 | 1,415 | 323 | 538 | 13% | 40% | 23% | 38% |
| Harrisburg MSA | | | | | | | | | | | | |
| Cumberland | 224,801 | $12,737 | 732 | 157 | 370 | 1,350 | 281 | 551 | 21% | 51% | 21% | 41% |
| Dauphin | 233,326 | $11,630 | 966 | 107 | 303 | 1,393 | 359 | 593 | 11% | 31% | 26% | 43% |
| Lebanon | 113,744 | $10,802 | 418 | 96 | 225 | 567 | 88 | 186 | 23% | 54% | 16% | 33% |
| Perry | 41,924 | $9,717 | 179 | 43 | 79 | 261 | 40 | 73 | 24% | 44% | 15% | 28% |
| MSA Total | 613,795 | | 2,295 | 403 | 977 | 3,571 | 768 | 1,403 | | | | |
| Johnstown MSA | | | | | | | | | | | | |
| Cambria | 159,602 | $7,764 | 483 | 19 | 153 | 727 | 64 | 170 | 4% | 32% | 9% | 23% |
| Somerset | 79,376 | $7,745 | 315 | 12 | 72 | 463 | 29 | 79 | 4% | 23% | 6% | 17% |
| MSA Total | 238,978 | | 798 | 31 | 225 | 1,190 | 93 | 249 | | | | |
| Lancaster MSA | | | | | | | | | | | | |
| Lancaster | 419,065 | $12,213 | 1,415 | 407 | 742 | 2,129 | 736 | 1,137 | 29% | 52% | 35% | 53% |
| Scranton MSA | | | | | | | | | | | | |
| Columbia | 74,147 | $8,864 | 254 | 49 | 107 | 395 | 141 | 197 | 19% | 42% | 36% | 50% |
| Lackawanna | 215,410 | $9,363 | 602 | 64 | 272 | 962 | 124 | 325 | 11% | 45% | 13% | 34% |
| Luzerne | 330,600 | $9,262 | 888 | 63 | 382 | 1,391 | 199 | 571 | 7% | 43% | 14% | 41% |
| Monroe | 98,927 | $10,143 | 393 | 251 | 305 | 565 | 631 | 674 | 64% | 78% | 112% | 119% |
| Wyoming | 28,297 | $9,555 | 102 | 7 | 40 | 175 | 27 | 74 | 7% | 39% | 15% | 42% |
| MSA Total | 747,381 | | 2,239 | 439 | 1,106 | 3,488 | 1,122 | 1,841 | | | | |
| Philadelphia MSA | | | | | | | | | | | | |
| Bucks | 538,589 | $14,051 | 1,700 | 456 | 948 | 3,034 | 1,062 | 1,740 | 27% | 56% | 35% | 57% |
| Chester | 375,833 | $17,005 | 1,230 | 399 | 664 | 2,046 | 598 | 999 | 32% | 54% | 29% | 49% |
| Delaware | 539,477 | $12,926 | 1,364 | 199 | 554 | 2,444 | 894 | 1,345 | 15% | 41% | 37% | 55% |
| Montgomery | 669,993 | $18,155 | 1,885 | 507 | 986 | 3,263 | 1,193 | 1,875 | 27% | 52% | 37% | 57% |
| Philadelphia | 1,585,577 | $6,842 | 5,027 | 666 | 1,556 | 6,804 | 2,302 | 3,143 | 13% | 31% | 34% | 46% |
| MSA Total | 3,709,469 | | 11,206 | 2,227 | 4,708 | 17,591 | 6,049 | 9,102 | | | | |
| Pittsburgh MSA | | | | | | | | | | | | |
| Allegheny | 1,335,916 | $11,501 | 3,849 | 356 | 1,780 | 6,251 | 1,598 | 3,117 | 9% | 46% | 26% | 50% |
| Fayette | 137,048 | $6,883 | 453 | 30 | 204 | 675 | 50 | 201 | 7% | 45% | 7% | 30% |
| Washington | 203,857 | $9,519 | 668 | 31 | 243 | 1,122 | 98 | 281 | 5% | 36% | 9% | 25% |
| Westmoreland | 379,093 | $9,984 | 1,178 | 95 | 464 | 1,734 | 262 | 720 | 8% | 39% | 15% | 42% |
| MSA Total | 2,055,914 | | 6,148 | 512 | 2,691 | 9,782 | 2,008 | 4,319 | | | | |
| Reading MSA | | | | | | | | | | | | |
| Berks | 357,727 | $12,143 | 1,210 | 326 | 670 | 1,755 | 659 | 969 | 27% | 55% | 38% | 55% |
| Sharon MSA | | | | | | | | | | | | |
| Mercer | 121,093 | $8,388 | 413 | 23 | 143 | 725 | 77 | 185 | 6% | 35% | 11% | 26% |
| State College MSA | | | | | | | | | | | | |
| Centre | 113,912 | $9,341 | 297 | 69 | 131 | 518 | 127 | 189 | 23% | 44% | 25% | 36% |
| Williamsport MSA | | | | | | | | | | | | |
| Lycoming | 119,904 | $9,346 | 423 | 24 | 145 | 729 | 140 | 299 | 6% | 34% | 19% | 41% |
| York MSA | | | | | | | | | | | | |
| Adams | 78,274 | $10,400 | 271 | 68 | 117 | 437 | 205 | 265 | 25% | 43% | 47% | 61% |
| York | 316,737 | $12,581 | 1,161 | 279 | 588 | 1,694 | 529 | 815 | 24% | 51% | 31% | 48% |
| MSA Total | 395,011 | | 1,432 | 347 | 705 | 2,131 | 734 | 1,080 | | | | |
| Beaver MSA | | | | | | | | | | | | |
| Beaver | 183,127 | $8,445 | 634 | 34 | 234 | 885 | 161 | 310 | 5% | 37% | 18% | 35% |
| Non-MSA Pa | | | | | | | | | | | | |
| Armstrong | 77,286 | $8,478 | 282 | 36 | 138 | 474 | 31 | 131 | 13% | 49% | 7% | 28% |
| Bedford | 49,580 | $6,988 | 199 | 30 | 79 | 285 | 25 | 68 | 15% | 40% | 9% | 24% |
| Bradford | 63,587 | $8,660 | 300 | 29 | 125 | 424 | 55 | 132 | 10% | 42% | 13% | 31% |

continued on next page

| Area | P90 | YP89 | 1990/1 PrimTch | New $Prim_a$ | New $Prim_e$ | 1990/1 SecTch | New $SecTch_a$ | New $SecTch_e$ | Replacement Hiring % $Prim_a$ | $Prim_e$ | $SecTch_a$ | $SecTch_e$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Butler | 145,514 | $10,163 | 519 | 103 | 255 | 809 | 138 | 274 | 20% | 49% | 17% | 34% |
| Cameron | 5,913 | $8,657 | 25 | 0 | 7 | 43 | 5 | 8 | 0% | 28% | 12% | 19% |
| Clarion | 49,354 | $7,614 | 179 | 41 | 78 | 268 | 21 | 47 | 23% | 44% | 8% | 18% |
| Clearfield | 93,681 | $8,169 | 360 | 48 | 156 | 522 | 22 | 86 | 13% | 43% | 4% | 16% |
| Clinton | 35,977 | $7,817 | 120 | 42 | 93 | 244 | 32 | 80 | 35% | 78% | 13% | 33% |
| Crawford | 71,213 | $8,544 | 280 | 27 | 117 | 468 | 32 | 117 | 10% | 42% | 7% | 25% |
| Elk | 34,132 | $10,074 | 101 | 7 | 40 | 152 | 18 | 35 | 7% | 40% | 12% | 23% |
| Forest | 5,388 | $6,532 | 18 | . | 11 | 40 | . | 1 | . | 61% | . | 3% |
| Franklin | 114,375 | $10,358 | 394 | 74 | 180 | 627 | 67 | 190 | 19% | 46% | 11% | 30% |
| Fulton | 13,837 | $8,261 | 64 | 10 | 26 | 85 | 0 | 9 | 16% | 41% | 0% | 11% |
| Greene | 39,550 | $6,596 | 153 | 15 | 36 | 280 | 10 | 41 | 10% | 24% | 4% | 15% |
| Huntingdon | 42,070 | $7,156 | 152 | 23 | 73 | 273 | 26 | 66 | 15% | 48% | 10% | 24% |
| Indiana | 87,235 | $7,936 | 323 | 56 | 133 | 495 | 61 | 134 | 17% | 41% | 12% | 27% |
| Jefferson | 40,557 | $8,484 | 168 | 10 | 49 | 235 | 23 | 64 | 6% | 29% | 10% | 27% |
| Juniata | 20,132 | $8,885 | 82 | 6 | 28 | 92 | 12 | 28 | 7% | 34% | 13% | 30% |
| Lawrence | 97,068 | $8,145 | 359 | 36 | 163 | 489 | 103 | 170 | 10% | 45% | 21% | 35% |
| Mckean | 48,155 | $8,159 | 188 | 15 | 73 | 316 | 31 | 88 | 8% | 39% | 10% | 28% |
| Mifflin | 43,075 | $8,087 | 168 | 18 | 54 | 251 | 19 | 96 | 11% | 32% | 8% | 38% |
| Montour | 18,749 | $11,301 | 66 | 10 | 24 | 95 | 18 | 35 | 15% | 36% | 19% | 37% |
| Northumberland | 97,267 | $8,261 | 287 | 22 | 107 | 555 | 60 | 171 | 8% | 37% | 11% | 31% |
| Pike | 15,821 | $9,951 | 80 | 54 | 62 | 87 | 129 | 132 | 68% | 78% | 148% | 152% |
| Potter | 16,931 | $7,507 | 85 | 3 | 20 | 124 | 3 | 11 | 4% | 24% | 2% | 9% |
| Schuylkill | 148,625 | $8,670 | 407 | 7 | 73 | 671 | 104 | 214 | 2% | 18% | 15% | 32% |
| Snyder | 36,680 | $9,012 | 116 | 41 | 79 | 215 | 35 | 71 | 35% | 68% | 16% | 33% |
| Sullivan | 6,104 | $7,916 | 26 | 1 | 7 | 37 | 2 | 9 | 4% | 27% | 5% | 24% |
| Susquehanna | 44,338 | $7,932 | 197 | 21 | 53 | 264 | 38 | 76 | 11% | 27% | 14% | 29% |
| Tioga | 41,070 | $7,894 | 166 | 30 | 76 | 225 | 15 | 51 | 18% | 46% | 7% | 23% |
| Union | 31,104 | $9,463 | 96 | 30 | 54 | 140 | 14 | 31 | 31% | 56% | 10% | 22% |
| Venango | 67,127 | $8,303 | 254 | 6 | 86 | 369 | 20 | 95 | 2% | 34% | 5% | 26% |
| Warren | 41,805 | $9,739 | 179 | 12 | 57 | 245 | 4 | 70 | 7% | 32% | 2% | 29% |
| Wayne | 45,713 | $8,896 | 173 | 78 | 114 | 286 | 129 | 159 | 45% | 66% | 45% | 56% |
| MSA Total | 1,789,013 | | 6,566 | 941 | 2,726 | 10,185 | 1,302 | 2,990 | | | | |
| State Total | 11,877,241 | | 38,270 | 6,344 | 16,639 | 59,548 | 15,349 | 26,368 | | | | |

Source: teacher demand and supply model simulation results
Definitions:
[4] K-6 Classroom Teachers in 1990/1 from Professional Personnel data files
[5] Projected New Hires of K-6 Teachers based on age 65 retirement assumption and student demographics
[6] Projected New Hires of K-6 Teachers based on 30 years of experience retirement assumption and student demographics
[7] 7-12 Classroom Teachers in 1990/1 from Professional Personnel data files
[8] Projected New Hires of K-6 Teachers based on age 65 retirement assumption and student demographics
[9] Projected New Hires of K-6 Teachers based on 30 years of experience retirement assumption and student demographics
[10] Projected primary replacement rate: ratio of [5]/[4]; retirement at age 65 assumption and student demographics
[11] Projected primary replacement rate: ratio of [6]/ [4]; 30 years experience retirement assumption and student demographics
[12] Projected secondary replacement rate: ratio of [7]/ [4]; retirement at age 65 assumption and student demographics
[13] Projected secondary replacement rate: ratio of [8]/ [4]; 30 years experience retirement assumption and student demographics

## 6.3 Best Practice Needs

We now turn to the staffing implications of "best practice" curricula. Table 6.11 displays for each of the 128 courses the number of districts which did not offer the course, the projected enrollment of these courses using the median enrollment rates displayed in Table 5.35, and the statewide number of teachers implied by these enrollment counts for school year 2000. Overall, this simulation implies some 1.4 million additional classroom students. Under the assumption that a teacher can teach 25 students in a course, (15 in the case of AP courses), and will offer 5 courses, this translates into a projected additional 11,338 teachers. Of course, in some school districts the projected enrollment is quite small, since enrollment rates of 3% times small secondary school enrollments can result in fractional students. Also, these calculations do not constrain student schedules. Presumably, application of best-practice curricula offerings would replace existing coursework[9]; however, the development of individual student schedules is beyond the scope of this study.

Table 6.12 displays a more limited set of courses which I designate as "academic"; under this view of what constitutes best practice, 6,483 additional teachers would need to be hired.

[9] A number of assignment areas such as general science indicate very high replacement rates. Districts which seek to strengthen their science curricula offerings might choose to require that their students take biology and chemistry, and accordingly find appropriately certificated teachers.

Table 6.11: Best Practice Enrollments and Teachers in School Year 2000

| Course | # of Districts | Minimum Enrollment in a SD | Maximum Enrollment in a SD | Statewide Enrollment in Course | Statewide Teachers for Course |
|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] |
| CBoard AP: Art | 478 | 0 | 75 | 2,714 | 36 |
| CBoard AP: Biology | 380 | 1 | 86 | 5,025 | 67 |
| CBoard AP: Chemistry | 372 | 1 | 60 | 3,746 | 50 |
| CBoard AP: Comp Sci | 430 | 1 | 132 | 3,997 | 53 |
| CBoard AP: English | 257 | 2 | 106 | 4,537 | 60 |
| CBoard AP: French | 455 | 1 | 34 | 2,660 | 35 |
| CBoard AP: German | 469 | 0 | 30 | 2,413 | 32 |
| CBoard AP: Gov/Politcs | 456 | 2 | 297 | 9,826 | 131 |
| CBoard AP: History | 324 | 2 | 106 | 6,452 | 86 |
| CBoard AP: Italian | 496 | 0 | 20 | 770 | 10 |
| CBoard AP: Latin | 486 | 0 | 58 | 2,125 | 28 |
| CBoard AP: Math | 315 | 2 | 72 | 4,227 | 56 |
| CBoard AP: Music | 488 | 0 | 44 | 1,628 | 22 |
| CBoard AP: Physics | 430 | 1 | 49 | 3,357 | 45 |
| CBoard AP: Spanish | 453 | 1 | 36 | 2,790 | 37 |
| Bus: Accting 1 | 11 | 5 | 80 | 278 | 2 |
| Bus: Accting 2 | 71 | 2 | 83 | 867 | 7 |
| Bus: Bus English | 222 | 2 | 139 | 5,295 | 42 |
| Bus: Bus Law | 197 | 3 | 132 | 4,629 | 37 |
| Bus: Bus Math | 107 | 4 | 633 | 4,948 | 40 |
| Bus: Data Process | 265 | 3 | 187 | 7,171 | 57 |
| Bus: Intro to Bus | 133 | 4 | 243 | 5,288 | 42 |
| Bus: Shorthand 1 | 126 | 1 | 74 | 1,818 | 15 |
| Bus: Shorthand 2 | 238 | 1 | 39 | 1,679 | 13 |
| Bus: Typing 1 | 6 | 11 | 567 | 1,001 | 8 |
| Bus: Typing 2 | 42 | 2 | 120 | 1,255 | 10 |
| Comp Sci: Computer Lit | 80 | 29 | 682 | 15,985 | 128 |
| Comp Sci: Comp Sci 1 | 235 | 6 | 370 | 15,557 | 124 |
| Comp Sci: Comp Sci 2 | 341 | 2 | 107 | 7,246 | 58 |
| Comp Sci: Programming 1 | 182 | 4 | 132 | 5,244 | 42 |
| Comp Sci: Programming 2 | 284 | 1 | 59 | 3,497 | 28 |
| Driver Ed: Classroom Theo | 90 | 20 | 16,229 | 41,470 | 332 |
| Driver Ed: Practicum | 190 | 13 | 10,700 | 42,516 | 340 |
| English: English | 1 | 742 | 742 | 742 | 6 |
| English: Literature | 255 | 31 | 1,812 | 74,489 | 596 |
| English: Speech | 198 | 6 | 235 | 9,445 | 76 |
| English: Writing | 165 | 8 | 345 | 10,817 | 87 |
| Environ Ed | 279 | 11 | 1,646 | 34,042 | 272 |
| Health | 8 | 44 | 382 | 1,618 | 13 |
| Humanity: Music Theor | 351 | 1 | 106 | 2,547 | 20 |
| Humanity: Aesthetics | 488 | 4 | 582 | 22,074 | 177 |
| Humanity: Arts Criticism | 484 | 4 | 3,089 | 24,785 | 198 |
| Humanity: Arts History | 428 | 3 | 167 | 12,304 | 98 |
| Humanity: Choral Music | 28 | 23 | 387 | 2,872 | 23 |
| Humanity: Dance | 481 | 2 | 149 | 12,439 | 100 |
| Humanity: Drama | 322 | 2 | 72 | 6,184 | 49 |
| Humanity: Film Studies | 463 | 4 | 206 | 18,959 | 152 |
| Humanity: Gen Art | 6 | 145 | 1,218 | 2,555 | 20 |
| Humanity: Gen Music | 12 | 134 | 758 | 3,735 | 30 |
| Humanity: Humanities | 368 | 6 | 377 | 23,801 | 190 |
| Humanity: Inst Music | 14 | 41 | 406 | 1,430 | 11 |
| Humanity: Philosophy | 482 | 2 | 136 | 13,441 | 108 |
| Humanity: Photography | 321 | 4 | 232 | 12,140 | 97 |
| Humanity: Studio Art | 246 | 6 | 282 | 12,937 | 103 |
| Industrial Arts | 3 | 316 | 716 | 1,564 | 13 |
| For Lang: Exploration | 348 | 18 | 1,157 | 69,054 | 552 |
| For Lang: French 1 | 67 | 5 | 162 | 2,250 | 18 |
| For Lang: French 2 | 68 | 4 | 125 | 1,789 | 14 |
| For Lang: French 3 | 111 | 2 | 66 | 1,435 | 11 |
| For Lang: French 4 | 160 | 1 | 33 | 1,024 | 8 |
| For Lang: French 5/6 | 408 | 1 | 32 | 2,226 | 18 |
| For Lang: German 1 | 224 | 3 | 99 | 4,997 | 40 |
| For Lang: German 2 | 227 | 2 | 66 | 3,313 | 27 |
| For Lang: German 3 | 248 | 1 | 56 | 2,283 | 18 |
| For Lang: German 4 | 286 | 1 | 33 | 1,733 | 14 |
| For Lang: German 5/6 | 456 | 1 | 459 | 3,193 | 26 |
| For Lang: Italian 1 | 483 | 2 | 262 | 9,570 | 77 |
| For Lang: Italian 2 | 484 | 1 | 181 | 6,645 | 53 |
| For Lang: Italian 3 | 489 | 1 | 130 | 4,884 | 39 |
| For Lang: Italian 4/5 | 491 | 1 | 103 | 3,896 | 31 |
| For Lang: Latin 1 | 338 | 3 | 153 | 8,269 | 66 |
| For Lang: Latin 2 | 348 | 1 | 80 | 4,452 | 36 |
| For Lang: Latin 3 | 401 | 1 | 44 | 3,012 | 24 |

[continued on next page]

| Course | # of Districts | Minimum Enrollment in a SD | Maximum Enrollment in a SD | Statewide Enrollment in Course | Statewide Teachers for Course |
|---|---|---|---|---|---|
| For Lang: Latin 4 | 436 | 0 | 27 | 1,964 | 16 |
| For Lang: Russian 1 | 469 | 1 | 40 | 3,243 | 26 |
| For Lang: Russian 2 | 484 | 0 | 28 | 2,379 | 19 |
| For Lang: Russian 3 | 493 | 1 | 39 | 3,424 | 27 |
| For Lang: Russian 4/5 | 496 | 0 | 12 | 1,044 | 8 |
| For Lang: Spanish 1 | 20 | 11 | 164 | 958 | 8 |
| For Lang: Spanish 2 | 24 | 7 | 114 | 883 | 7 |
| For Lang: Spanish 3 | 45 | 3 | 48 | 695 | 6 |
| For Lang: Spanish 4 | 118 | 1 | 50 | 970 | 8 |
| For Lang: Spanish 5/6 | 408 | 1 | 49 | 3,514 | 28 |
| For Lang: Spanish for Sp | 491 | 1 | 125 | 4,688 | 38 |
| Math: Alg 1 | 1 | 71 | 71 | 71 | 1 |
| Math: Alg 2 | 7 | 13 | 303 | 818 | 7 |
| Math: Alg 3 | 320 | 5 | 794 | 18,381 | 147 |
| Math: Anal Geo | 373 | 5 | 309 | 18,760 | 150 |
| Math: Arith | 222 | 34 | 1,859 | 86,089 | 689 |
| Math: Calculus | 155 | 3 | 144 | 4,609 | 37 |
| Math: AP Calculus | 324 | 2 | 70 | 4,320 | 35 |
| Math: Comb Calc/Ana Geom | 407 | 3 | 484 | 14,991 | 120 |
| Math: Comb Plane / Solid | 311 | 11 | 712 | 38,241 | 306 |
| Math: Cons Math | 195 | 5 | 248 | 10,127 | 81 |
| Math: Fund of Math | 294 | 8 | 414 | 22,835 | 183 |
| Math: Gen Math 1 | 45 | 9 | 236 | 3,632 | 29 |
| Math: Gen Math 2 | 159 | 6 | 171 | 7,793 | 62 |
| Math: Gen Math 3 | 301 | 5 | 281 | 13,871 | 111 |
| Math: Intro to College Ma | 382 | 3 | 192 | 12,346 | 99 |
| Math: Plane Geometry | 160 | 12 | 658 | 17,403 | 139 |
| Math: Porb/Stat | 373 | 2 | 106 | 6,168 | 49 |
| Math: SolidGeometry | 476 | 8 | 492 | 42,286 | 338 |
| Math: Trig | 50 | 7 | 396 | 3,627 | 29 |
| Adapted Phys Ed | 158 | 1 | 26 | 916 | 7 |
| Phys Ed | 7 | 253 | 621 | 2,961 | 24 |
| Develop Reading | 20 | 36 | 887 | 7,802 | 62 |
| Remedial Reading | 82 | 9 | 359 | 4,317 | 35 |
| Sci: Biology 1 | 5 | 22 | 296 | 833 | 7 |
| Sci: Biology 2 | 139 | 4 | 187 | 4,851 | 39 |
| Sci: Chemistry 1 | 5 | 11 | 99 | 277 | 2 |
| Sci: Chemistry 2 | 203 | 2 | 117 | 4,311 | 34 |
| Sci: Earth/ Space Sci 1 | 81 | 21 | 744 | 14,311 | 114 |
| Sci: Earth/ Space Sci 2 | 434 | 5 | 732 | 23,682 | 189 |
| Sci: Gen Sci (JHS) | 226 | 36 | 1,960 | 90,886 | 727 |
| Sci: Gen Sci (SHS) | 186 | 10 | 405 | 17,685 | 141 |
| Sci: Life Science | 137 | 21 | 808 | 26,674 | 213 |
| Sci: Physical Science | 102 | 31 | 602 | 17,803 | 142 |
| Sci: Physics 1 | 14 | 6 | 106 | 531 | 4 |
| Sci: Physics 2 | 377 | 1 | 84 | 5,109 | 41 |
| Soc Studies: Anthropology | 441 | 4 | 609 | 20,104 | 161 |
| Soc Studies: Economics | 137 | 17 | 871 | 21,010 | 168 |
| Soc Studies: Geography | 122 | 28 | 1,340 | 29,849 | 239 |
| Soc Studies: Govt/Civics | 43 | 23 | 716 | 9,074 | 73 |
| Soc Studies: Pa History | 270 | 21 | 3,095 | 76,756 | 614 |
| Soc Studies: Psychology | 196 | 7 | 396 | 11,912 | 95 |
| Soc Studies: Sociology | 192 | 6 | 317 | 9,991 | 80 |
| Soc Studies: US History/C | 5 | 162 | 455 | 1,719 | 14 |
| Soc Studies: World Cultur | 10 | 40 | 425 | 2,804 | 22 |
| Total | | | | 1,417,257 | 11,338 |

Source: Analysis of PDE curriculum files and enrollment projections

Definitions:

[2] number of school districts NOT currently offering the course.

[3] smallest enrollment among districts [2] districts that would offer course.

[4] largest smallest enrollment among districts [2] districts that would offer course.

[5] sum of simulated enrollment across [2] districts

[6] Column [5]/125 or /75 in case of AP courses.

Table 6.12: Best Practice Enrollments for Academic Courses in School Year 2000

| Course | # of Districts | Minimum Enrollment in a SD | Maximum Enrollment in a SD | Statewide Enrollment in Course | Statewide Teachers for Course |
|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] |
| CBoard AP: Art | 478 | 0 | 75 | 2,714 | 36 |
| CBoard AP: Biology | 380 | 1 | 86 | 5,025 | 67 |
| CBoard AP: Chemistry | 372 | 1 | 60 | 3,746 | 50 |
| CBoard AP: Comp Sci | 430 | 1 | 132 | 3,997 | 53 |
| CBoard AP: English | 257 | 2 | 106 | 4,537 | 60 |
| CBoard AP: French | 455 | 1 | 34 | 2,660 | 35 |
| CBoard AP: German | 469 | 0 | 30 | 2,413 | 32 |
| CBoard AP: Gov/Politcs | 456 | 2 | 297 | 9,826 | 131 |
| CBoard AP: History | 324 | 2 | 106 | 6,452 | 86 |
| CBoard AP: Italian | 496 | 0 | 20 | 770 | 10 |
| CBoard AP: Latin | 486 | 0 | 58 | 2,125 | 28 |
| CBoard AP: Math | 315 | 2 | 72 | 4,227 | 56 |
| CBoard AP: Music | 488 | 0 | 44 | 1,628 | 22 |
| CBoard AP: Physics | 430 | 1 | 49 | 3,357 | 45 |
| CBoard AP: Spanish | 453 | 1 | 36 | 2,790 | 37 |
| English: Literature | 255 | 31 | 1,812 | 74,489 | 596 |
| Humanity: Music Theory | 351 | 1 | 106 | 2,547 | 20 |
| Humanity: Aesthetics | 488 | 4 | 582 | 22,074 | 177 |
| Humanity: Arts Criticism | 484 | 4 | 3,089 | 24,785 | 198 |
| Humanity: Arts History | 428 | 3 | 167 | 12,304 | 98 |
| Humanity: Choral Music | 28 | 23 | 387 | 2,872 | 23 |
| Humanity: Dance | 481 | 2 | 149 | 12,439 | 100 |
| Humanity: Drama | 322 | 2 | 72 | 6,184 | 49 |
| Humanity: Film Studies | 463 | 4 | 206 | 18,959 | 152 |
| Humanity: Gen Art | 6 | 145 | 1,218 | 2,555 | 20 |
| Humanity: Gen Music | 12 | 134 | 758 | 3,735 | 30 |
| Humanity: Humanities | 368 | 6 | 377 | 23,801 | 190 |
| Humanity: Inst Music | 14 | 41 | 406 | 1,430 | 11 |
| Humanity: Philosophy | 482 | 2 | 136 | 13,441 | 108 |
| Humanity: Photography | 321 | 4 | 232 | 12,140 | 97 |
| Humanity: Studio Art | 246 | 6 | 282 | 12,937 | 103 |
| For Lang: French 1 | 67 | 5 | 162 | 2,250 | 18 |
| For Lang: French 2 | 68 | 4 | 125 | 1,789 | 14 |
| For Lang: French 3 | 111 | 2 | 66 | 1,435 | 11 |
| For Lang: French 4 | 160 | 1 | 33 | 1,024 | 8 |
| For Lang: French 5/6 | 408 | 1 | 32 | 2,226 | 18 |
| For Lang: German 1 | 224 | 3 | 99 | 4,997 | 40 |
| For Lang: German 2 | 227 | 2 | 66 | 3,313 | 27 |
| For Lang: German 3 | 248 | 1 | 56 | 2,283 | 18 |
| For Lang: German 4 | 286 | 1 | 33 | 1,733 | 14 |
| For Lang: German 5/6 | 456 | 1 | 459 | 3,193 | 26 |
| For Lang: Italian 1 | 483 | 2 | 262 | 9,570 | 77 |
| For Lang: Italian 2 | 484 | 1 | 181 | 6,645 | 53 |
| For Lang: Italian 3 | 489 | 1 | 130 | 4,884 | 39 |
| For Lang: Italian 4/5 | 491 | 1 | 103 | 3,896 | 31 |
| For Lang: Latin 1 | 338 | 3 | 153 | 8,269 | 66 |
| For Lang: Latin 2 | 348 | 1 | 80 | 4,452 | 36 |
| For Lang: Latin 3 | 401 | 1 | 44 | 3,012 | 24 |
| For Lang: Latin 4 | 436 | 0 | 27 | 1,964 | 16 |
| For Lang: Russian 1 | 469 | 1 | 40 | 3,243 | 26 |
| For Lang: Russian 2 | 484 | 0 | 28 | 2,379 | 19 |
| For Lang: Russian 3 | 493 | 1 | 39 | 3,424 | 27 |
| For Lang: Russian 4/5 | 496 | 0 | 12 | 1,044 | 8 |
| For Lang: Spanish 1 | 20 | 11 | 164 | 958 | 8 |
| For Lang: Spanish 2 | 24 | 7 | 114 | 883 | 7 |
| For Lang: Spanish 3 | 45 | 3 | 48 | 695 | 6 |
| For Lang: Spanish 4 | 118 | 1 | 50 | 970 | 8 |
| For Lang: Spanish 5/6 | 408 | 1 | 49 | 3,514 | 28 |
| For Lang: Spanish for Sp | 491 | 1 | 125 | 4,688 | 38 |
| Math: Alg 1 | 1 | 71 | 71 | 71 | 1 |
| Math: Alg 2 | 7 | 13 | 303 | 818 | 7 |
| Math: Alg 3 | 320 | 5 | 794 | 18,381 | 147 |
| Math: Analytic Geometry | 373 | 5 | 309 | 18,760 | 150 |
| Math: Calculus | 155 | 3 | 144 | 4,609 | 37 |
| Math: AP Calculus | 324 | 2 | 70 | 4,320 | 35 |
| Math: Comb Calc/Ana Geom | 407 | 3 | 484 | 14,991 | 120 |
| Math: Comb Plane / Solid | 311 | 11 | 712 | 38,241 | 306 |
| Math: Intro to College Ma | 382 | 3 | 192 | 12,346 | 99 |
| Math: Plane Geometry | 160 | 12 | 658 | 17,403 | 139 |
| Math: Prob/Stat | 373 | 2 | 106 | 6,168 | 49 |
| Math: SolidGeometry | 476 | 8 | 492 | 42,286 | 338 |
| Math: Trig | 50 | 7 | 396 | 3,627 | 29 |
| Sci: Biology 1 | 5 | 22 | 296 | 833 | 7 |

[continued on next page]

| Course | # of Districts | Minimum Enrollment in a SD | Maximum Enrollment in a SD | Statewide Enrollment in Course | Statewide Teachers for Course |
|---|---|---|---|---|---|
| Sci: Biology 2 | 139 | 4 | 187 | 4,851 | 39 |
| Sci: Chemistry 1 | 5 | 11 | 99 | 277 | 2 |
| Sci: Chemistry 2 | 203 | 2 | 117 | 4,311 | 34 |
| Sci: Physics 1 | 14 | 6 | 106 | 531 | 4 |
| Sci: Physics 2 | 377 | 1 | 84 | 5,109 | 41 |
| Soc Studies: Anthropology | 441 | 4 | 609 | 20,104 | 161 |
| Soc Studies: Economics | 137 | 17 | 871 | 21,010 | 168 |
| Soc Studies: Geography | 122 | 28 | 1,340 | 29,849 | 239 |
| Soc Studies: Govt/Civics | 43 | 23 | 716 | 9,074 | 73 |
| Soc Studies: Pa History | 270 | 21 | 3,095 | 76,756 | 614 |
| Soc Studies: Psychology | 196 | 7 | 396 | 11,912 | 95 |
| Soc Studies: Sociology | 192 | 6 | 317 | 9,991 | 80 |
| Soc Studies: US History/C | 5 | 162 | 455 | 1,719 | 14 |
| Soc Studies: World Cultur | 10 | 40 | 425 | 2,804 | 22 |
| Total | | | | 772,848 | 6,483 |

Source: Analysis of PDE curriculum files and enrollment projections
Definitions:
[2] number of school districts NOT currently offering the course.
[3] smallest enrollment among districts [2] districts that would offer course.
[4] largest smallest enrollment among districts [2] districts that would offer course.
[5] sum of simulated enrollment across [2] districts
[6] Column [5]/125 or /75 in case of AP courses.

## 6.4 Projected Teacher Demand vs. Historical Teacher Supply

We now turn to compare these projections of teacher demand for the balance of the decade against the sources of supply which we analyzed in Chapter 5. During the 1980's, the number of new teachers trained by Pennsylvania's certifying institutions varied from a low of 5,946 in 1985/6 to a high of 7,327 in 1989/90. We now address the question of how the teacher demand projections by assignment area compare to the historical patterns of teacher production by assignment area and the latent supply of certificated, but non-teaching individuals.

### 6.4.1 Comparison of Projected Teacher Demand to the Number of Education Graduates from Pennsylvania's Certificating Institutions in the 1980's

Table 6.13 carries the quit and demand projection data reported in Table 6.2, and the total count of teachers trained during the period 1981/2 through 1989/90 by Pennsylvania's certificating institutions. During this nine year period, these institutions graduated 25,410 primary school teachers and 26,398 secondary school teachers. Annually, this averaged 6,524 teachers per year. In the aggregate, we project quits of 27,265 and between 21,693 to 53,565 new teachers needed to replace retiring teachers and to respond to student demographics. Under the age 65 retirement assumption, then, there would appear to be an aggregate balance between aggregate demand (48,958 teachers demanded in the balance of the decade, and a projected supply of 53,565.) Under the 30 years of experience retirement assumption, aggregate teacher demand would be 70,310 compared to the historical supply of new teachers of 58,723. And, under the 27 years of experience retirement assumption, aggregate teacher demand would be 80,830 compared to the historical supply of new teachers of 58,723.

Columns [10] through [12] of Table 6.13 show the ratio of these demand projections to the historical supply of teachers by assignment area. It is immediately evident that while there may be an approximate aggregate balance between projected demand and historical supply of teachers under the age 65 retirement assumption, most assignment areas (see column [10]) show ratios of projected demand to supply to be 75% *or greater.* The projected demand for chemistry teachers is 98.7% of the number graduated from Pennsylvania certificating institutions, while the projected number of mathematics teachers is 121% of the historical number of Pennsylvania graduates.

Table 6.13: Hiring Needs based on Historical Quits and Demographic Models of Teacher Retirement and Student Demographics Compared to Number of New Pennsylvania Teaching Graduates, 1981/2-1989/90

| Code | Prim. Assignment | 1990/1 Tch. | Pred. Quits | Pred. $H^a$ | Pred. $H^e$ | Pred. $H^m$ | Tch 1982/9 | Ave Tch | Quits $+H^a$/ Tch | Quits $+H^e$/ Tch | Quits $+H^m$/ Tch |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] |
| 1200 | Agriculture | 188 | 113 | 25 | 43 | 48 | 164 | 18.2 | 84.3% | 95.2% | 98.3% |
| 2300 | Art | 3,058 | 1,105 | 343 | 517 | 572 | 1,468 | 163.1 | 98.6% | 110.5% | 114.2% |
| 8410 | Biology | 1,835 | 481 | 543 | 986 | 1,029 | 1,618 | 179.8 | 63.3% | 90.7% | 93.3% |
| 1600 | Business Ed | 2,443 | 877 | 623 | 869 | 959 | 1,325 | 147.2 | 113.2% | 131.8% | 138.6% |
| 8420 | Chemistry | 935 | 282 | 264 | 373 | 367 | 553 | 61.4 | 98.7% | 118.4% | 117.3% |
| 5200 | Driver Ed | 397 | 60 | 84 | 73 | 63 | na | na | na | na | na |
| 8430 | Earth/Space | 697 | 229 | 125 | 217 | 204 | 330 | 36.7 | 107.3% | 135.2% | 131.3% |
| 3200 | English | 7,157 | 2,124 | 2,323 | 4,419 | 5,393 | 2,571 | 285.7 | 173.0% | 254.5% | 292.4% |
| 4410 | French | 886 | 394 | 233 | 373 | 407 | 332 | 36.9 | 189.0% | 231.1% | 241.4% |
| 2810 | Gen Elem.&Ear.Ch. | 39,554 | 8,267 | 6,344 | 16,646 | 23,279 | 25,410 | 2823.0 | 57.5% | 98.0% | 124.1% |
| 8450 | General Science | 2,227 | 585 | 721 | 1,236 | 1,347 | 428 | 47.6 | 305.0% | 425.4% | 451.3% |
| 4420 | German | 430 | 168 | 119 | 157 | 158 | 136 | 15.1 | 211.1% | 239.1% | 239.8% |
| 9210 | Gifted | 619 | 204 | 56 | 90 | 88 | na | na | na | na | na |
| 4800 | Health/Phys Ed | 5,908 | 1,463 | 1,306 | 2,718 | 3,085 | 3,654 | 406.0 | 75.8% | 114.4% | 124.5% |
| 9200 | Hearing Impaired | 77 | 10 | 28 | 29 | 39 | 336 | 37.3 | 11.3% | 11.6% | 14.6% |
| 5600 | Home Economics | 1,981 | 906 | 619 | 811 | 1,013 | 351 | 39.0 | 434.5% | 489.2% | 546.8% |
| 6000 | Industrial Arts | 2,345 | 641 | 588 | 879 | 984 | 989 | 109.9 | 124.3% | 153.7% | 164.3% |
| 6800 | Mathematics | 6,388 | 1,732 | 1,890 | 4,118 | 4,819 | 2,993 | 332.6 | 121.0% | 195.5% | 218.9% |
| 9230 | Mental/Phys Hand | 6,718 | 2,588 | 1,571 | 1,941 | 2,548 | 6,709 | 745.4 | 62.0% | 67.5% | 76.6% |
| 7200 | Music | 4,254 | 1,686 | 865 | 1,452 | 1,668 | 2,679 | 297.7 | 95.2% | 117.1% | 125.2% |
| 4490 | Other Languages | 229 | 183 | 53 | 53 | 68 | 84 | 9.3 | 281.5% | 281.5% | 299.4% |
| 8490 | Other Science | 45 | 22 | 8 | 13 | 17 | na | na | na | na | na |
| 8470 | Physics | 496 | 73 | 111 | 139 | 147 | 215 | 23.9 | 85.7% | 98.7% | 102.4% |
| 8800 | Social Studies | 6,256 | 2,337 | 2,119 | 3,905 | 4,151 | 3,302 | 366.9 | 135.0% | 189.0% | 196.5% |
| 4430 | Spanish | 1,342 | 299 | 361 | 567 | 652 | 524 | 58.2 | 126.0% | 165.3% | 181.5% |
| 9270 | Speech/Lang Impa | 394 | 151 | 79 | 106 | 135 | 1,480 | 164.4 | 15.5% | 17.3% | 19.3% |
| 9280 | Visually Impaire | 37 | 13 | 10 | 13 | 17 | 213 | 23.7 | 10.9% | 12.3% | 14.2% |
| 2000 | Vocational Ed | 746 | 186 | 246 | 232 | 259 | 859 | 107.4 | 50.3% | 48.6% | 51.8% |
| 2200 | Vocational Health | 36 | 13 | 13 | 6 | 10 | na | na | na | na | na |
| 2100 | Vocational Tech | 123 | 48 | 14 | 25 | 30 | na | na | na | na | na |
| 9900 | Not Listed Elsew | 66 | 23 | 9 | 9 | 9 | na | na | na | na | na |
| | Total Primary | 39,554 | 8,267 | 6,344 | 16,646 | 23,279 | 25,410 | 2,823.0 | 57.5% | 98.0% | 124.1% |
| | Total Secondary | 58,313 | 18,998 | 15,349 | 26,399 | 30,286 | 26,398 | 2,933.1 | 130.1% | 172.0% | 186.7% |
| | Total | 97,867 | 27,265 | 21,693 | 43,045 | 53,565 | 58,723 | 6524.8 | 83.4% | 119.7% | 137.6% |

Source: Analysis of PED files.
Definitions:
[3] 1990/1 inventory of classroom teachers.
[4] Predicted quits based on historical quit rates by primary assignment area during 1982-9 applied to 1990/1 inventory.
[5] $H^a$: replacement hires due to retirements at age 65 and student demographics, 1992-1999
[6] $H^e$: replacement hires due to retirements at 30 years of service and student demographics,1992-1999
[7] $H^m$: replacement hires due to retirements at 27 years of service and student demographics, 1992-1999
[8] Total number of teaching graduates during 1981/2-1989/90 from Pennsylvania certificating institutions.
[10] Demand/Supply, age 65 retirement assumption and student demographics; ([4] + [5]) / [8].
[11] Demand/Supply, 30 years of experience retirement assumption and student demographics; ([4] + [6]) / [8].
[12] Demand/Supply, 27 years of experience retirement assumption and student demographics; ([4] + [7]) / [8].

### 6.4.2 Comparison of Projected Teacher Demand to Latent Supply Analysis: Certificated Non-Teachers

We next compare the projected teacher demand to the other major source of certificated teachers: those certificated individuals who are not currently teaching. Here, we analyze the *future* latent supply of individuals who are certificated, not currently teaching, and who will be under age 65 by the close of the decade.[10] Table 6.14 shows that there will be 251,065 such individuals who might be available. Column [7] of Table 6.14 shows the totals by each assignment area, while Column [8] shows the predicted number of quits expecting during the balance of the decade by assignment area. Recall that 27,263, so the predicted quits which were calculated in Column [4] of Table 6.13 are reproduced in Column [8] of Table 6.14. Columns [10], [12], and [14] show the total predicted number of hires (quits + replacement teachers) based on various retirement assumptions. In each instance, the total number of certificated teachers easily exceeds the total numbers projected.

With the exception of Driver Education, General Science and Gifted, there appear to be sufficient numbers of certificated non-teachers compared to the most pessimistic (i.e. the impact of the

[10]The 1990/1 teacher inventory was merged with the historical PDE certification file, and those under 65 in the year 2000, but not currently teaching were retained for the analysis reported below.

Mellow Bill) scenarios (compare Column [14] with [7]).

On the other hand, to the extent that districts seek to hire teachers from particular types of training institutions, there may be difficulties. For example, if the positive correlation of .36 reported in Chapter 5 between the percentage high school graduates and the percentage of teachers in a district from private colleges and universities is indicative of quality differentials among the latent supply of teachers, [11] it may encourage districts to hire teachers trained from such private colleges and universities. They might wish to do this in order to improve the odds of their high school graduates going on to post-secondary education. While the analysis of the latent supply of those from private colleges and universities indicates there will be a latent supply of 58,312 potential teachers in 2000, this is less than those needed under the 30 or 27 years of experience scenarios (compare 48,954 or 80,828 with 58,312). While the total needed of 48,954 under the age 65 retirement assumption is less than this latent supply of 58,312, it is evident, upon inspection of Table 6.14 that there are many assignment areas where "shortages" will appear. Although there are 25,002 general elementary school teachers in the latent supply from private colleges and universities, and needs of 14,611 under the age 65 retirement scenario, or an excess "supply" of about 10,000, most of the other assignment areas display excess demand.

[11] Contrast this positive relationship with the inverse relationship of -.45 found between post-secondary school attendance and the percentage of teachers from public universities.

Table 6.14: Comparison of Certificated Non-Teachers by Source to Hiring Needs in School Year 2000

| Assign | State Univ | StRl Univ | PvStRel Univ | Priv Univ | NonPa Univ | Total Non-Tch | Pred Quits | $H^a$ | Quits+ $H^a$ | $H^e$ | Quits+ $H^e$ | $H^m$ | Quits+ $H^m$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] | [14] |
| Agriculture | 5 | 481 | 0 | 5 | 100 | 591 | 113 | 25 | 138 | 43 | 156 | 48 | 161 |
| Art | 3,424 | 1,545 | 372 | 1,375 | 1,668 | 8,384 | 1,105 | 343 | 1,448 | 517 | 1,622 | 572 | 1,677 |
| Biology | 2,472 | 774 | 112 | 1,977 | 1,533 | 6,868 | 481 | 543 | 1,024 | 986 | 1,467 | 1,029 | 1,510 |
| Business Educat | 2,038 | 704 | 52 | 1,093 | 1,170 | 5,057 | 877 | 623 | 1,500 | 869 | 1,746 | 959 | 1,836 |
| Chemistry | 498 | 309 | 36 | 525 | 348 | 1,716 | 282 | 264 | 546 | 373 | 655 | 367 | 649 |
| Driver Education | 61 | 7 | 0 | 4 | 33 | 105 | 60 | 84 | 144 | 73 | 133 | 63 | 123 |
| Earth/Space | 704 | 128 | 1 | 60 | 86 | 979 | 229 | 125 | 354 | 217 | 446 | 204 | 433 |
| English | 6,099 | 3,189 | 417 | 6,931 | 5,730 | 22,366 | 2,124 | 2,323 | 4,447 | 4419 | 6,543 | 5,393 | 7,517 |
| French | 932 | 523 | 80 | 1,378 | 879 | 3,792 | 394 | 233 | 627 | 373 | 767 | 407 | 801 |
| General Elementa | 40,253 | 14,195 | 953 | 25,002 | 21,994 | 102,397 | 8,267 | 6,344 | 14,611 | 16646 | 24,913 | 23,279 | 31,546 |
| General Science | 293 | 178 | 21 | 267 | 495 | 1,254 | 585 | 721 | 1,306 | 1236 | 1,821 | 1,347 | 1,932 |
| German | 456 | 159 | 15 | 422 | 270 | 1,322 | 168 | 119 | 287 | 157 | 325 | 158 | 326 |
| Gifted | 0 | 0 | 0 | 0 | 2 | 2 | 204 | 56 | 260 | 90 | 294 | 88 | 292 |
| Health/Phys Educ | 10,352 | 2,354 | 8 | 428 | 3,698 | 16,840 | 1,463 | 1,306 | 2,769 | 2718 | 4,181 | 3,085 | 4,548 |
| Hearing Impaired | 93 | 408 | 0 | 14 | 394 | 909 | 10 | 26 | 36 | 29 | 39 | 39 | 49 |
| Home Economics | 1,947 | 645 | 282 | 1,128 | 1,342 | 5,344 | 906 | 619 | 1,525 | 811 | 1,717 | 1,013 | 1,919 |
| Industrial Arts | 2,386 | 325 | 2 | 13 | 420 | 3,146 | 641 | 588 | 1,229 | 879 | 1,520 | 984 | 1,625 |
| Mathematics | 4,436 | 1,503 | 176 | 3,155 | 2,479 | 11,749 | 1,732 | 1,890 | 3,622 | 4118 | 5,850 | 4,819 | 6,551 |
| Mental/Phys Hand | 5,175 | 1,505 | 18 | 1,450 | 2,501 | 10,649 | 2,588 | 1,571 | 4,159 | 1941 | 4,529 | 2,548 | 5,136 |
| Music | 3,417 | 977 | 190 | 3,720 | 2,055 | 10,359 | 1,686 | 865 | 2,551 | 1452 | 3,138 | 1,668 | 3,354 |
| Not Listed Elsew | 47 | 9 | 3 | 20 | 92 | 171 | 23 | 9 | 32 | 0 | 23 | 9 | 32 |
| Other Languages | 99 | 69 | 25 | 261 | 185 | 639 | 183 | 53 | 236 | 53 | 236 | 68 | 251 |
| Other Science | 39 | 19 | 3 | 27 | 52 | 140 | 22 | 8 | 30 | 13 | 35 | 17 | 39 |
| Physics | 367 | 147 | 28 | 278 | 190 | 1,010 | 73 | 111 | 184 | 139 | 212 | 147 | 220 |
| Social Studies | 8,760 | 2,747 | 412 | 6,977 | 4,390 | 23,286 | 2,337 | 2,119 | 4,456 | 3905 | 6,242 | 4,151 | 6,488 |
| Spanish | 1,200 | 531 | 47 | 1,253 | 809 | 3,840 | 299 | 361 | 660 | 567 | 866 | 652 | 951 |
| Speech/Lang Impa | 3,060 | 941 | 2 | 299 | 1,146 | 5,448 | 151 | 79 | 230 | 106 | 257 | 135 | 286 |
| Visually Impaire | 38 | 82 | 1 | 3 | 40 | 164 | 13 | 10 | 23 | 13 | 26 | 17 | 30 |
| Vocational Educa | 332 | 1,078 | 4 | 239 | 625 | 2,278 | 186 | 246 | 432 | 232 | 418 | 259 | 445 |
| Vocational Healt | 10 | 52 | 1 | 3 | 42 | 108 | 13 | 13 | 26 | 6 | 19 | 10 | 23 |
| Vocational Tech | 4 | 73 | 0 | 5 | 70 | 152 | 48 | 14 | 62 | 25 | 73 | 30 | 78 |
| Total | 98,997 | 35,657 | 3,261 | 58,312 | 54,838 | 251,065 | 27,263 | 21,691 | 48,954 | 43,006 | 70,269 | 53,565 | 80,828 |

Source: Analysis of PDE certification file and demographic simulation model.
Definitions:
[2]: Certificated non-teachers under age 65 in 2000 from (14) public universities
[3]: Certificated non-teachers under age 65 in 2000 from state-related public pniversities
[4]: Certificated non-teachers under age 65 in 2000 from private state-related universities
[5]: Certificated non-teachers under age 65 in 2000 from Pa. private colleges and universities
[6]: Certificated non-teachers under age 65 in 2000 from Non-Pa. colleges and universities
[7]: Total certificated non-teachers under age 65 in 2000; [2]+[3]+[4]+[5]+[6]
[8]: Predicted quits other than retirement based on 1982-9 quit rates by assignment area
[9]: Predicted hires through 2000 under age 65 retirement assumption and student demographics
[10]:Total predicted hires through 2000 under age 65 retirement assumption and student demographics
[11]:Predicted hires through 2000 under 30 years experience retirement assumption and student demographics
[12]:Total predicted hires through 2000 under 30 years exp. retirement assumption and student demographics
[13]:Predicted hires through 2000 under 27 years experience retirement assumption and student demographics
[14]:Total predicted hires through 2000 under 27 years exp. retirement assumption and student demographics

The balance between these measures of latent supply and various projections of demand is shown more directly in Table 6.15 which takes the ratios of various supply measures to various demand projections. Ratios greater than 1 indicate latent supply greater than projected demand, while ratios less than 1 indicate latent supply less than projected demand. Column [2] indicates that the situation of excess supply would appear to be pervasive—the inventory of General Elementary School teachers is predicted to be 7.0 times that of projected total demand under the age 65 retirement assumption (including predicted quits). The latent supply of teachers from public state related universities, which exhibited a modest positive +.15 correlation in Chapter 5 with the fraction of high school graduates who desire to go on to some form of post-secondary education, like the latent supply from private colleges and universities, are generally insufficient to meet the various measures of projected demand. However, between these two sources, there would generally appear to be sufficient numbers of teachers.

The ratio analysis can also be viewed as an indicator of the difficulty which districts may face when recruiting. Assignment areas with large ratios of latent supply to demand should permit districts to be generally more selective, and also allow them to overcome the problems of adverse geographical distribution of potential teachers vs. job opportunities.[12]

[12]Unfortunately, the PDE certification file does not keep track of the current location of those who are certified but

Table 6.15: Ratio of Latent Supply of Certificated Non-Teachers by Source to Hiring Needs in School Year 2000

| | Total Lat.S/ Tot$H^a$ | Total Lat.S/ Tot$H^e$ | Total Lat.S/ Tot$H^m$ | Pub U Lat.S/ Tot$H^a$ | Pub U Lat.S/ Tot$H^e$ | Pub U Lat.S/ Tot$H^m$ | Pub St Lat.S/ Tot$H^a$ | Pub St Lat.S/ Tot$H^e$ | Pub St Lat.S/ Tot$H^m$ | Priv Lat.S/ Tot$H^a$ | Priv Lat.S/ Tot$H^e$ | Priv Lat.S/ Tot$H^m$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Agriculture | 4.283 | 0.641 | 0.621 | 0.036 | 0.032 | 0.031 | 3.486 | 3.083 | 2.988 | 0.036 | 0.032 | 0.031 |
| Art | 5.790 | 1.028 | 0.995 | 2.365 | 2.111 | 2.042 | 1.067 | 0.953 | 0.921 | 0.950 | 0.848 | 0.820 |
| Biology | 6.707 | 1.045 | 1.015 | 2.414 | 1.685 | 1.637 | 0.756 | 0.528 | 0.513 | 1.931 | 1.348 | 1.309 |
| Business Educati | 3.371 | 0.670 | 0.637 | 1.359 | 1.167 | 1.110 | 0.469 | 0.403 | 0.383 | 0.729 | 0.626 | 0.595 |
| Chemistry | 3.143 | 0.531 | 0.536 | 0.912 | 0.760 | 0.767 | 0.566 | 0.472 | 0.476 | 0.962 | 0.802 | 0.809 |
| Driver Education | 0.729 | 0.248 | 0.268 | 0.424 | 0.459 | 0.496 | 0.049 | 0.053 | 0.057 | 0.028 | 0.030 | 0.033 |
| Earth/Space | 2.766 | 0.193 | 0.199 | 1.989 | 1.578 | 1.626 | 0.362 | 0.287 | 0.296 | 0.169 | 0.135 | 0.139 |
| English | 5.029 | 0.876 | 0.762 | 1.371 | 0.932 | 0.811 | 0.717 | 0.487 | 0.424 | 1.559 | 1.059 | 0.922 |
| French | 6.048 | 1.146 | 1.097 | 1.486 | 1.215 | 1.164 | 0.834 | 0.682 | 0.653 | 2.198 | 1.797 | 1.720 |
| General Elementa | 7.008 | 0.883 | 0.697 | 2.755 | 1.616 | 1.276 | 0.972 | 0.570 | 0.450 | 1.711 | 1.004 | 0.793 |
| General Science | 0.960 | 0.272 | 0.256 | 0.224 | 0.161 | 0.152 | 0.136 | 0.098 | 0.092 | 0.204 | 0.147 | 0.138 |
| German | 4.606 | 0.831 | 0.828 | 1.589 | 1.403 | 1.399 | 0.554 | 0.489 | 0.488 | 1.470 | 1.298 | 1.294 |
| Gifted | 0.008 | 0.007 | 0.007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Health/Phys Educ | 6.082 | 0.884 | 0.813 | 3.739 | 2.476 | 2.276 | 0.850 | 0.563 | 0.518 | 0.155 | 0.102 | 0.094 |
| Hearing Impaired | 25.250 | 10.103 | 8.041 | 2.583 | 2.385 | 1.898 | 11.333 | 10.462 | 8.327 | 0.389 | 0.359 | 0.286 |
| Home Economics | 3.504 | 0.782 | 0.699 | 1.277 | 1.134 | 1.015 | 0.423 | 0.376 | 0.336 | 0.740 | 0.657 | 0.588 |
| Industrial Arts | 2.560 | 0.276 | 0.258 | 1.941 | 1.570 | 1.468 | 0.264 | 0.214 | 0.200 | 0.011 | 0.009 | 0.008 |
| Mathematics | 3.244 | 0.424 | 0.378 | 1.225 | 0.758 | 0.677 | 0.415 | 0.257 | 0.229 | 0.871 | 0.539 | 0.482 |
| Mental/Phys Hand | 2.560 | 0.552 | 0.487 | 1.244 | 1.143 | 1.008 | 0.362 | 0.332 | 0.293 | 0.349 | 0.320 | 0.282 |
| Music | 4.061 | 0.655 | 0.613 | 1.339 | 1.089 | 1.019 | 0.383 | 0.311 | 0.291 | 1.458 | 1.185 | 1.109 |
| Not Listed Elsew | 5.344 | 4.000 | 2.875 | 1.469 | 2.043 | 1.469 | 0.281 | 0.391 | 0.281 | 0.625 | 0.870 | 0.625 |
| Other Languages | 2.708 | 0.784 | 0.737 | 0.419 | 0.419 | 0.394 | 0.292 | 0.292 | 0.275 | 1.106 | 1.106 | 1.040 |
| Other Science | 4.667 | 1.486 | 1.333 | 1.300 | 1.114 | 1.000 | 0.633 | 0.543 | 0.487 | 0.900 | 0.771 | 0.692 |
| Physics | 5.489 | 0.896 | 0.864 | 1.995 | 1.731 | 1.668 | 0.799 | 0.693 | 0.668 | 1.511 | 1.311 | 1.264 |
| Social Studies | 5.226 | 0.703 | 0.677 | 1.966 | 1.403 | 1.350 | 0.616 | 0.440 | 0.423 | 1.566 | 1.118 | 1.075 |
| Spanish | 5.818 | 0.934 | 0.851 | 1.818 | 1.386 | 1.262 | 0.805 | 0.613 | 0.558 | 1.898 | 1.447 | 1.318 |
| Speech/Lang Impa | 23.687 | 4.459 | 4.007 | 13.304 | 11.907 | 10.699 | 4.091 | 3.661 | 3.290 | 1.300 | 1.163 | 1.045 |
| Visually Impaire | 7.130 | 1.538 | 1.333 | 1.652 | 1.462 | 1.267 | 3.565 | 3.154 | 2.733 | 0.130 | 0.115 | 0.100 |
| Vocational Educa | 5.273 | 1.495 | 1.404 | 0.769 | 0.794 | 0.746 | 2.495 | 2.579 | 2.422 | 0.553 | 0.572 | 0.537 |
| Vocational Healt | 4.154 | 2.211 | 1.826 | 0.385 | 0.526 | 0.435 | 2.000 | 2.737 | 2.261 | 0.115 | 0.158 | 0.130 |
| Vocational Tech | 2.452 | 0.959 | 0.897 | 0.065 | 0.055 | 0.051 | 1.177 | 1.000 | 0.936 | 0.081 | 0.068 | 0.064 |
| Total | 5.129 | 0.780 | 0.678 | 2.022 | 1.409 | 1.225 | 0.728 | 0.507 | 0.441 | 1.191 | 0.830 | 0.721 |

Source: Analysis of Pennsylvania Department of Education certification file and demographic simulation model.
Definitions:
[2]: Total certificated non-teachers under age 65 in 2000 / predicted quits + $Hire^a$
[3]: Total certificated non-teachers under age 65 in 2000 / predicted quits + $Hire^e$
[4]: Total certificated non-teachers under age 65 in 2000 / predicted quits + $Hire^m$
[5]: Certificated non-teachers from public universities under age 65 in 2000 / predicted quits + $Hire^a$
[6]: Certificated non-teachers from public universities under age 65 in 2000 / predicted quits + $Hire^e$
[7]: Certificated non-teachers from public universities under age 65 in 2000 / predicted quits + $Hire^m$
[8]: Certificated non-teachers from public state related universities under age 65 in 2000 / predicted quits + $Hire^a$
[9]: Certificated non-teachers from public state related universities under age 65 in 2000 / predicted quits + $Hire^e$
[10]: Certificated non-teachers from public state related universities under age 65 in 2000 / predicted quits + $Hire^m$
[11]: Certificated non-teachers from Pa. private colleges and universities under age 65 in 2000 / predicted quits + $Hire^a$
[12]: Certificated non-teachers from Pa. private colleges and universities under age 65 in 2000 / predicted quits + $Hire^e$
[13]: Certificated non-teachers from Pa. private colleges and universities under age 65 in 2000 / predicted quits + $Hire^m$

## 6.5 Summary

We have explored in this chapter the implications of several different assumptions about Pennsylvania's classroom teachers' retirement and quit decisions in conjunction with projected student enrollments through the balance of the decade. The demographic models and the analysis above suggest that Pennsylvania's school districts will be doing relatively more hiring during the rest of this decade than they did in the previous decade. This is likely to occur for several reasons. First, total student enrollments will grow, and secondary school enrollments will grow differentially faster than primary school enrollments. Second, secondary teachers are somewhat older than primary school teachers, so these two effects will combine to increase replacement hiring needs. Under the age 65 retirement assumption, 55% of the replacement teachers needed will be due to enrollment growth, and 45% will be due solely to teacher retirements. Under the assumption that teachers

not teaching. To ascertain an individual's actual location, it would be necessary to match their social security number with other administrative records. To the extent that such individuals remain in Pennsylvania, the unemployment insurance and individual income tax systems would potentially permit more effective identification of the geo-location of such individuals; however, agencies beyond the Department of Education would need to do such analysis because of confidentiality considerations.

retire with 30 years experience, then 75% of the hires will be driven by teacher retirements rather than enrollment growth.

Between 22,000 and 53,500 teachers will be sought in the balance of the decade under varying assumptions about the retirement decision and with student demographic projections. To this figure, one can reasonably add projected voluntary quits of about 25,000 to 27,000. By the close of the decade, Pennsylvania's public school districts may turn over between 48% to 80% of their current inventory of teachers. Were school districts to move their curricula to "best practice" curricula, then as many as 6,500 additional teachers would need to be hired to staff the new sections of Advanced Placement courses and other academic courses.

While there is likely to be significantly more hiring done in the remainder of this decade than in the previous decade, when one compares these projections of teacher demand to the likely sources of teacher supply—newly trained teachers and the inventory of certificated individuals who are not teaching– it is difficult to conclude there will be teacher shortages in the sense that districts will be unable to find certificated teachers. While particular assignment areas, when contrasted to the numbers of new education school graduates in the 1980's, show very high ratios of projected teacher demand to new supply, we also know that there are literally tens of thousands of individuals who are not currently teaching but have the requisite teacher certifications. [13]

The personnel problems which districts will experience in locating replacement teachers to meet the projected demand will most likely involve problems of information matching, likely problems of selection and quality. and problems of new hire financing.

As noted in Chapter 5, there is evidence that teaching graduates from Pennsylvania's private colleges and universities are more frequently employed than their counterparts from the public university system. Also, there is evidence that districts which have higher percentages of their teacher inventory from such private colleges and universities also find that their high school graduates wish to go on to post-secondary educational pursuits, while districts which have higher percentages of their teacher inventory from the public university system find that their high school graduates are less likely to desire to go on to post-secondary education. To the extent that school districts seek to differentiate among various certificated individuals when making the employment decision, they may find that there are fewer certificated individuals from private colleges and universities than they wish to employ.

While these generalizations hold at the state level, they vary considerably by Metropolitan Statistical Area. Generally, MSA's which are experiencing population and enrollment growth will find that they will be doing much more hiring than areas which are losing population and experiencing enrollment declines. Also, there are significant differences in hiring needs by type of teacher assignment and certification across the Commonwealth.

[13] It should also be recalled that in the period 1980-1990, the Pennsylvania Department of Education issued 149,630 teaching certifications (see Table 5.2). This figure includes certificates granted to those who were educated in non-Pennsylvania institutions as well as individuals who earned teaching certificates but did not necessarily obtain bachelor or masters degrees in education from schools of education.

# Chapter 7

# Aggregate Models of Teacher Supply and the Retirement and Quit Decisions

## 7.1 Introduction

We explore in this chapter a number of related supply and demand issues. First, we statistically examine the long-run, aggregate supply curve of new teachers from Pennsylvania's certificating institutions; second, we explore the individual decision to retire or voluntarily quit teaching in a district. These behavioral modeling efforts complement the demographic teacher demand projections and historical data on quits vs. hires contained in Chapter 6. There, the projected hiring problem was contrasted against each district's hiring and quit experiences during the 1980's.

Here, we construct several econometric models of the decision to pursue a teaching career based on economic considerations, and models of the decision to either work, retire, or voluntarily withdraw from a district's employed labor force. These models, in conjunction with alternative assumptions about the future average level of teaching salaries in Pennsylvania, the relationship of such salaries to the overall level of state income, and the structure of teaching salaries in each district, allow a further, and perhaps more realistic, appraisal of whether or not there will be sufficient teachers through the balance of the decade to meet districts' hiring needs.

## 7.2 The Aggregate, Long-Run Supply of Pennsylvania Trained Teachers

### 7.2.1 Econometric Estimates of the Supply of Pennsylvania Trained Teachers

As school districts address the hiring problem that will result from the significant teacher and student demographic changes documented in Chapter 6, the question arises whether the supply of newly trained teachers will respond to changing employment opportunities. Above, various sources of latent teacher supplies, certificated non-teachers, and retirees, have been compared to predicted hiring needs, and possible problem areas identified in terms of particular areas of certification, and the type of institution from which districts may differentially recruit. There remains the important question of the behavioral responses by college sophomores in making their career decisions in the years to come, and how these decisions may relate to predicted teacher needs for the balance of the

decade.

The earlier review of the number of new teachers trained during the period 1965-1989 indicated that there have been extremely large variations in the numbers of teachers graduating from Pennsylvania's certificating institutions: from a high of 19,453 in 1971/2 to a low of 5,987 in 1983/4, or a peak-to-trough-ratio of 3.25. Over the same period, the national peak-to-trough ratio was 2.48 (1971/2 and 1984/5, respectively).[1]

In this section, we seek first to model the aggregate supply of new teachers from Pennsylvania teacher preparation institutions, and then to make projections of newly trained teachers which can be compared to the numbers predicted to be hired from the demographic models.

The national [2] and state specific literature [3] on teacher supply suggests that the decision to choose a career in education is based on the expected wage rate in education, the wages that might be obtained in alternative occupations, and the projected demand for one's services over time. These formulations typically follow the human capital formulation of the educational decision problem.

Some authors have also attempted to take into account the effect of draft deferments available to those pursuing a teaching degree during the Vietnam War. Most have found that the real and relative wage effects impact students' sophomore year when they decide in what field they will major. Zarkin(1985) found that expected *future* enrollments, which he takes to proxy for future demand for teachers, are also significant in affecting the number who graduate with teaching degrees.

The manner in which individuals' expectations about these economic considerations are formed is a complex issue, and often limited by data availability. Some have assumed that individuals have perfect foresight, others have assumed that they form future expectations based on recent evidence at hand. Many presume that the results of the process, graduates at a point in time, reflect decisions made earlier (e.g. in one's sophomore year) based on various forecasts of the future. Few studies have available actual elicitations from college students about the nature and way in which such expectations are formed.

We shall proceed parsimoniously, and operationalize these economic considerations which effect the choices of college students for the estimation of the long-run supply curve of Pennsylvania trained teachers as follows:

- *teachers trained*: primary school teachers, $P$, and secondary school teachers, $S$, graduated from Pennsylvania's certificating institutions each year,$t$;
- *the real wage rate*: the average teaching salary for Pennsylvania teachers in 1960 dollars, using the national Consumer Price Index as the relevant cost of living deflator; [4]
- *alternative wage rate*: ratio of average teaching salary for Pennsylvania teachers to Pennsylvania per capita personal income; [5]
- *Vietnam Draft*: three year moving average of number of draftees in Pennsylvania; [6]
- *enrollment*: total, primary, or secondary public school students in Pennsylvania; [7]

[1] See Table 2, Association for School, College, and University Staffing, *ASCUS Research Report*, "Teacher Supply and Demand in the United States: A Look Ahead," July, 1992.

[2] See Zarkin(1985), Carnegie Forum on Education and the Economy(1986), Manski(1987), Guilford and Tenenbaum(1990), Murnane et al.(1991), Boe and Guilford (1992), and Hanushek and Pace(1993) for a more complete discussion of the various approaches to modeling the occupational choice decision by those who elect teaching.

[3] See Coelen(1992) for a series of autoregressive models of teacher supply for various New England states.

[4] Data provided by the Pennsylvania State Education Association

[5] Data provided by BEA

[6] Data provided by the Office of Intergovernmental Relations, US Department of Defense

[7] Data provided by the Pennsylvania Department of Education

Several points should be made about the absolute and relative wage measures. First, average starting teacher salaries for Pennsylvania were not available over a sufficiently long time period to perform the regression analysis. Second, the average teacher salary may be more relevant in affecting the occupational choice decision of teaching versus other occupations, because it can be readily viewed as the long-run, expected wage. Thus, it is more important in making an occupational choice decision, than merely the starting salary. Third, wage data of young, college graduates were also unavailable over a sufficiently long time period for the construction of counterfactual occupational wage opportunities. To the extent that the overall, *relative* Pennsylvania distribution of income is constant through time, per capita income can be viewed as a reasonable counterfactual which is monotonic to the other educational investment choices available besides teaching.

The construction of the time paths of each of the variables requires some further elaboration. The multiple regression equations reported below were estimated with $P_t$, and $S_t$ the respective dependent variables.

Following Zarkin(1985), the real wage, $W$, and the relative wage, $RelW$, are lagged two years. This form suggests that economic considerations are weighed during students' sophomore year, and are manifested with subsequent graduation. The moving average of Pennsylvania Vietnam draftees is lagged three periods based on best-fit experiments. A longer lag for the effect of the draft is consistent with individuals initially enrolling in higher education to avoid the draft, and choosing an education major in their sophomore year because subsequent public school teaching also provided a draft deferment.

Each year, the Pennsylvania Department of Education publishes its projections of total, primary, and secondary enrollment for the next five years. These figures are publicly discussed and readily available. It seems reasonable to surmise that college students are aware of these projections, and construe them to be surrogates for the future demand for their services were they to become teachers. Various measures of expected enrollment were constructed and used to capture this effect in the statistical estimation process. Generally, current enrollment proved the most successful in the sense that the adjusted $R^2$ was highest. One can interpret current enrollment as being a two year forecast of future demand by college sophomores in making their decision about in what they should major. In the primary teacher model, future primary school enrollment, defined as $[Enroll_t + Enroll_{t+1} + Enroll_{t+2}]/3$ was the most successful regressor.

We expect that all regressors will be positively related to the number of new graduating teachers each year. Table 7.1 displays the teacher supply functions. Both models explain better than 95% of the variation in the number of new teaching graduates during the period 1965-89. It is evident that the Vietnam draft had a significant effect on the numbers of primary, and secondary teachers graduated during this period. The t-statistics of the draftee measure are all over 6.0. The elasticities of teachers with respect to the draft are rather small; however, it should be recalled that the draft was only in effect during the period 1965-72, and as measured by the lagged, moving average of draftees for the period 1966-77. Thus, the draftee variable was nonzero between 8/25 to 12/25 of the sample period. One could thus double (or triple) the estimated teacher-draftee elasticities if one wanted to interpret them as conditional on the existence of a draft.

Table 7.1: Pennsylvania New Teacher Supply Functions: Primary and Secondary Teachers

| | $B_0$ | *Pa.Vietnam Draftees*$_{-3}$ | *Real Wage*$_{-2}$ | *Alternative Wage*$_{-2}$ | *Student Enrollment*$_t$ | *Adjusted* $R^2$ | *Durbin–Watson* | $\hat{\rho}$ |
|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] |
| Primary Teachers | -7,460.4 (-2.70) | 0.2640 (6.30) | 1.1860 (3.88) | 1,238.2 (.92) | -0.0002 (-.08) | .9518 | 1.3690 | 0.6279 |
| Elasticity | | +.2599 | +1.8029 | +.5917 | +.04573 | | | |
| Secondary Teachers | -14634 (-7.00) | .16185 (6.72) | .34568 (1.81) | 6367.8 (6.70) | .0050288 (4.27) | .9844 | 1.9993 | 0.13798 |
| Elasticity | | +.1022 | +.3369 | +1.9513 | +.7034 | | | |

Note: t-ratio in parentheses. Regression results based on Cochran-Orcutt corrections for autocorrelation.
Source: analysis of PDE statistics, 1965-89
Definitions:
[2]: $\frac{1}{3}\sum_{t=-3}^{-5} Draftees_t$
[6] Secondary enrollment is total enrollment at time t;
Enrollment for primary regression, $P$, formed as:
$\frac{1}{3}\Sigma[P_t + P_{t+1} + P_{t+2}]$
Elasticity is calculated at the means.

We find that the numbers of primary school teachers is more responsive to the level of the real, average teaching salary (note the supply elasticity of +1.8) than are the numbers of secondary school teachers (note the supply elasticity of +.33). On the other hand, the supply of secondary school teachers is far more responsive to relative wage differentials (average teaching salaries vis a vis per capita income) than is the supply of primary school teachers. The supply of secondary school teachers shows a supply elasticity with respect to the relative wage of +1.95, while the supply elasticity of primary school teachers shows an elasticity with respect to the relative wage of 1/3 that figure, although it is not statistically significant at any reasonable confidence level. Finally, note that the student enrollment variable, which we interpret to reflect projected demand for teachers, is not significant for the primary school supply equation, but is for the supply of secondary school teachers, with an elasticity of +.7.[8]

The differences in supply responses to absolute and relative salaries may reflect differences in alternative (e.g. non-teaching) employment opportunities for women, who dominated primary school preparation and employment during the period in question, and employment opportunities for men (who are generally about 45% of those prepared and hired among secondary school teachers) and are presumed to have greater occupational choices.

Estimates of the same equations without a variable that reflects the Vietnam war years did not yield the same pattern of real and relative wage effects. Table 7.2 reports the same model as in Table 7.1 without a draft variable; note that the adjusted $R^2$s are lower in both cases, and that the significance levels drop substantially for the real wage and alternative wage regressors.

[8]These elasticity findings are broadly consistent with Manski(1987) and Zarkin(1985).

Table 7.2: Pennsylvania New Teacher Supply Functions without Vietnam Draft: Primary and Secondary Teachers

| | $B_0$ | *Real* $Wage_{-2}$ | *Alternative* $Wage_{-2}$ | *Student* $Enrollment_t$ | *Adjusted* $R^2$ | *Durbin–Watson* | $\hat{\rho}$ |
|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| Primary Teachers | -16299 (-3.75) | .6214 (1.00) | 3,004.5 (1.36) | .010569 (2.68) | .8424 | .8884 | 0.888 |
| Elasticity | | +2.1703 | +1.4131 | +1.4062 | | | |
| Secondary Teachers | -14751 (-3.13) | .7261 (1.08) | 3876.1 (1.55) | .007808 (2.83) | .9502 | 1.6904 | 0.1548 |
| Elasticity | | +.9865 | +1.2914 | +1.469 | | | |

Note: t-ratio in parentheses.
Regression results for Secondary based on Cochrane-Orcutt corrections for autocorrelation
Regression results for Primary based on Prais-Winsten corrections for autocorrelation
Source: Analysis of PDE statistics, 1965-89
Definitions:
[6] Enrollment for primary is total enrollment at time t;
Enrollment, $S$, formed as: $\frac{1}{3}\Sigma[S_t + S_{t+1} + S_{t+2}]$

### 7.2.2 Projections of the Supply of Pennsylvania Teachers through 2000

With these long-run supply functions, we may, with assumptions about the future pattern of salaries, per capita income and enrollments, make projections for the number of future primary and secondary teachers. We entertain three alternative assumptions about the future course of teachers' salaries:

1. *Optimistic Assumption*: real, average salaries continue to grow as they have during the ten year period, 1981/2-1990/1, or 2.78% per year; relative salaries will continue to be 1.9 times the average per capita income in Pennsylvania; enrollment of students will follow the predictions of the Pennsylvania Department of Education, as reflected in Table 5.29;
2. *Pessimistic Assumption*: 1.0% growth rate/year in real, average salaries; all other assumptions the same as in Optimistic scenario;
3. *Very Pessimistic Assumption*: 0% growth rate/year in real, average salaries; all other assumptions the same as in Optimistic scenario; this implies that only predicted enrollment will lead to greater numbers of teachers.

Figures 7.1,7.2 and 7.3 display the results of these assumptions as well as the historical pattern of teachers across the estimation period of 1965-1989. One can see that continued real wage growth (2.78%/year) will create by the close of this decade a 50% increase (from 4,000 to 6,800 teachers/year) in the annual number of primary school teaching graduates, but a smaller growth in the annual numbers of secondary school teaching graduates (from 3,300 to 4,600). Since starting teaching salaries, and salaries during one's teaching career are independent of the level or certification a teacher has under virtually all collective bargaining agreements in Pennsylvania, it is clear that a simple policy of raising average teacher salaries or starting salaries will not ensure that the teachers educated will be matched to the differential needs identified in Chapter 6.

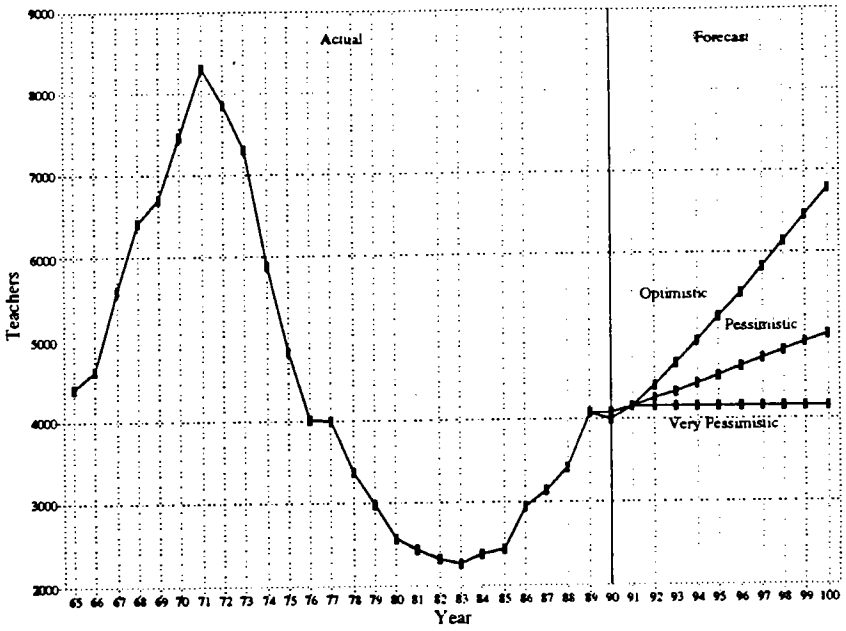



**Figure 7.1: Actual and Forecasted Supply of Pennsylvania Trained Primary Teachers 1965-2000**

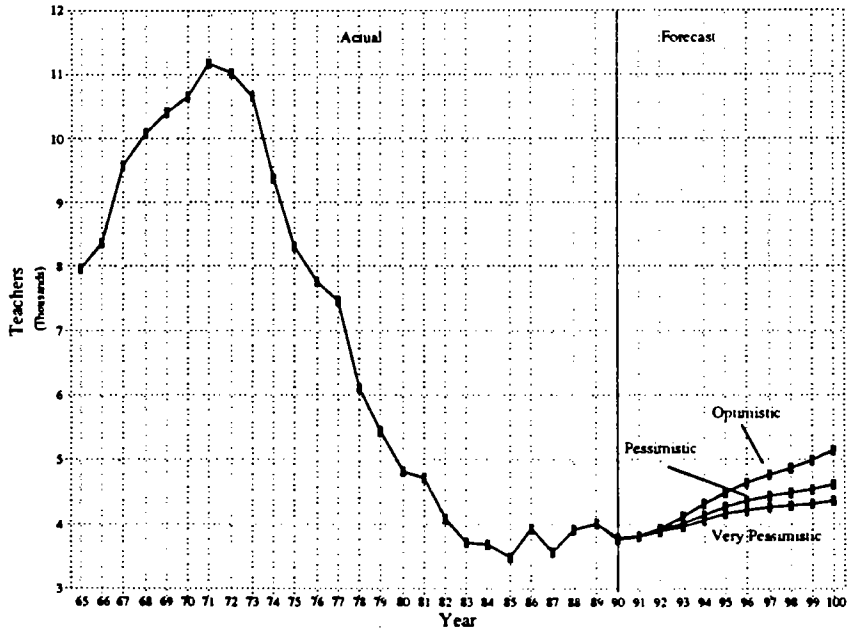



**Figure 7.2: Actual and Forecasted Supply of Pennsylvania Trained Secondary Teachers 1965-2000**

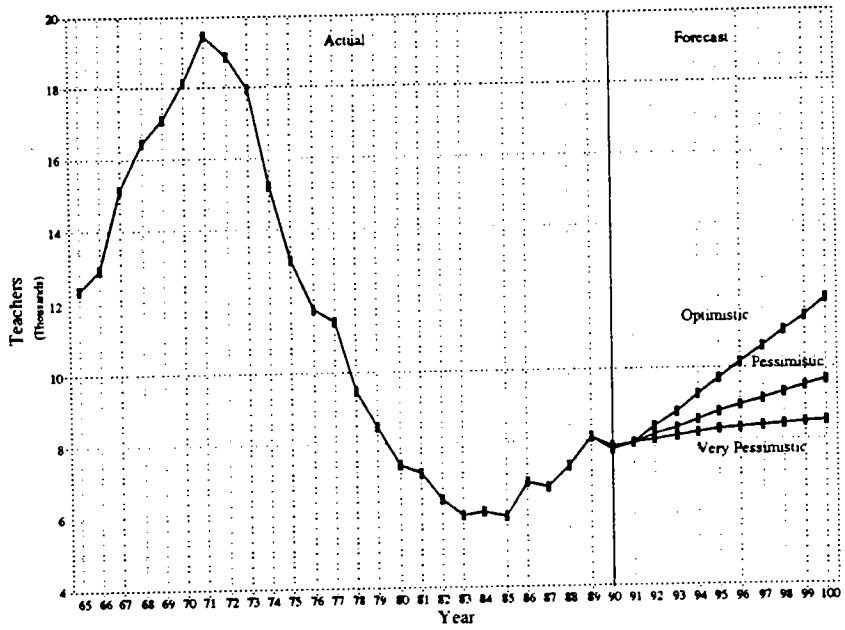



Figure 7.3: Actual and Forecasted Total Supply of Pennsylvania Trained Teachers 1965-2000

### 7.2.3 Long-Run Supply and Long-Run Demand through 2000

Table 7.3 juxtaposes the cumulative teacher supply forecasts against the three teacher demand forecasts developed in Chapter 6. By "optimistic" teacher demand, we mean the numbers of teachers needed to maintain current student teacher ratios in the future under the assumption of retirement at age 65 and taking into account future student demographics; recall that we denoted this by $H_a$. By "pessimistic", we mean the numbers of teachers needed to maintain current student-teacher ratios under the assumption of retirement with 30 years of experience and taking into account future student demographics,$H^e$; by "very pessimistic", we mean the numbers of teachers needed to maintain current student-teacher ratios under the assumption of retirement with 27 years of experience and taking into account student demographics,$H^m$. In each instance, we add the number of predicted quits from Table 6.1 that reflect the differential quit experience by area of certification at the state level.

Table 7.3: Comparison of Long-Run Supply of New Pennsylvania Teachers and Demand for Teachers Under Alternative Assumptions: 1992/3-2000/1

| | Optimistic | Pessimistic | Very Pessimistic |
|---|---|---|---|
| | [2] | [3] | [4] |
| Total Teachers | | | |
| Projected Supply | 91,260 | 80,382 | 74,749 |
| Projected Demand | 48,958 | 70,310 | 80,830 |
| Supply/Demand % | 186 % | 114 % | 92 % |
| Primary Teachers | | | |
| Projected Supply | 50,029 | 41,607 | 37,243 |
| Projected Demand | 14,611 | 24,913 | 31,546 |
| Supply/Demand % | 342 % | 167 % | 118 % |
| Secondary Teachers | | | |
| Projected Supply | 41,231 | 38,775 | 37,506 |
| Projected Demand | 34,347 | 45,397 | 49,284 |
| Supply/Demand % | 120 % | 85 % | 76.1 % |

Source: Supply model contained in Table 7.1.
Demand Projections from Table 6.1.
Definitions:
[2]: Optimistic supply based on 2.78 % real growth/year in average teacher salary (1990s average);
Optimistic demand based on $H^a$(Retirement at age 65 assumption) + Predicted Quits.
[3]: Pessimistic supply based on 1 % real growth/year in average teacher salary;
Pessimistic demand based on $H^e$ (Retirement with 30 years experience assumption) + Predicted Quits.
[4]: Very pessimistic supply based on constant real and relative wages, with only student enrollment growth;
Very pessimistic demand based on $H^m$ (Retirement with 27 years experience) + Predicted Quits.
All Projections assume constant relative wages.

Perhaps not surprisingly, we find that under optimistic supply (e.g. a rising real wage) and demand (slow retirement) assumptions, the cumulative supply of newly trained teachers will be 198% of the cumulative demand for teachers. However, between primary and secondary school teachers, there is a distinct difference in this supply-demand relationship. The secondary school teacher market will balance, while the primary school teacher market will be in excess supply. If we entertain very pessimistic assumptions about teacher supply (no real wage growth) and demand(retirement with 27 years of experience), then the primary school teacher market will essentially balance, but the secondary school teacher market will be in shortfall by about 25%. However, several caveats to these projections must be added: first they also presume that districts are indifferent to from where they hire such primary and secondary school teachers; second they presume, in effect, that districts will be able to recruit statewide, although we know that, at least historically, such recruiting takes place within a 70 mile radius of each district; third, the projection results ignore the latent supplies (e.g. retired and certificated non-teachers) discussed in Chapter 5, Section 5.2.2.

What we may conclude from these behavioral projections is that the likely supply of new primary school teachers from Pennsylvania's certificating institutions appears in the aggregate to be ample to meet a range of projected demands. On the other hand, the likely supply of new secondary school teachers appears, in the case of no real wage growth, and rapid retirement to be less than likely to meet demand if districts seek to maintain current student-teacher ratios and curricula

offerings.

## 7.3 Modeling the Retirement and Quit Decisions

A number of observers [9]of teacher supply have expressed concern that national demographic projection models such as those used by the National Center for Educational Statistics have overestimated the likely number of teachers who will retire, and therefore have overstated the personnel problem which school districts will have to address. Several analysts have explored statistical modeling approaches to the prediction problem which take into account factors other than years of professional experience and age of the employed teacher labor force.

Our purpose here is to construct a statistical model of the withdrawal decision which allows us to appraise the demographic projections presented in Chapter 6. Of particular interest is the role of economic incentives, both absolute and relative, on the decision to quit or retire each year. We conjecture that a teacher considers the following decision problem each year:

$$\begin{aligned} Work, Retire, Quit \;=\; & f(Race, Sex, Experience, Experience^2, MADegree,\ Exp \geq 10, \\ & SourceofDegree, Salary, RelativeSalary, StudentTestScore) \quad (7.1) \end{aligned}$$

Generally, we expect that the more years of professional experience a teacher has, the more likely it is that retirement will be pursued. On the other hand we expect that, at least initially, the likelihood of quitting will be significant, and then decline as the teacher obtains tenure and becomes accustomed to the rigors of the classroom. The effects of race and sex are difficult to anticipate. There is some evidence that black teachers are less mobile [10] than white teachers, and there is some reason to expect that there will be gender differences. To the extent that men are usually the primary wage earners in a household, one might expect them to be more mobile, e.g. more prone to quit, if alternative job sources become available. By relative salary, we mean the ratio of current salary to community income (proxied for by 1989 per capita income). Both absolute and relative salary effect a teacher's attachment to his or her current job. More income generally reflects a higher wage rate which allows one to purchase more goods, (the positive effect on job attachment), and which makes the price of leisure higher, (the negative effect on job attachment).

Finally, we incorporate student test scores on the TELLS exam as the final component of the model. Begun in 1984/5, the State Board of Education established the TELLS program to serve as an early indicator of student weaknesses in reading and mathematics. In order to initiate the program, the Board added *Chapter 3: Student Testing* to its regulations and the governor signed into law bills (Act 7-A-1984 and Act 93-1984) which appropriated two million dollars to the testing program and $24 million to the learning assistance program. The tests, which are administered to all public school students in grades 3, 5, and 8, are used both to gather data on students and to determine eligibility for the state-funded assistance programs. "Cut scores", or minimum passing standards, initially determined by a committee of Pennsylvania reading and math teachers are now set at 16% below the state median on each test.

In the analysis below, the *sum* of the fraction of students who are below grade level in math and reading may be viewed as a reflection of the problem which teachers must address in their jobs, and in effect represents an important non-pecuniary aspect of a professional teacher's career. We may conjecture that high scores can be viewed as having positive and negative effects on job attachment.

[9]See Stapleton (1989) or Murnane (1991) Chapter 2.

[10]See Murnane (1991), Chapter 5 for example

The positive component involves the possible impact the teacher can have by improving reading and math skills to grade level; the negative component involves the difficulty the teacher faces each day in conveying the day's materials.

We employ the *multinomial* logit model of occupational choice[11] to measure the effects of these factors on the decision to remain with a school district, retire or quit.

We estimate for all 1989/90 teachers, and by broad area of certification, logit functions which determine the probability, P, of working, retiring, and quitting. The basic logit equations estimated compute the *relative* probabilities of retiring vs. working, and quitting vs. working:

$$\begin{aligned} log_e \frac{P_{retire}}{P_{work}} &= \beta_{11} + \beta_{12}Race + \beta_{13}Sex + \beta_{14}Exp + \beta_{15}Exp^2 + \beta_{16}MA + \beta_{17}Exp \geq 10 + \\ &\beta_{18}StateU + \beta_{19}StateRel + \beta_{110}PriveStateRel + \beta_{111}Private + \\ &\beta_{112}Salary + \beta_{113}Salary/YP89 + \beta_{114}Tells \end{aligned}$$

$$\begin{aligned} log_e \frac{P_{quit}}{P_{work}} &= \beta_{21} + \beta_{22}Race + \beta_{23}Sex + \beta_{24}Exp + \beta_{25}Exp^2 + \beta_{26}MA + \beta_{27}Exp \geq 10 + \\ &\beta_{28}StateU + \beta_{29}StateRel + \beta_{210}PrivStateRel + \beta_{211}Private + \beta_{212}Salary + \\ &\beta_{213}Salary/YP89 + \beta_{214}Tells \end{aligned} \quad (7.2)$$

Since the decision to work, retire or quit must be made in the base year, 1989/90, the relative and absolute probabilities must add to 1.0 for each of the over 91,000 observations.

Table 7.4 displays the overall estimation results for these equations. Many of the explanatory variables conjectured to have an impact on the decision to retire or quit are quite significant statistically, and in the expected direction. We can not reject the null hypothesis that the Race and Sex variables are equal to 0 at the 95% confidence level or better. Note that to be a male (Sex=1) *increases* the odds of retiring vs. working, while being nonwhite (Race=1) increases the odds of retiring vs. working, and quitting vs. working.

Table 7.4: Estimates of Multinomial Logit Model of Work, Retire, Quit in 1989/90

| All Teachers | | |
|---|---|---|
| Log $L: \beta = 0$ | -19,297.0 | |
| **Retire/Work** | **Coeff.** | **t-stat.** |
| Constant | -6.3177 | -33.0 |
| Race | 0.2349 | 2.23 |
| Sex | 0.2589 | 4.11 |
| Experience | 0.2154 | 10.33 |
| $Experience^2$ | -0.0005 | -1.32 |
| MA Degree | -0.1086 | -1.75 |
| Exp$\geq$ 10yrs | -1.2395 | -5.87 |
| StateU | -0.6431 | -8.25 |
| StateRel | 0.1730 | 2.07 |
| PrivStateAid | 0.0622 | 0.29 |
| Priv | -0.2761 | -3.02 |
| Salary | -3.059E-05 | -7.80 |
| Salary/YP89 | -.21128 | -5.64 |
| Tells | 0.0188 | 12.23 |
| **Quit/Work** | **Coeff.** | **t-stat.** |
| Constant | 0.5472 | 5.95 |
| Race | 0.0127 | 1.83 |
| Sex | 0.3644 | 0.26 |
| Experience | -0.2816 | -25.21 |
| $Experience^2$ | 0.0049 | 16.56 |

[continued on next page]

[11] See Schmidt and Strauss(1975) for an early application of this technique, or Chapter 20 of Greene (1991) for a more general discussion.

| | | |
|---|---|---|
| MA Degree | 0.1463 | 2.98 |
| Exp≥ 10yrs | 0.4675 | 4.99 |
| StateU | -0.2301 | -4.45 |
| StateRel | 0.0011 | 0.02 |
| PrivStateAid | 0.1139 | 0.55 |
| Priv | -0.0827 | -1.32 |
| Salary | -5.941E-05 | -15.07 |
| Salary/YP89 | -0.1624 | -4.48 |
| Tells | 0.0002 | 0.17 |

Source: multinomial logit analysis of PDE files.

As hypothesized, increased experience leads to a greater likelihood that one will retire vs. work, and a *decreased* likelihood of quitting vs. working. Having a masters degree makes it more likely that one will quit vs. work, but has no statistically significant effect on the odds of retiring vs. working. A number of the college-of-degree dummy variables are statistically significant; note that these effects should be compared to the omitted category of obtaining one's highest degree from outside Pennsylvania.

It is clear that both absolute and relative salary are significant determinants of the decision to retire vs. work and the decision to quit vs. work. The t-statistics are always over 5.0. [12] We find that higher salaries reduce both the odds of retiring vs. working and quitting vs. working. Higher salary relative to the average community salary where one teaches has the effect of increasing teachers' job attachment. Evidently, the greater socioeconomic status that comes from being more highly compensated encourages teachers to continue to work instead of retiring or quitting.

Finally, higher Tells scores appear to increase the odds of retiring vs. working in a statistically significant fashion, but have no effect on the probability of quitting vs. working.

Analogous statistical estimation has been performed for each area of teacher certification. The results are in Table 7.5. Although race and sex are not significant in most certification areas, they are in the larger certification areas. We find that non-white teachers[13] are more likely to retire vs. work in areas that encompass 40% of all classroom teachers, while male teachers are more likely to quit vs. work in areas that encompass 48% of all classroom teachers. [14] Experience and/or experience squared is statistically significant in most of the retire or quit equations [15], Teachers with masters degrees are indistinguishable from teachers with bachelors degrees vis a vis the retirement and quit decision in virtually all areas of certification.[16]

Salary and/or relative salary are not statistically significantly different from zero, in the expected direction in 10 of 35 certification areas analyzed in Table 7.5; however, these ten certification areas account for only 4.5% of the teachers in 1989/90.[17] That is, economic considerations affect the retirement and quit decision in virtually all of the sizeable certification categories. Finally, poor student achievement accelerates the retirement decision for teachers in Art, Elementary Education, Reading and Social Studies, but has no discernable effect on the quit decision.

[12]Given that we are using the universe of teachers in the statistical analysis, it is somewhat unclear whether calculating sample statistics is meaningful. Given that the analysis is from a cross-section of one year, it can be viewed as a sample in that sense, and the t-statistics become more relevant.

[13]Race is statistically significant in the retirement equations of Biology, Elementary, and General Science and statistically significant in the quit equations of Biology, Health, Hearing, Mental/Physical Therapy, Not Elsewhere and Other Languages.

[14]Sex is statistically significant in the retire equations of English 2nd, German, Health, Hearing, Music and Social Studies and in the quit equations of Chemistry, Elementary, Industrial Arts, Mathematics, Not Elsewhere, Other Handicapped and Spanish.

[15]Experience or Experience squared is not statistically significant in either the retire or quit equations of Administration, Agriculture, Earth/Space, French, Gifted, Other Science, Physics, Speech, and Visually Impaired.

[16]This suggests that the significant coefficients in the overall logit may be picking up effects of different certifications which are then reflected in the intercepts, rather than the logit coefficients on the MA variable in the stratified analysis.

[17]Administration, Agriculture, Earth/Space Science, Gifted, Not Elsewhere, Other Handicapped, Other Languages, Speech, Visually Impaired, and Vocational Education do not have significant salary and/or relative salary coefficients.

Table 7.5: Logit Models for Pennsylvania Teachers by Teaching Specialty

| | Admin. | n=944 | Agri. | n=174 | Art | n=2665 | Bio. | n=1516 | Bus.Ed | n=2073 | Chem. | n=805 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID Number | [1a] | [1b] | [2a] | [2b] | [3a] | [3b] | [4a] | [4b] | [5a] | [5b] | [6a] | [6b] |
| Log $L : \beta = 0$ | -167.0 | | -41.6 | | -583.3 | | -302.2 | | -498.8 | | -146.4 | |
| Retire/Work | | | | | | | | | | | | |
| | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. |
| Constant | -16.4360 | -0.06 | -37.4570 | -0.00 | -5.9646 | -4.95 | -15.8290 | -0.07 | -16.6870 | -0.12 | -16.4920 | -0.09 |
| Race | -0.0307 | -0.05 | 18.3950 | 0.00 | 0.1066 | 0.13 | 2.6632 | 2.62 | 0.0264 | 0.03 | -11.8010 | -0.02 |
| Sex | 0.5841 | 1.24 | -15.5400 | -0.00 | 0.1048 | 0.22 | -0.3550 | -0.46 | -0.0490 | -0.16 | 0.3190 | 0.32 |
| Experience | -0.1144 | -0.70 | -0.3211 | -0.62 | 0.1777 | 1.23 | -0.2092 | -0.99 | 0.3196 | 2.08 | 0.2740 | 0.59 |
| $Experience^2$ | 0.0052 | 1.70 | 0.0096 | 0.85 | -0.0001 | -0.05 | 0.0083 | 2.09 | -0.0028 | -1.01 | 0.0002 | 0.02 |
| MA Degree | -0.4046 | -0.75 | -18.6170 | -0.00 | -0.2107 | -0.45 | 0.0014 | 0.00 | 0.1081 | 0.35 | 1.4916 | 1.69 |
| Exp$\geq$ 10yrs | 11.9380 | 0.04 | 20.3650 | 0.00 | -1.0019 | -0.74 | 12.1990 | 0.05 | 8.5233 | 0.06 | 6.1214 | 0.03 |
| StateU | 0.1146 | 0.16 | 0.7006 | 0.00 | -1.0954 | -1.91 | -1.0119 | -1.38 | -0.6858 | -1.53 | 0.0277 | 0.03 |
| StateRel | 0.1043 | 0.19 | 18.7880 | 0.00 | -0.1318 | -0.22 | -14.0020 | -0.05 | 0.3300 | 0.78 | 0.9278 | 0.92 |
| PrivStateAid | 0.7147 | 0.76 | | | -0.3261 | -0.37 | -13.2460 | -0.01 | 2.1585 | 2.37 | -10.2390 | -0.01 |
| Priv | -0.0471 | -0.06 | 0.9378 | 0.00 | -0.7175 | -0.90 | -0.0914 | -0.14 | 0.3675 | 0.89 | -1.3334 | -0.97 |
| Salary | -3.5E-05 | -0.77 | -1.6E-04 | -1.38 | -5.0E-05 | -3.16 | -1.4E-05 | -0.37 | -3.4E-05 | -1.61 | 1.29E-07 | 0.00 |
| Salary/YP89 | 0.0593 | 0.15 | 0.6353 | 0.75 | -0.0230 | -1.49 | -0.2826 | -0.84 | -0.0292 | -0.17 | -0.6505 | -1.38 |
| Tells | 0.0172 | 1.12 | -0.0003 | -0.01 | 0.0208 | 2.70 | 0.0213 | 1.31 | 0.0023 | 0.29 | 0.0066 | 0.17 |
| Quit/Work | | | | | | | | | | | | |
| Constant | -2.1360 | -1.34 | 15.1120 | 1.39 | 0.8307 | 1.71 | 1.2960 | 1.93 | 1.8609 | 2.63 | 1.0306 | 0.90 |
| Race | -0.4281 | -0.37 | -16.7410 | 0.00 | 0.7056 | 1.44 | 1.4200 | 2.18 | -0.8245 | -0.75 | -10.5200 | -0.01 |
| Sex | 0.3644 | 0.48 | 0.7419 | 0.44 | -0.0227 | -0.08 | 0.2150 | 0.64 | 0.0853 | 0.22 | 1.5966 | 2.55 |
| Experience | 0.0986 | 0.42 | -1.2888 | -0.73 | -0.3199 | -5.24 | -0.3324 | -3.00 | -0.4422 | -4.90 | -0.4932 | -2.87 |
| $Experience^2$ | -0.0052 | -0.73 | 0.1018 | 0.49 | 0.0064 | 4.02 | 0.0048 | 1.39 | 0.0088 | 3.71 | 0.0100 | 2.76 |
| MA Degree | -0.0424 | -0.06 | -15.5250 | -0.00 | 0.2886 | 1.00 | 0.6742 | 1.69 | -0.0336 | -0.09 | 0.0550 | 0.08 |
| Exp$\geq$ 10yrs | -0.7302 | -0.50 | -84.9580 | -0.34 | 0.2909 | 0.58 | 1.0937 | 1.41 | 1.3779 | 2.07 | 3.1581 | 2.04 |
| StateU | -0.0947 | -0.10 | -17.0340 | -0.00 | -0.2681 | -0.95 | -0.6908 | -1.67 | -0.4437 | -1.27 | -0.4082 | -0.56 |
| StateRel | -0.0394 | -0.04 | -0.2601 | -0.13 | -0.3898 | -1.03 | -0.2775 | -0.53 | -0.5449 | -0.95 | -0.3225 | -0.36 |
| PrivStateAid | -10.3310 | -0.02 | | | 0.3477 | 0.65 | -13.5290 | -0.01 | 2.4404 | 2.10 | 1.2919 | 0.84 |
| Priv | -11.0600 | -0.03 | -20.5050 | 0.00 | 0.1742 | 0.50 | -0.5429 | -1.21 | -1.0305 | -2.19 | -0.0260 | -0.04 |
| Salary | -2.2E-05 | -0.35 | -6.3E-04 | -1.10 | -6.4E-05 | -5.61 | -9.5E-05 | -2.88 | -1.2E-04 | -3.87 | -1.0E-04 | -2.05 |
| Salary/YP89 | -0.6996 | -1.12 | -0.0543 | -0.04 | 0.0126 | 1.00 | 0.2257 | 0.76 | 0.2845 | 1.08 | -0.4628 | -0.99 |
| Tells | 0.0244 | 1.25 | -0.0062 | -0.11 | -0.0082 | -1.67 | -0.0146 | -1.50 | -0.0040 | -0.38 | 0.0025 | 0.16 |
| | Coord. | n=506 | Driv.Ed. | n=333 | Ear.Ch. | n=1048 | Earth/Sp. | n=634 | Eng.2nd | n=144 | Eng. | n=6250 |
| ID Number | [7a] | [7b] | [8a] | [8b] | [9a] | [9b] | [10a] | [10b] | [11a] | [11b] | [12a] | [12b] |
| Log $L : \beta = 0$ | -109.3 | | -204.9 | | -204.9 | | -121.2 | | -471.1 | | -1393.8 | |
| Retire/Work | | | | | | | | | | | | |
| | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. |
| Constant | -19.3360 | -0.03 | -30.6360 | -0.03 | -31.3490 | -0.04 | -14.9810 | -0.04 | -18.2210 | -0.09 | -7.8653 | -7.95 |
| Race | -15.0140 | -0.02 | -0.0301 | -0.02 | -0.0281 | -0.02 | -13.5920 | -0.00 | 0.5205 | 0.63 | -0.0849 | -0.16 |
| Sex | 13.4480 | 0.02 | 11.2290 | 0.01 | 11.2750 | 0.01 | 1.0470 | 0.79 | 1.0367 | 2.70 | 0.3264 | 1.50 |
| Experience | -0.3453 | -0.78 | 0.5586 | 2.13 | 0.5725 | 2.22 | 0.1971 | 0.28 | 0.4622 | 4.76 | 0.4922 | 5.34 |
| $Experience^2$ | 0.0085 | 0.62 | -0.0062 | -1.28 | -0.0064 | -1.35 | 0.0001 | 0.01 | -0.0040 | -2.86 | -0.0054 | -3.35 |
| MA Degree | 1.0970 | 1.08 | 0.7397 | 0.94 | 0.7486 | 0.95 | -0.2575 | -0.24 | -0.3761 | -1.07 | 0.2207 | 1.05 |
| Exp$\geq$ 10yrs | 2.4095 | 0.84 | 7.7971 | 0.04 | 7.9048 | 0.04 | 8.5083 | 0.02 | 7.6067 | 0.04 | -2.6148 | -2.60 |
| StateU | -345.96 | -0.36 | -1.4838 | -1.53 | -1.3154 | -1.33 | -12.8730 | -0.05 | -0.3552 | -0.84 | -0.6897 | -2.59 |
| StateRel | -13.6420 | -0.01 | 0.5188 | 0.53 | 0.6291 | 0.64 | -0.5449 | -0.43 | 0.0179 | 0.04 | 0.0102 | 0.03 |
| PrivStateAid | -14.6750 | -0.01 | -10.9070 | -0.01 | | | -11.3680 | -0.00 | 1.2792 | 1.03 | 0.5299 | 0.69 |
| Priv | 0.5532 | 0.50 | -11.9290 | -0.03 | -11.8100 | -0.03 | -12.8160 | -0.02 | -0.0835 | -0.17 | -0.6314 | -2.10 |
| Salary | 4.09E-05 | 0.33 | -7.0E-05 | -2.02 | -2.8E-05 | -0.47 | -1.3E-04 | -1.62 | -4.9E-05 | -3.62 | -5.6E-05 | -6.77 |
| Salary/YP89 | -0.3792 | -0.40 | -0.0253 | -0.80 | -0.4854 | -0.85 | 0.5856 | 0.84 | 0.0058 | 0.31 | -0.0081 | -0.68 |
| Tells | 0.0371 | 1.14 | 0.0268 | 1.89 | 0.0378 | 1.86 | 0.0086 | 0.24 | -0.0029 | -0.39 | 0.0065 | 1.62 |
| Quit/Work | | | | | | | | | | | | |
| Constant | 1.3720 | 0.93 | -10.4570 | -0.01 | -10.5740 | -0.01 | 0.2627 | 0.23 | 0.5068 | 0.79 | 0.8623 | 2.57 |
| Race | 0.1817 | 0.14 | -1.5285 | -1.82 | -1.4820 | -1.77 | -13.3270 | -0.00 | -0.3069 | -0.36 | 0.4399 | 1.11 |
| Sex | -0.4764 | -0.63 | 12.6340 | 0.01 | 12.6210 | 0.01 | -0.2392 | -0.44 | 0.1944 | 0.66 | -0.1267 | -0.70 |
| Experience | -0.3264 | -2.09 | -0.4928 | -4.13 | -0.4887 | -4.08 | 0.0675 | 0.33 | -0.2408 | -3.37 | -0.2423 | -6.92 |
| $Experience^2$ | 0.0091 | 2.08 | 0.0099 | 4.06 | 0.0098 | 4.02 | -0.0111 | -1.33 | 0.0036 | 2.55 | 0.0034 | 5.92 |
| MA Degree | 1.3176 | 2.32 | -0.2365 | -0.39 | -0.2351 | -0.39 | -0.1674 | -0.26 | -0.4509 | -1.02 | 0.2493 | 1.33 |
| Exp$\geq$ 10yrs | -1.1703 | -0.78 | 1.5290 | 1.49 | 1.5299 | 1.48 | 0.8526 | 0.74 | -0.1486 | -0.20 | -0.0059 | -0.02 |
| StateU | 0.2170 | 0.33 | -0.5144 | -1.05 | -0.4694 | -0.96 | -0.7542 | -1.24 | -0.0211 | -0.05 | -0.3617 | -1.79 |
| StateRel | 0.2820 | 0.29 | 0.0860 | 0.15 | 0.1231 | 0.22 | -0.5003 | -0.56 | -0.2098 | -0.41 | 0.0261 | 0.10 |
| PrivStateAid | -14.1740 | -0.02 | -13.4030 | -0.01 | | | -6.1528 | -0.00 | -12.3420 | -0.01 | 0.2335 | 0.29 |
| Priv | -0.9775 | -1.06 | -1.0211 | -1.50 | -0.9910 | -1.46 | 0.9419 | 1.29 | 0.0773 | 0.17 | -0.1822 | -0.84 |
| Salary | -8.9E-05 | -2.66 | -1.1E-04 | -5.05 | -9.0E-05 | -1.90 | -4.6E-05 | -0.98 | -6.2E-05 | -3.15 | -7.4E-05 | -8.40 |
| Salary/YP89 | 0.0153 | 0.79 | 0.0147 | 0.47 | -0.1954 | -0.43 | -0.5181 | -1.19 | 0.0069 | 0.37 | 0.0005 | 0.04 |
| Tells | -0.0127 | -1.20 | -0.0114 | -1.64 | -0.0089 | -0.90 | 0.0031 | 0.21 | -0.0064 | -0.85 | 0.0019 | 0.50 |

[continued on next page]

| | Fr. | n=772 | Elem. | n=33717 | Gen.Sci. | n=1976 | Ger. | n=380 | Gift. | n=508 | Health | n=5201 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID Number | [13a] | [13b] | [14a] | [14b] | [15a] | [15b] | [16a] | [16b] | [17a] | [17b] | [18a] | [18b] |
| Log $L : \beta = 0$ | -191.0 | | -6352.2 | | -471.1 | | -471.1 | | -113.4 | | -971.8 | |
| Retire/Work | | | | | | | | | | | | |
| | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. |
| Constant | -17.0080 | -0.09 | -8.2684 | -16.31 | -18.3960 | -0.08 | -18.2210 | -0.09 | -29.6600 | -0.20 | -8.2871 | -5.67 |
| Race | -11.1100 | -0.02 | 0.2805 | 2.06 | 1.0179 | 2.66 | 0.5205 | 0.63 | -1.7802 | -0.00 | -0.6085 | -0.86 |
| Sex | -1.3706 | -1.52 | 0.1594 | 0.88 | 0.3127 | 0.39 | 1.0367 | 2.70 | 10.7670 | 0.07 | 0.9423 | 3.04 |
| Experience | 0.5385 | 0.97 | 0.3043 | 7.22 | 0.4705 | 4.82 | 0.4622 | 4.76 | 1.4238 | 1.52 | 0.3950 | 2.42 |
| *Experience*$^2$ | -0.0111 | -0.90 | -0.0021 | -2.64 | -0.0041 | -2.93 | -0.0040 | -2.86 | -0.0200 | -1.26 | -0.0022 | -0.75 |
| MA Degree | -1.0892 | -0.97 | -0.1820 | -1.70 | -0.3714 | -1.05 | -0.3761 | -1.07 | 0.9578 | 0.89 | -0.4054 | -1.25 |
| Exp$\geq$ 10yrs | 7.7886 | 0.04 | -0.4179 | -0.78 | 7.5590 | 0.04 | 7.6067 | 0.04 | -13.2720 | -1.88 | -2.7346 | -1.67 |
| StateU | -0.5940 | -0.41 | -0.6049 | -4.61 | -0.3507 | -0.83 | -0.3552 | -0.84 | 1.9038 | 1.03 | -0.9648 | -2.83 |
| StateRel | 1.1018 | 0.85 | 0.3334 | 2.21 | -0.0331 | -0.06 | 0.0179 | 0.04 | 3.6524 | 2.07 | -0.8180 | -1.72 |
| PrivStateAid | 2.7066 | 1.88 | 0.1270 | 0.28 | | | 1.2792 | 1.03 | 3.5857 | 1.83 | 3.4542 | 2.99 |
| Priv | -0.4761 | -0.32 | -0.2479 | -1.56 | -0.1270 | -0.26 | -0.0835 | -0.17 | 2.1178 | 1.19 | -0.6926 | -0.89 |
| Salary | -3.7E-06 | -0.07 | -3.0E-05 | -4.41 | -3.7E-05 | -1.91 | -4.9E-05 | -3.62 | 2.20E-05 | 0.28 | -4.8E-05 | -4.26 |
| Salary/YP89 | -0.2036 | -0.40 | -0.2201 | -3.41 | -0.1478 | -0.75 | 0.0058 | 0.31 | 0.2051 | 0.29 | -0.0104 | -0.86 |
| Tells | 0.0130 | 0.54 | 0.0170 | 6.20 | 0.0038 | 0.39 | -0.0029 | -0.39 | 0.0443 | 0.99 | 0.0107 | 1.74 |
| Quit/Work | | | | | | | | | | | | |
| Constant | 0.5015 | 0.61 | 0.4549 | 2.39 | 0.3862 | 0.59 | 0.5068 | 0.79 | -2.2764 | -1.38 | 0.5399 | 1.38 |
| Race | -13.0820 | -0.02 | -0.0656 | -0.59 | 0.1838 | 0.63 | -0.3069 | -0.36 | -11.0660 | -0.01 | -1.5415 | -2.06 |
| Sex | -0.4920 | -0.92 | -0.3897 | -2.27 | -0.3508 | -0.41 | 0.1944 | 0.66 | 0.9756 | 0.91 | 0.0821 | 0.44 |
| Experience | -0.1664 | -1.51 | -0.2870 | -13.71 | -0.2340 | -3.26 | -0.2408 | -3.37 | 0.1373 | 0.78 | -0.3285 | -5.48 |
| *Experience*$^2$ | 0.0022 | 0.65 | 0.0051 | 8.93 | 0.0034 | 2.44 | 0.0036 | 2.55 | -0.0052 | -0.96 | 0.0058 | 3.32 |
| MA Degree | 0.1452 | 0.38 | 0.1645 | 1.81 | -0.4943 | -1.12 | -0.4509 | -1.02 | -1.3877 | -2.31 | 0.1289 | 0.52 |
| Exp$\geq$ 10yrs | 0.2436 | 0.33 | 0.5693 | 3.26 | -0.1517 | -0.20 | -0.1486 | -0.20 | -0.9369 | -1.00 | 0.6979 | 1.61 |
| StateU | -0.1950 | -0.44 | -0.1962 | -2.07 | 0.0107 | 0.03 | -0.0211 | -0.05 | -0.0329 | -0.05 | -0.1602 | -0.71 |
| StateRel | 0.1711 | 0.27 | -0.0005 | -0.00 | -0.1870 | -0.36 | -0.2098 | -0.41 | -0.0044 | -0.01 | 0.5976 | 2.12 |
| PrivStateAid | 0.8674 | 0.72 | 0.4117 | 0.99 | | | -12.3420 | -0.01 | -9.9219 | -0.02 | -8.5787 | -0.05 |
| Priv | -0.2047 | -0.42 | 0.0222 | 0.20 | 0.0877 | 0.19 | 0.0773 | 0.17 | 0.5497 | 0.83 | 0.9119 | 2.20 |
| Salary | -5.4E-05 | -1.90 | -5.9E-05 | -8.32 | -4.1E-05 | -1.40 | -6.2E-05 | -3.15 | -1.6E-05 | -0.46 | -7.2E-05 | -4.08 |
| Salary/YP89 | -0.1243 | -0.46 | -0.2000 | -3.04 | -0.2415 | -0.92 | 0.0069 | 0.37 | -0.3909 | -1.05 | 0.1283 | 0.80 |
| Tells | 0.0052 | 0.56 | -0.0005 | -0.28 | -0.0016 | -0.18 | -0.0064 | -0.85 | 0.0009 | 0.04 | -0.0087 | -1.63 |
| | Hear. | n=75 | HomeEc. | n=1721 | Ind.Art | n=2057 | Math | n=5671 | Men/Ph | n=6132 | Mus. | n=3525 |
| ID Number | [19a] | [19b] | [20a] | [20b] | [21a] | [21b] | [22a] | [22b] | [23a] | [23b] | [24a] | [24b] |
| Log $L : \beta = 0$ | -971.8 | | -430.5 | | -373.4 | | -1013.9 | | -1357.5 | | -832.6 | |
| Retire/Work | | | | | | | | | | | | |
| | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. |
| Constant | -8.2871 | -5.67 | -328.12 | -0.04 | -8.5841 | -6.26 | -6.5388 | -6.31 | -6.0602 | -6.59 | -8.5095 | -6.62 |
| Race | -0.6085 | -0.86 | 0.4023 | 0.43 | 0.4559 | 0.57 | 0.9763 | 1.75 | 0.2403 | 0.60 | 0.1291 | 0.17 |
| Sex | 0.9423 | 3.04 | 13.0280 | 0.00 | 1.3815 | 1.16 | 0.2790 | 0.90 | 0.1439 | 0.41 | 0.7626 | 2.21 |
| Experience | 0.3950 | 2.42 | 0.4135 | 2.27 | 0.5045 | 4.53 | 0.1799 | 1.62 | 0.2246 | 2.27 | 0.4156 | 2.85 |
| *Experience*$^2$ | -0.0022 | -0.75 | -0.0040 | -1.13 | -0.0047 | -2.94 | 0.0008 | 0.38 | -0.0017 | -0.83 | -0.0037 | -1.44 |
| MA Degree | -0.4054 | -1.25 | -0.4825 | -1.02 | 0.2006 | 0.52 | -0.0549 | -0.19 | -0.0747 | -0.24 | 0.2287 | 0.68 |
| Exp$\geq$ 10yrs | -2.7346 | -1.67 | 306.3700 | 0.98 | -4.3127 | -2.74 | -0.9315 | -0.79 | -0.9957 | -1.51 | -2.6707 | -1.94 |
| StateU | -0.9648 | -2.83 | -0.8510 | -1.50 | 0.2034 | 0.49 | -0.8821 | -2.34 | -0.8746 | -2.16 | -0.4432 | -1.02 |
| StateRel | -0.8180 | -1.72 | -0.1303 | -0.19 | -0.8360 | -1.04 | 0.4631 | 1.14 | 0.5505 | 1.40 | 0.0353 | 0.07 |
| PrivStateAid | 3.4542 | 2.99 | -0.0016 | -0.00 | -12.4870 | -0.01 | -9.9070 | -0.06 | -10.2460 | -0.04 | 0.8800 | 0.78 |
| Priv | -0.6926 | -0.89 | 0.0389 | 0.07 | -10.6730 | -0.04 | -0.0533 | -0.14 | -0.4705 | -0.83 | -0.5968 | -1.28 |
| Salary | -4.8E-05 | -4.26 | -3.7E-05 | -1.41 | -2.7E-05 | -1.47 | -6.2E-05 | -5.84 | -6.6E-05 | -2.43 | -3.0E-05 | -2.25 |
| Salary/YP89 | -0.0104 | -0.86 | -0.3201 | -1.16 | -0.0098 | -0.73 | -0.0111 | -0.73 | 0.1969 | 0.85 | -0.0087 | -0.55 |
| Tells | 0.0107 | 1.74 | 0.0160 | 1.16 | 0.0064 | 0.76 | 0.0151 | 2.73 | 0.0102 | 1.29 | 0.0087 | 1.31 |
| Quit/Work | | | | | | | | | | | | |
| Constant | 0.5399 | 1.38 | -10.5830 | -0.00 | -0.3988 | -0.51 | 1.0342 | 2.52 | 0.4512 | 1.26 | 0.1353 | 0.33 |
| Race | -1.5415 | -2.06 | -0.2001 | -0.27 | -0.1900 | -0.15 | -0.4602 | -0.59 | -0.6823 | -2.46 | -0.0595 | -0.11 |
| Sex | 0.0821 | 0.44 | 11.2160 | 0.00 | 1.4126 | 2.18 | 0.4913 | 2.43 | 0.2490 | 1.15 | -0.0127 | -0.07 |
| Experience | -0.3285 | -5.48 | -0.2168 | -2.52 | -0.1714 | -2.49 | -0.3272 | -6.42 | -0.2155 | -4.86 | -0.3347 | -6.43 |
| *Experience*$^2$ | 0.0058 | 3.32 | 0.0029 | 0.87 | 0.0026 | 2.60 | 0.0076 | 6.09 | 0.0030 | 1.57 | 0.0067 | 4.97 |
| MA Degree | 0.1289 | 0.52 | 0.8772 | 2.95 | 0.1531 | 0.33 | 0.5962 | 2.35 | -0.0488 | -0.32 | 0.2895 | 1.31 |
| Exp$\geq$ 10yrs | 0.6979 | 1.61 | -0.4633 | -0.94 | -0.2928 | -0.41 | -0.5356 | -1.13 | 0.4581 | 1.65 | 0.7071 | 1.72 |
| StateU | -0.1602 | -0.71 | 0.0999 | 0.31 | 0.5279 | 1.02 | -0.2721 | -1.08 | -0.2115 | -1.21 | 0.3944 | 1.52 |
| StateRel | 0.5976 | 2.12 | 0.5218 | 1.15 | 0.0121 | 0.01 | 0.0144 | 0.05 | 0.3093 | 1.35 | 0.9882 | 3.08 |
| PrivStateAid | -8.5787 | -0.05 | 0.7380 | 1.04 | -8.6268 | -0.01 | 1.2543 | 1.04 | -9.4619 | -0.04 | -10.1570 | -0.07 |
| Priv | 0.9119 | 2.20 | 0.0394 | 0.10 | -9.5967 | -0.03 | 0.2396 | 0.92 | -0.3356 | -1.34 | 0.2054 | 0.74 |
| Salary | -7.2E-05 | -4.08 | -7.5E-05 | -5.71 | -7.2E-05 | -3.47 | -9.5E-05 | -8.93 | -8.3E-05 | -6.27 | -8.2E-05 | -4.57 |
| Salary/YP89 | 0.1283 | 0.80 | 0.0116 | 0.84 | 0.0101 | 0.67 | 0.0069 | 1.25 | 0.0139 | 0.12 | 0.2839 | 1.82 |
| Tells | -0.0087 | -1.63 | -0.0071 | -0.90 | -0.0072 | -0.68 | -0.0085 | -1.65 | -0.0020 | -0.56 | -0.0087 | -1.61 |

[continued on next page]

| | No Else. | n=629 | Oth.Han. | n=11 | Oth.Lan. | n=193 | Oth.Sci. | n=45 | Phy. | n=440 | Read. | n=3684 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID Number | [26a] | [26b] | [27a] | [27b] | [28a] | [28b] | [29a] | [29b] | [30a] | [30b] | [31a] | [31b] |
| Log $L: \beta = 0$ | -523.3 | | -54.6 | | -54.6 | | -70.4 | | -70.4 | | -607.8 | |
| Retire/Work | | | | | | | | | | | | |
| | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. |
| Constant | -7.2443 | -3.18 | -36.2560 | -0.09 | -36.2490 | -0.09 | -13.2180 | -0.05 | -13.1930 | -0.05 | -20.8290 | -0.11 |
| Race | -0.0225 | -0.05 | 3.3327 | 0.00 | 0.3783 | 0.24 | 4.2423 | 0.00 | 0.8759 | 0.69 | -0.4741 | -0.42 |
| Sex | 0.6830 | 1.58 | 0.3784 | 0.24 | 3.3225 | 0.00 | 0.8215 | 0.64 | -1.4521 | -0.00 | 0.9204 | 1.45 |
| Experience | -0.4303 | -2.08 | 1.7033 | 0.96 | 1.7040 | 0.96 | -0.6225 | -1.02 | -0.6546 | -1.08 | 0.5327 | 2.49 |
| *Experience*$^2$ | 0.0135 | 3.40 | -0.0293 | -0.88 | -0.0293 | -0.88 | 0.0160 | 1.24 | 0.0168 | 1.30 | -0.0067 | -1.64 |
| MA Degree | -0.8999 | -1.10 | 0.7425 | 0.48 | 0.7415 | 0.48 | -1.1852 | -0.85 | -1.1190 | -0.81 | 0.0990 | 0.23 |
| Exp$\geq$ 10yrs | -0.4499 | -0.16 | -0.4812 | -0.00 | -0.4863 | -0.00 | 14.2970 | 0.06 | 14.5350 | 0.06 | 8.0602 | 0.04 |
| StateU | -0.3735 | -0.66 | 11.5680 | 0.04 | 11.5550 | 0.04 | -0.1619 | -0.10 | -0.1178 | -0.07 | 0.5464 | 0.81 |
| StateRel | -1.4133 | -2.20 | -0.2453 | 0.00 | -0.2616 | 0.00 | -9.7711 | -0.03 | -9.7249 | -0.03 | 0.6622 | 0.90 |
| PrivStateAid | -0.1861 | -0.13 | 0.4918 | 0.00 | | | -11.5850 | -0.01 | | | 0.3948 | 0.29 |
| Priv | 0.3773 | 0.61 | 11.4050 | 0.04 | 11.3880 | 0.04 | 1.2421 | 0.82 | 1.3317 | 0.88 | 0.6418 | 0.85 |
| Salary | 4.33E-05 | 0.56 | -5.3E-05 | -0.64 | -5.3E-05 | -0.64 | -5.4E-05 | -0.70 | -5.8E-05 | -0.76 | -4.3E-05 | -1.67 |
| Salary/YP89 | 0.1425 | 0.26 | -0.1537 | -0.17 | -0.1529 | -0.17 | 1.4518 | 2.00 | 1.4700 | 2.02 | -0.2787 | -1.15 |
| Tells | 0.0530 | 2.57 | 0.0152 | 0.30 | 0.0152 | 0.29 | -0.1397 | -1.77 | -0.1382 | -1.77 | 0.0291 | 2.89 |
| Quit/Work | | | | | | | | | | | | |
| Constant | -2.4494 | -2.47 | 3.1216 | 1.44 | 3.0482 | 1.41 | 2.9808 | 1.60 | 2.9841 | 1.60 | 0.1636 | 0.26 |
| Race | 0.9736 | 3.00 | -13.2800 | -0.01 | -2.2006 | -2.46 | -13.7110 | -0.01 | -1.1457 | -0.93 | 0.0903 | 0.12 |
| Sex | 0.8426 | 2.76 | -2.1704 | -2.43 | -13.1960 | -0.01 | -1.1440 | -0.93 | -13.6970 | -0.01 | 0.1126 | 0.31 |
| Experience | -0.3945 | -3.09 | -0.5963 | -2.18 | -0.5907 | -2.16 | -0.4883 | -1.77 | -0.4883 | -1.77 | -0.1910 | -2.65 |
| *Experience*$^2$ | 0.0069 | 1.61 | 0.0118 | 1.79 | 0.0117 | 1.77 | 0.0090 | 1.00 | 0.0089 | 0.99 | 0.0021 | 0.68 |
| MA Degree | -0.4712 | -1.08 | 0.7752 | 0.92 | 0.7427 | 0.88 | 1.8219 | 1.55 | 1.8240 | 1.55 | 0.0239 | 0.11 |
| Exp$\geq$ 10yrs | 1.9426 | 2.06 | 3.9032 | 2.01 | 3.8071 | 1.98 | -0.0048 | -0.00 | -0.0028 | -0.00 | 0.3191 | 0.78 |
| StateU | -0.0656 | -0.18 | -12.1260 | -0.02 | -12.0450 | -0.02 | -1.0001 | -0.92 | -0.9991 | -0.92 | -0.0477 | -0.17 |
| StateRel | -0.9190 | -2.32 | 2.1152 | 1.64 | 2.1707 | 1.68 | -0.3817 | -0.38 | -0.3811 | -0.38 | -0.0780 | -0.22 |
| PrivStateAid | -1.1410 | -0.95 | -12.5700 | -0.01 | | | -7.4504 | -0.01 | | | 0.2215 | 0.32 |
| Priv | 0.0192 | 0.04 | 0.5856 | 0.63 | 0.6498 | 0.71 | -0.8394 | -0.79 | -0.8385 | -0.79 | -0.6554 | -1.69 |
| Salary | 6.65E-06 | 0.14 | -4.6E-05 | -0.75 | -4.5E-05 | -0.72 | -2.4E-05 | -0.38 | -2.4E-05 | -0.38 | -3.3E-05 | -1.83 |
| Salary/YP89 | -0.0837 | -0.24 | -0.3842 | -0.61 | -0.3754 | -0.60 | -0.9847 | -1.46 | -0.9848 | -1.46 | -0.3352 | -1.94 |
| Tells | 0.0286 | 3.54 | -0.0280 | -0.99 | -0.0283 | -0.99 | -0.0358 | -0.94 | -0.0358 | -0.94 | -0.0015 | -0.20 |

| | Soc.St. | n=5295 | Span. | n=1174 | Speech | n=361 | Vis.Imp. | n=34 | Voc.Ed. | n=670 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ID Number | [32a] | [32b] | [33a] | [33b] | [34a] | [34b] | [35a] | [35b] | [36a] | [36b] | | |
| Log $L: \beta = 0$ | -1029.1 | | -286.8 | | -72.3 | | -14.9 | | -175.1 | | | |
| Retire/Work | | | | | | | | | | | | |
| | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | Coeff. | t-stat. | | |
| Constant | -7.6326 | -6.01 | -13.5040 | -0.06 | -779.91 | -0.04 | -83.7970 | -0.00 | -5.0708 | -3.62 | | |
| Race | 0.4212 | 0.90 | 0.5579 | 0.57 | -126.20 | -0.02 | -3.8386 | 0.00 | 0.6650 | 1.43 | | |
| Sex | 0.7745 | 2.84 | -1.0214 | -1.31 | 147.2000 | 0.01 | -22.2000 | -0.00 | -0.1082 | -0.20 | | |
| Experience | 0.2910 | 2.22 | -0.1398 | -0.53 | 41.2360 | 0.01 | -1.0124 | 0.00 | 0.3062 | 2.04 | | |
| *Experience*$^2$ | -0.0009 | -0.38 | 0.0074 | 1.42 | -0.4571 | -0.00 | 0.0356 | 0.00 | -0.0040 | -1.24 | | |
| MA Degree | 0.1897 | 0.89 | -0.3612 | -0.50 | -93.0790 | -0.03 | 35.9670 | 0.01 | -0.9501 | -1.60 | | |
| Exp$\geq$ 10yrs | -1.8513 | -1.22 | 12.1230 | 0.05 | -254.20 | -0.01 | -32.6800 | -0.00 | -0.4640 | -0.41 | | |
| StateU | -0.3578 | -1.30 | -12.5630 | -0.06 | 7.9382 | 0.00 | 12.5470 | 0.00 | -13.5970 | -0.02 | | |
| StateRel | 0.5066 | 1.71 | -0.2166 | -0.21 | -100.94 | -0.01 | 19.5830 | 0.00 | 0.4565 | 1.09 | | |
| PrivStateAid | -0.6695 | -0.61 | -13.3040 | -0.01 | | | | | | | | |
| Priv | -0.4695 | -1.45 | -0.1608 | -0.21 | 14.9510 | 0.00 | 11.4120 | 0.00 | -0.1005 | -0.09 | | |
| Salary | -4.6E-05 | -5.04 | -6.8E-05 | -1.62 | -2.1E-03 | -0.01 | 1.32E-03 | 0.00 | -7.4E-05 | -1.74 | | |
| Salary/YP89 | -0.0135 | -1.50 | -0.4784 | -1.10 | -15.6350 | -0.00 | 4.0465 | 0.00 | -0.1400 | -0.39 | | |
| Tells | 0.0134 | 3.21 | 0.0264 | 1.48 | 4.0604 | 0.01 | -0.2690 | -0.00 | 0.0223 | 1.94 | | |
| Quit/Work | | | | | | | | | | | | |
| Constant | 0.1874 | 0.41 | 1.1228 | 1.57 | -0.3314 | -0.18 | -73.6030 | -0.02 | 0.5205 | 0.22 | | |
| Race | -0.0699 | -0.12 | -0.0061 | -0.01 | -1.0788 | -0.96 | 590.2000 | 0.05 | -11.5030 | -0.03 | | |
| Sex | 0.2333 | 1.02 | -0.8634 | -2.12 | -0.0366 | -0.03 | 3.7706 | 0.00 | -11.8500 | -0.03 | | |
| Experience | -0.3761 | -5.15 | -0.1831 | -2.10 | -0.1864 | -0.85 | -35.7170 | -0.04 | -0.3809 | -1.27 | | |
| *Experience*$^2$ | 0.0071 | 3.80 | 0.0031 | 1.01 | 0.0019 | 0.25 | 1.3591 | 0.05 | 0.0079 | 0.99 | | |
| MA Degree | 0.2719 | 0.98 | 0.4876 | 1.40 | -0.4083 | -0.74 | 223.1500 | 0.06 | -12.0070 | -0.03 | | |
| Exp$\geq$ 10yrs | 0.9126 | 1.65 | -0.5720 | -0.84 | 0.9436 | 0.89 | -313.23 | -0.05 | 0.8488 | 0.40 | | |
| StateU | -0.3626 | -1.26 | -0.2448 | -0.59 | -0.1067 | -0.17 | 134.4900 | 0.03 | -13.2480 | -0.02 | | |
| StateRel | 0.2466 | 0.66 | 0.2108 | 0.42 | -0.7527 | -0.87 | -244.4300 | -0.05 | -1.2976 | -1.27 | | |
| PrivStateAid | -10.7360 | -0.08 | 1.6170 | 1.31 | | | | | | | | |
| Priv | 0.0294 | 0.10 | 0.0444 | 0.11 | -19.2190 | -0.00 | 141.8600 | 0.07 | -12.1230 | -0.01 | | |
| Salary | -5.9E-05 | -4.31 | -6.2E-05 | -2.15 | 1.52E-05 | 0.29 | 1.44E-02 | 0.07 | 6.95E-06 | 0.06 | | |
| Salary/YP89 | -0.0113 | -1.82 | -0.3729 | -1.28 | -0.7391 | -1.58 | -198.2400 | -0.07 | -0.5145 | -0.54 | | |
| Tells | 0.0066 | 1.13 | 0.0123 | 1.40 | 0.0192 | 1.32 | 5.2659 | 0.07 | 0.0074 | 0.28 | | |

Source: Limdep analysis of PDE files.

We now turn to interpret the size of these various coefficients. For example, note that since $\beta_{123}$ = -.000030596, the effect of salary on the odds of retiring vs. working is quite small. On the other hand, the average salary in the sample is $32,224, so it is not obvious whether to conclude that this is a small or large effect. These relative probability functions, with assumptions about characteristics of teachers (e.g. experience, race, sex, etc.) can be turned into *absolute* probability functions of a teacher making the decision to work, retire or quit which are more intuitive to interpret. One way

to ascertain the size of this salary effect is to solve the logit equations for the absolute probabilities, and to calculate them for various combinations of values of the regressors such as experience, salary, relative salary, etc. Equations 7.4, 7.5, and 7.5 below display the formulae for calculating actual probabilities. Note that one must know x to make the calculations in the equations below:

$$P_{work} = \frac{1}{1 + e^{x\beta_{retire}} + e^{x\beta_{quit}}} \tag{7.3}$$

$$P_{retire} = \frac{e^{x\beta_{retire}}}{1 + e^{x\beta_{retire}} + e^{x\beta_{quit}}} \tag{7.4}$$

$$P_{quit} = \frac{e^{x\beta_{quit}}}{1 + e^{x\beta_{retire}} + e^{x\beta_{quit}}} \tag{7.5}$$

Let us pick a representative teacher's x values and change a few key factors. Table 7.6 shows the probability of working, retiring, and quitting at various combinations of key, right hand side variables. In the first instance, the hypothetical teacher has 16 years of professional experience, a salary of $32,224, is white, female, and has a masters degree. The teacher is in a district with a combined Tells test score of 43; 21% of the students are below grade level in math and reading. This is in fact a generally average teacher whose characteristics have been drawn from the means of each of the respective regressors. The logit model predicts that the absolute probability of the teacher working is .983, the absolute probability of retiring is .007[18], and the absolute probability of quitting is .010. Subsequent rows show the effects of different demographics, experience levels and salaries.

Table 7.6: Probabilities of Working, Retiring, Quitting with Varying Experience, Salary and Demographic Assumptions

| Experience (Years) | Salary (1990/1 $) | Race (NonWhite=1) | Sex (Female=1 | MA Degree | Probability Working | Retiring | Quitting |
|---|---|---|---|---|---|---|---|
| 16 | $32,224 | 0 | 1 | 1 | 0.983 | 0.007 | 0.010 |
| 16 | $32,224 | 0 | 0 | 1 | 0.984 | 0.005 | 0.011 |
| 16 | $32,224 | 0 | 0 | 0 | 0.985 | 0.006 | 0.009 |
| 8 | $25,080 | 0 | 1 | 1 | 0.958 | 0.006 | 0.037 |
| 8 | $25,080 | 0 | 0 | 1 | 0.959 | 0.001 | 0.036 |
| 8 | $25,080 | 0 | 0 | 0 | 0.964 | 0.005 | 0.032 |
| 4 | $25,000 | 0 | 1 | 1 | 0.912 | 0.002 | 0.086 |
| 4 | $30,000 | 0 | 1 | 1 | 0.933 | 0.002 | 0.065 |
| 4 | $20,000 | 0 | 1 | 1 | 0.885 | 0.003 | 0.112 |

Now, consider various hypothetical teachers with four years of experience. The model shows a slight (.002) probability of retiring. Note the effects of varying the teacher's salary on the probability of quitting: in moving from $25,000 to $30,000, a 20% increase in salary, the probability of quitting drops from .086 to .065, a 24.4% decrease. Thus, the elasticity of retention with respect to salary in this range of the model is +1.22 (24.4/20). Movement to the lower salary displays similarly large local elasticities. These calculations reflect not only the direct effect of salary on the relative odds of retiring and quitting, but also the effects of changing the relative salary in the two equations as well.

We may visualize the offsetting effects of salary on the decision to retire, and the decision to quit, by simultaneously varying the experience and salary of a hypothetical teacher, and graphing the resulting retirement and quit rates. To keep the calculations realistic, we tabulate median salaries by experience across all 91,000 teachers in this sample and use the medians with the model's

[18]We know that this is actually not possible under current law, and must treat this as a forecast error.

equations. The other assumptions employed for this graphical analysis are: white, female, trained at an out of state institution, Tells score of 43, and with a masters degree. The range of salaries used is $22,000 for one year of experience to $40,000 for 40 years of experience. These are median salaries as of 1989/90 across the state.

Figure 7.4 graphs the resulting retirement and quit rates, and the sum of the two. With 1 year of experience, the model predicts for the hypothetical teacher a quit rate of 20%. While this seems extremely high, it is consistent with studies in other states of particular teaching areas which find very high turnover rates in the first five years of experience. [19] It may also explain why new hires in districts averaged 40% with previous teaching experience. With 16 years of experience, the combined quit-retirement rates are at a minimum, and begin to grow rapidly. By 28 years of experience the retirement rate is projected to be 5%; there are essentially no measurable quit rates once a teacher obtains 20 years of experience. By 35 years of experience, the combined retirement-quit rate is 15%. While this may not seem very high, if one adds up the area under the curve from 20 years of experience through 35 years of experience, one will have the odds of the teacher who would have left teaching, and it is quite large.

Figure 7.5 shows the cumulative retirement and quit functions for the hypothetical teacher; the curves are the additions of predicted prior year retirement and quit rates. Note that by year 35, the cumulative retirement function shows the cumulative odds that a teacher will retire of 90%; the cumulative quit function shows the cumulative probability that a teacher will quit of 70%. These predictions are made under ordinary salary circumstances which we observe from the cross-section of teachers across experience groups.

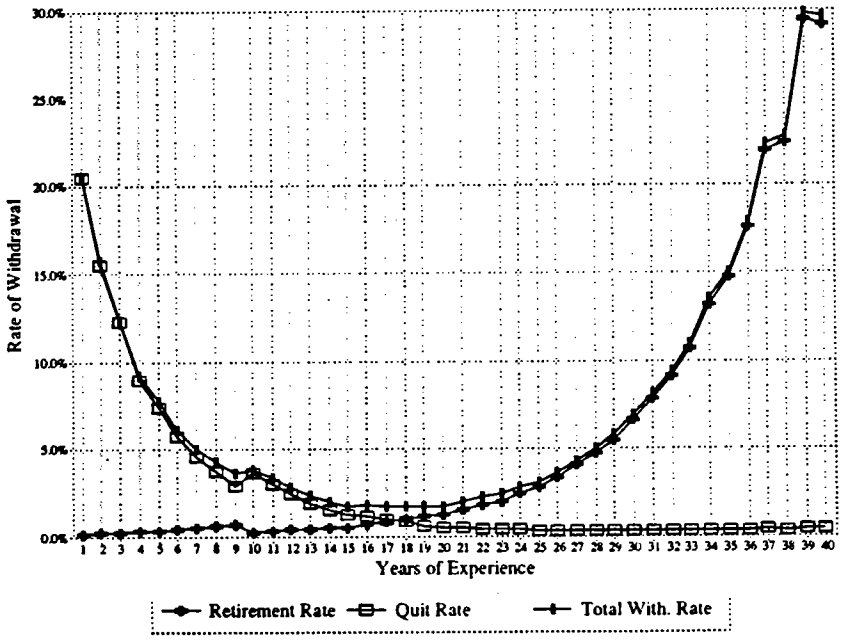



Figure 7.4: Hypothetical Teacher: Marginal Retirement and Quit Rates at Median Salaries

[19] see, for example, Kirby, Grissmer and Hudson (1991) and Grissmer and Kirby (1987).

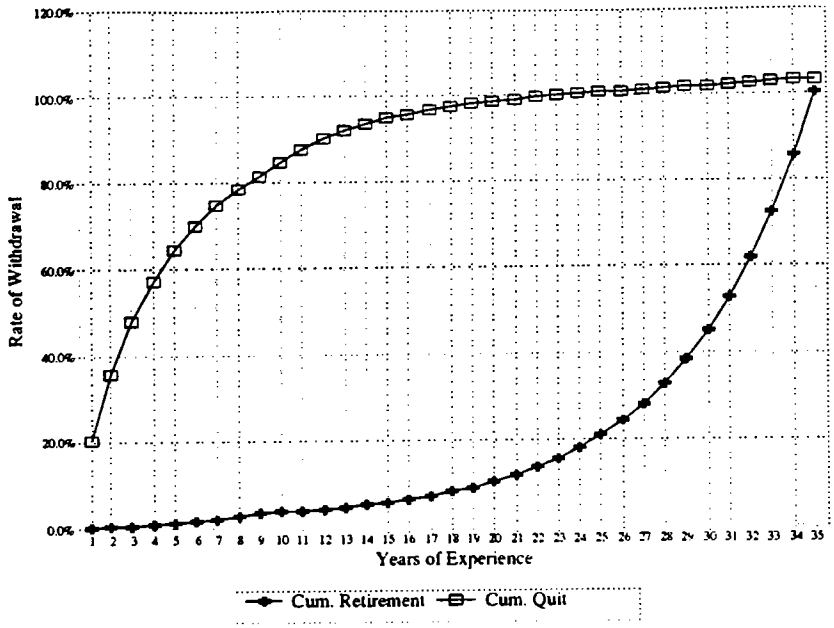



Figure 7.5: Cumulative Retirement, Quit and Total Rates at Median Salaries

Finally, let us examine the effects of below and above average salaries for this hypothetical teacher. We know from Table 7.4 that lower salaries will be associated with higher quit rates and more rapid retirement rates; conversely, higher salaries will be associated with lower quit rates, and slower retirement rates. Figures 7.6 displays the effects of the teacher receiving first quartile (relatively low) or third quartile (relatively high) salaries. The model shows quite dramatically that lower salaries will accelerate retirement rates by as much as 15 percentage points (see 37 years of experience). Also note that the effects of compensation differentials do not manifest themselves until after 20 years of experience.

For quit rates, differential compensation has an early dramatic effect. The teacher receiving the first quartile of salary is likely to quit with a probability of 24% in the first year; the teacher receiving a salary at the third quartile is likely to quit with a probability of 14%. By 20 years of experience, the effects of salary differentials on the hypothetical teacher's quit rate becomes negligible (See Figures 7.6 and 7.7).

This analysis of retirement and quit functions suggests strongly that compensation policy, which is ultimately affected by budget policy, impacts the ability of districts to retain teachers at various stages of their careers. Poorer districts which offer lower starting salaries find themselves with chronic turnover as teachers either move to higher paying teaching jobs or leave teaching altogether. Later, districts which pay below average salaries have difficulty retaining teachers who find retirement increasingly attractive. Districts which are able to provide ample compensation to their teachers will find that these teachers tend to stay rather than to retire.

It should be recalled that in the 1980's, average teacher salaries in Pennsylvania grew annually in real terms by 2.78%. We observed earlier that this sort of real wage increase has the effect of encouraging more college sophomores to pursue a teaching career. On the other hand, for older teachers, this sort of real wage growth has had the effect of prolonging their teaching careers rather than moving them into retirement.

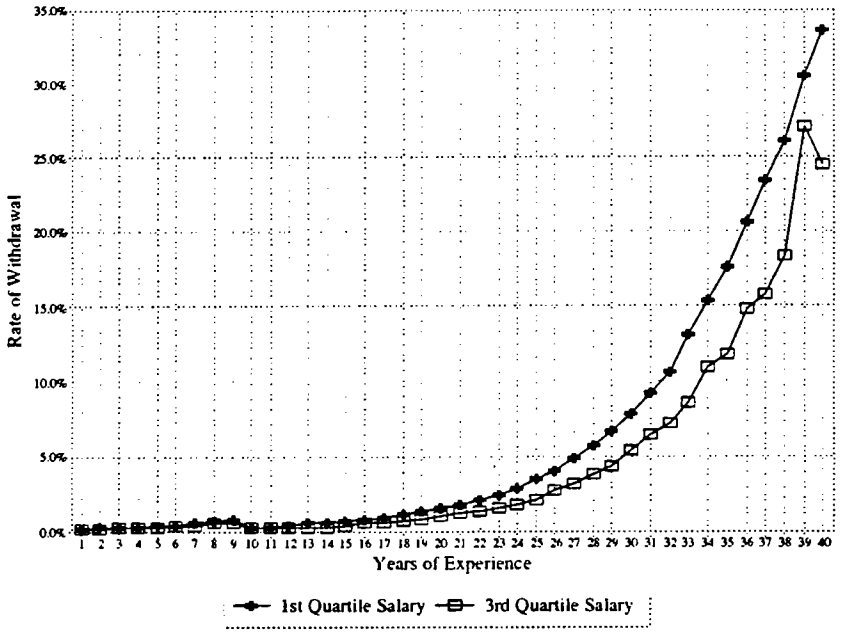



Figure 7.6: All Teachers: Marginal Retirement Rates: First and Third Quartile Salaries

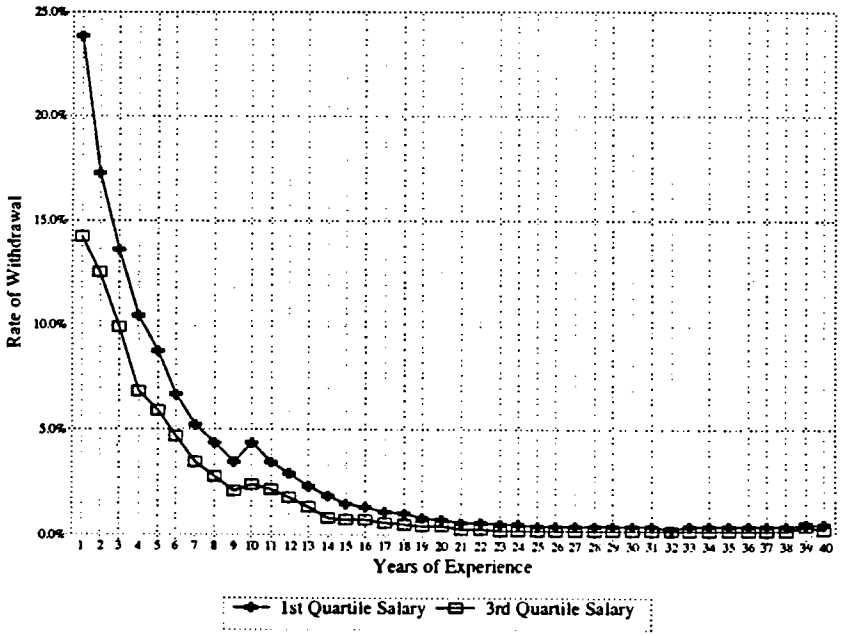



Figure 7.7: All Teachers: Marginal Quit Rates: First and Third Quartile Salaries

Finally, we shall utilize the logit model and the information about Pennsylvania's teachers in 1989/90 to make projections *over time* of the likely retirements and quits throughout the 1990's. These behavioral retirement and quit projections can be compared with the demographic projections calculated in Chapter 6. The logit model accounts for far more than simply age or experience; it accounts for the gender and race differences, possible nonlinearity in the effect of experience on the retirement and quit decisions through the use of experience squared, and the direct and relative effects of salary.

This temporal analysis must also take into account the fact that as the total experience and salary distribution of teachers shifts to the right, some will retire each year, making them unavailable for subsequent retirement. We must, therefore, account for the survival from the prior period of the 91,481 teachers, and also entertain assumptions about future salary growth.

By calculating the probability of retiring for each teacher, conditional on surviving to the beginning of the year, e.g. not having already retired or quit, and adding up the probability across teachers, we can form for each year an estimate of the number of teachers who will retire in that year. In so doing, we are making the assumption that three individuals who each has a probability of .33 of retiring in a year, constitute through aggregation, one retire.
[20]

It should also be noted that since we are not adding teachers to the inventory each period, there will be relatively few quits calculated. This is due to the heavy concentration of quits in the first year of experience. Fewer and fewer teachers will quit because of the behaviour noted in Figure 7.4.

Table 7.7 displays the results of simulating the logit model from 1989/90 through 2000. The simulation predicts that 21,881 teachers will retire across the forecast period, 1990/1-2000/1, while 19,251 will retire across the forecast period 1992/3-2000/1.

Figure 7.8 displays the annual and cumulative retirements predicted by the logit model simulated through time conditional on each person surviving, in probability terms, to the period in question. Under the assumption that salaries were to grow by 5.5% per year we find that in 1990/1, the first forecast year, 1,261 retirements are predicted to occur; in 1991/2 the number of predicted retirements rises to 1,369. Actual retirements in 1990/1 numbered 1,917, while in 1991/2 actual retirements numbered 2,075.[21]

[20] If we denote the predicted probability of withdrawing due to retirement or voluntarily quitting from the logit model in a year, t, as $W_t$, the remainder of an individual surviving at the end of the year, $S_t$ is 1-$W_t$. More generally, $S_t = (1 - W_t)S_{t-1}$.

[21] See Appendix D, Pennsylvania Department of Education, 1992, *Public Schools Personnel: 1991/2*, and Appendix D of the 1993 volume.

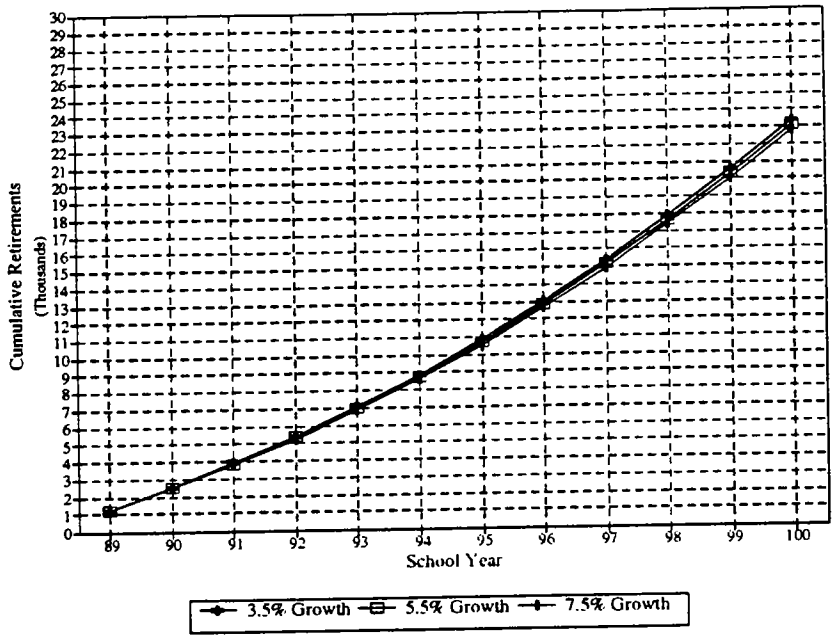



Figure 7.8: Cumulative and Annual Predicted Retirements at Different Salary Growth Rates from Multinomial Logit Model: 1989/90-2000/1

Table 7.7: Predicted Retirements from Logit Model: 1990/1-2000/1 under 5.5% Salary Growth Assumption

| School Year | Predicted Quits | Actual Retirement | Predicted Retirement | Cumulative Pred. Retirement |
|---|---|---|---|---|
| | [2] | [3] | [4] | [5] |
| 1989/0 | 2,861 | 1,251 | 1,251 | 1,251 |
| 1990/1 | 1,953 | 1,917 | 1,261 | 2,512 |
| 1991/2 | 1,495 | 2,075 | 1,369 | 3,881 |
| 1992/3 | 1,118 | NA | 1,494 | 5,375 |
| 1993/4 | 973 | NA | 1,635 | 7,010 |
| 1994/5 | 818 | NA | 1,788 | 8,798 |
| 1995/6 | 702 | NA | 1,951 | 10,749 |
| 1996/7 | 613 | NA | 2,122 | 12,871 |
| 1997/8 | 542 | NA | 2,299 | 15,170 |
| 1998/9 | 488 | NA | 2,471 | 17,641 |
| 1999/0 | 423 | NA | 2,656 | 20,297 |
| 2000/1 | 371 | NA | 2,835 | 23,132 |

Source: simulation model using logit model.

It is interesting to note that the retirement simulations performed with the logit model, which take into account survival odds, create more retirements during the decade than under the first of the three scenarios analyzed in Chapter 6. Contrast the 19,251 cumulative retirements here with the prediction of 9,860 retirements on the basis of retirement at age 65. Total hires due to teacher *and* student demographics were 21,692: 9,860 due to teacher retirements at age 65 + 11,832 due to student demographics.

On the other hand, the second scenario analyzed in Chapter 6 which was based on retirement at 30 years of service predicted that 32,427 teachers would retire through the balance of the decade. This second demographic retirement scenario thus predicts rather more (32,427-19,251 or 13,176) retirements than the logit model predicts. On the other hand, it should be noted that the logit model *underpredicted* 1990/1 and 1991/2 retirements. These considerations suggest that cumulative retirements in the range between 19,300 and 32,000 are most likely for the decade. In the interests of conservatism, we shall use 24,500 as a working estimate from these models.

Whether or not the assumed quits in Chapter 6 are too high is difficult to analyze. The logit simulations, made without replacement hires for either retires or quits, simply can not address that question because quits occur so early in the life cycle of a classroom teacher. We do know that if new graduates are used to replace retiring or quitting teachers, the initial quit rates will be high themselves. Certainly, persistence of the simulated quits in 1989/90 of 2,860 over a ten year period would generate the level of quits assumed in Chapter 6 (25,247 to 27,265). Again, recall the quit rates for inexperienced teachers displayed in Figure 7.4.[22]

[22]This probably explains why districts elect to hire experienced teachers from other districts as opposed to hiring just new graduates.

## 7.4 Summary

We have sought in this chapter to model the aggregate long run supply of new teaching graduates from Pennsylvania's certificating institutions. We find for the period 1965-1989 that economic opportunities represented by average, inflation-adjusted salaries, and average salaries relative to the general income level in Pennsylvania have significant and substantial effects on the decision to obtain teaching credentials. A question arises whether or not simply raising salaries to encourage more college sophomores to pursue teaching will effectively provide the predicted number of secondary school teachers who will be needed in the balance of the decade.

The statistical analysis of the decision to quit or retire confirms that experience and absolute and relative salaries affect both decisions. Moreover, there is evidence that both early in a teacher's career cycle and at the end, salaries affect, respectively, the decision to quit, and the decision to retire. In both instances, higher absolute and relative salaries reduce the odds of quitting and reduce the odds of retiring. While this is quite intuitive, it also suggests that the **composition** or **structure** of teacher salaries can have important effects on who remains in teaching. The very rapid growth in teacher salaries over the last several years has had several related effects;

- it has encouraged more college students to obtain teaching degrees;
- it has increased the odds that inexperienced teachers remain in their current teaching position; and,
- it has encouraged older teachers to postpone the retirement decision.

Application of the statistical model which predicts quits and retirements through the balance of the decade confirms the validity of the demographic retirement projections made in Chapter 6. It seems reasonable to expect that through the decade that between 19,300 and 32,000 teachers, say 24,500 as a conservative estimate, will retire. Student demographics will require, if student-teacher ratios are to remain constant, that an additional 11,382 teachers be hired. Finally, teacher quits will likely aggregate to some 25,000 replacement teachers being sought. Thus, it seems likely that some 60,000 plus teachers, out of a current inventory of about 100,000, will be replaced by individual districts by the close of the decade.

# Chapter 8

# Teachers, Curricula & Postsecondary Educational Plans

## 8.1 Introduction

In developing and applying the detailed demographic teacher demand model of Chapter 4, it was necessary to characterize secondary school curricula offerings. By linking student enrollments in various secondary courses to teacher certifications, we were able to make predictions about teacher needs by specialty through the balance of the decade. The development in Chapter 5 and 7 of "best practice" curricula estimates, which implies greater teacher needs, indicated that a significant number of districts do not offer advanced secondary school electives. We explore here the issue of differential access to curricula offerings in two steps: first, we diagnose differential curricula access in terms of the overall size and per capita income of school districts, and second, we examine the possible effects such differential access and other factors may have on students' post-secondary educational plans.

## 8.2 A Framework for Examining Curricula Access

The classification of school districts in terms of their overall enrollment size and per capita income is motivated by the observation that the scale and financial position of the residents of a district impact the district's ability to provide a diverse curricula. Few districts are able or willing to provide advanced classes when enrollment in such classes is less than five or seven students. Districts with larger enrollments will find, given student tastes, that they can offer a more diverse curricula. That is, they enjoy greater economies of scale.

We use per capita income as a measure of ability to pay, while some researchers have used median family income, assessed value per student, or used other techniques to characterize the economic position of a school district. This district economic position can, through the process which levies taxes, be translated into school resources. Median family income is not yet available from the 1990 Census of Population by school district, so we shall differentiate districts on the basis of their average or per capita income.

Per capita income is used as an component in the general school aid formula. By per capita income, however, we mean the ratio of **total** community income to **total** community population. Operationally, we divided 1990 taxable income per school district, as collected and reported by the Pennsylvania Department of Revenue, by the 1990 Census of Population enumeration of local area

Table 8.1: Distribution of School Districts by Enrollment Size and Percapita Income

| Total Enrollment | 1990 Per capita Taxable Income $4,681- $7,500 | $7,501- $9,450 | $9,451- $11,810 | $11,811- $39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 18 | 18 | 4 | 4 | 44 |
| 1,001 - 1,500 | 32 | 33 | 18 | 4 | 87 |
| 1,501 - 2,000 | 18 | 26 | 19 | 14 | 77 |
| 2,001 - 2,500 | 7 | 21 | 27 | 17 | 72 |
| 2,501 - 3,000 | 7 | 22 | 15 | 20 | 64 |
| 3,001 - 4,000 | 1 | 22 | 15 | 30 | 68 |
| 4,001 - 6,000 | 3 | 7 | 12 | 20 | 42 |
| 6,001 - 8,000 | 3 | 4 | 9 | 7 | 23 |
| 8,001 -10,001 | 1 | 3 | 2 | 7 | 13 |
| 10,001 -13,397 | 0 | 2 | 3 | 1 | 6 |
| Pittsburgh: 39,560 | 0 | 1 | 0 | 0 | 1 |
| Philadelphia: 191,632 | 1 | 0 | 0 | 0 | 1 |
| Total | 91 | 159 | 124 | 124 | 498 |

population, aggregated by the project to the school district level.

Table 8.1 shows the joint distribution of school districts by overall total enrollment size, based on 1990 enrollment counts, and 1990 per capita income. Note that Pittsburgh and Philadelphia, by virtue of their much larger scale, are shown separately. The per capita income ranges were chosen to create four groups of districts with roughly the same number of students (See Table 8.2 and Table 8.3) and the enrollment size groups were chosen to make ten groups of fairly comparable size. Note the important effect of Pittsburgh and Philadelphia in any of these comparisons; together they account for 234,020 students or 14.3% of the total Pennsylvania students; the two districts account for 13.8% of the state's secondary students.

Generally, we would expect that as one moves down such a table, one will find greater numbers of secondary school electives being offered, the scale effect, and, for a given size district, more electives being offered as one moves to the right in such a table. Higher income districts are able, through greater wage tax receipts and higher property tax revenues, to provide more secondary school electives.

## 8.3 Access to Secondary Electives: Advanced Placement

In recent years, the Pennsylvania Department of Education has collected data on enrollment in 14 different advanced placement courses. [1] These courses span the humanities, sciences, languages, mathematics and social sciences. The curricula for each of these courses is derived from national curricula, and a student who successfully passes a test administered by the College Board in such a course can receive college credit for the course at virtually any college or university in the U.S.. Overall, 49.8% of Pennsylvania's school districts offered one or several of these AP courses. Table 8.4 displays the percentage of school districts which offered any of these courses in 1989.

If we examine the total figures, we see that the fraction of districts offering such AP courses rises with the enrollment or size of the district: from a low of 15.9% of the districts in the smallest

[1] See Table5.35 for the complete list and median enrollment rates in 1989.

Table 8.2: Total Enrollment of School Districts by District Enrollment Size and Percapita Income

| Total Enrollment | 1990 Per capita Taxable Income $4,681- $7,500 | $7,501- $9,450 | $9,451- $11,810 | $11,811- $39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 13,662 | 13,407 | 3,496 | 3,070 | 33,635 |
| 1,001 - 1,500 | 38,972 | 41,301 | 22,853 | 5,638 | 108,764 |
| 1,501 - 2,000 | 30,602 | 45,327 | 33,461 | 23,999 | 133,389 |
| 2,001 - 2,500 | 15,583 | 46,942 | 61,302 | 37,848 | 161,675 |
| 2,501 - 3,000 | 17,858 | 59,823 | 41,774 | 55,550 | 174,955 |
| 3,001 - 4,000 | 3,687 | 75,554 | 51,878 | 101,177 | 232,296 |
| 4,001 - 6,000 | 13,240 | 33,229 | 58,254 | 96,307 | 201,030 |
| 6,001 - 8,000 | 20,162 | 28,526 | 62,552 | 46,961 | 158,201 |
| 8,001 -10,001 | 8,973 | 26,430 | 16,598 | 66,627 | 118,628 |
| 10,001 -13,397 | 0 | 24,121 | 35,531 | 10,406 | 70,058 |
| Pittsburgh: 39,560 | 0 | 39,388 | 0 | 0 | 39,388 |
| Philadelphia: 191,632 | 194.632 | 0 | 0 | 0 | 194,632 |
| Total | 357,371 | 434,048 | 387,669 | 447,553 | 1,626,651 |

Table 8.3: Total High School Enrollment of School Districts by District Enrollment Size and Percapita Income

| Total Enrollment | 1990 Per capita Taxable Income $4,681- $7,500 | $7,501- $9,450 | $9,451- $11,810 | $11,811- $39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 4,369 | 4,152 | 1,072 | 934 | 10,527 |
| 1,001 - 1,500 | 11,898 | 12,692 | 6,737 | 1,665 | 32,992 |
| 1,501 - 2,000 | 9,466 | 13,911 | 9,929 | 7,329 | 40,635 |
| 2,001 - 2,500 | 4,864 | 14,472 | 18,575 | 11,261 | 49,172 |
| 2,501 - 3,000 | 5,413 | 18,814 | 12,356 | 16,669 | 53,252 |
| 3,001 - 4,000 | 1,028 | 23,320 | 15,770 | 30,181 | 70,299 |
| 4,001 - 6,000 | 3,745 | 9,723 | 17,855 | 28,777 | 60,100 |
| 6,001 - 8,000 | 5,001 | 8,523 | 19,304 | 14,052 | 46,880 |
| 8,001 -10,001 | 2,772 | 7,366 | 5,242 | 19,140 | 34,520 |
| 10,001 -13,397 | 0 | 6,591 | 9,573 | 3,121 | 19,285 |
| Pittsburgh: 39,560 | 0 | 11,866 | 0 | 0 | 11,866 |
| Philadelphia: 191,632 | 55,094 | 0 | 0 | 0 | 55,094 |
| Total | 103,650 | 131,430 | 116,413 | 133,129 | 484,622 |

Table 8.4: Percent of Districts Offering Any Advanced Placement Courses

| Total Enrollment | 1990 Per capita Taxable Income $4,681-$7,500 | $7,501-$9,450 | $9,451-$11,810 | $11,811-$39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 16.7% | 11.1% | 25.0% | 25.0% | 15.9% |
| 1,001 - 1,500 | 15.6% | 9.1% | 38.9% | 75.0% | 20.7% |
| 1,501 - 2,000 | 16.7% | 30.8% | 52.6% | 78.6% | 41.6% |
| 2,001 - 2,500 | 28.6% | 47.6% | 48.1% | 58.8% | 48.6% |
| 2,501 - 3,000 | 14.3% | 45.5% | 53.3% | 85.0% | 56.3% |
| 3,001 - 4,000 | 100.0% | 59.1% | 73.3% | 83.3% | 73.5% |
| 4,001 - 6,000 | 100.0% | 57.1% | 91.7% | 70.0% | 76.2% |
| 6,001 - 8,000 | 33.3% | 50.0% | 100.0% | 85.7% | 78.3% |
| 8,001 -10,001 | 100.0% | 100.0% | 100.0% | 85.7% | 92.3% |
| 10,001 -13,397 | 0.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Pittsburgh: 39,560 | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 23.1% | 36.5% | 60.5% | 75.8% | 49.8% |

enrollment category, 255-1,000, to 100.0% for districts with 10,000 or more students. These percentages can be viewed as probabilities, conditional on the size of the district, that a student in a district of a given size might have access to such an advanced placement course.

If we examine the last row of Table 8.4, we observe that the percentage of districts which offer any advanced placement course rises with the per capita income of the district: from a low of 23.1% of districts with the lowest per capita income, to a high of 75.8% of districts with the highest per capita income. Again, these percentages can be viewed as probabilities, conditional on the per capita income of the district, that a student in a district of a given per capita income might have access to such an advanced placement course. It is evident that the range of the scale effect (compare 100.0% to 15.9%) is much greater than the range of the per capita income effect (compare 75.8% to 23.1%). However, the extent of variation in access by size or per capita income may raise questions about the quality of education which is generally available to students in smaller, lower per capita income districts.

## 8.4 Access to Secondary Electives: Science and Math

We next examine the extent to which districts offer elective science and math courses. The availability of elective biology, chemistry and physics courses are determined by positive enrollment in the respective second year course, and/or respective Advanced Placement course as reported to the Pennsylvania Department of Education in 1988/9. [2]

With respect to advanced biology, half of the smallest (enrollment of 255-1,000) districts (9 of 18) offered such a course, while among the middle and top per capita income groups, either all (4 of 4) or 3/4 (3 of 4) offered such a course. If one examines the overall percentage of districts which offer advanced biology, we see that 63.6% of the smallest districts offer the course, and that this

[2]The project had available such enrollment reports from the mid-1980's through the early 1990's; however only the more recent years data contain Advanced Placement information. The availability of courses across time was extremely stable.

Table 8.5: Percent of Districts Offering Advanced Biology

| Total Enrollment | 1990 Per capita Taxable Income $4,681-$7,500 | $7,501-$9,450 | $9,451-$11,810 | $11,811-$39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 50.0% | 66.7% | 100.0% | 75.0% | 63.6% |
| 1,001 - 1,500 | 71.9% | 60.6% | 88.9% | 50.0% | 70.1% |
| 1,501 - 2,000 | 61.1% | 92.3% | 73.7% | 85.7% | 79.2% |
| 2,001 - 2,500 | 71.4% | 85.7% | 77.8% | 82.4% | 80.6% |
| 2,501 - 3,000 | 85.7% | 86.4% | 73.3% | 85.0% | 82.8% |
| 3,001 - 4,000 | 0.0% | 90.9% | 46.7% | 83.3% | 76.5% |
| 4,001 - 6,000 | 66.7% | 100.0% | 91.7% | 95.0% | 92.8% |
| 6,001 - 8,000 | 66.7% | 100.0% | 100.0% | 100.0% | 95.6% |
| 8,001 -10,001 | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| 10,001 -13,397 | 0.0% | 50.0% | 100.0% | 100.0% | 80.0% |
| Pittsburgh: 39,560 | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 65.6% | 81.1% | 79.0% | 86.6% | 79.1% |

fraction rises to a high of 100% for districts in the 8,000-10,000 enrollment size. If we examine the lowest per capita income districts, we find that 65.6% of them offer advanced biology, and that this percentage rises to 86.3% for the highest per capita income districts. Overall, 394 of 498 districts or 79.1 % of the districts offer advanced biology.

We note again that the overall fraction of districts offering advanced biology rises with enrollment size, from a low of 63.6% to a high of 100.0%, and rises with per capita income from a low of 65.6% in the lowest per capita income group, to a high of 86.6% in the highest per capita income group. The range of variation in the fraction of districts offering advanced biology, due to the size of the district, is somewhat larger than the range of variation, due to the per capita income of the district.

The pattern of advanced chemistry is quite similar as shown in Table 8.6. Overall, 344 of 498 districts or 69% offer some form of advanced chemistry. Only 43.2% of the smallest districts offer it, and the fraction offering the course rises with the size of the district; fully 100.0% of the districts in the 8,000-10,000 enrollment size offer advanced chemistry. Also, the fraction of districts offering advanced chemistry rises across per capita income groups; from 58.2% of the districts in the lowest per capita income group to 80.6% of the districts in the highest group.

The overall pattern of districts offering advanced chemistry by enrollment size and per capita income follows the earlier pattern in which the scale effect is larger than the per capita effect in districts offering advanced chemistry. Overall, 43.3% of the smallest districts offered advanced chemistry, while 100.0% of the largest districts offered advanced chemistry; the respective range of variation from lowest per capita income districts to highest per capita income districts was 58.2% to 80.6%.

The pattern of districts offering advanced physics follows the same pattern, Overall, 157 of 498 or 31.5% of the districts offer advanced physics; only 9.1% of the smallest districts offer advanced physics, while 66.7% of the largest districts offer this course. Only 15.4% of the districts in the lowest per capita income group offer advanced physics, while 49.2% of the districts in the highest per capita income districts offer advanced physics. (See Table 8.7.)

While 462 of 498 districts offer some form of calculus, we note that, again, the smaller, lower

Table 8.6: Percent of Districts Offering Advanced Chemistry

| Total Enrollment | 1990 Per capita Taxable Income $4,681-$7,500 | $7,501-$9,450 | $9,451-$11,810 | $11,811-$39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 44.4% | 27.8% | 100.0% | 50.0% | 43.2% |
| 1,001 - 1,500 | 53.1% | 45.5% | 55.6% | 50.0% | 50.6% |
| 1,501 - 2,000 | 66.7% | 65.4% | 63.2% | 85.7% | 68.8% |
| 2,001 - 2,500 | 100.0% | 71.4% | 66.7% | 70.6% | 73.4% |
| 2,501 - 3,000 | 42.9% | 81.8% | 60.0% | 85.0% | 79.1% |
| 3,001 - 4,000 | 100.0% | 86.4% | 66.7% | 80.0% | 85.7% |
| 4,001 - 6,000 | 100.0% | 85.7% | 91.7% | 80.0% | 82.6% |
| 6,001 - 8,000 | 0.0% | 100.0% | 88.9% | 100.0% | 100.0% |
| 8,001 -10,001 | 100.0% | 100.0% | 100.0% | 100.0% | 80.0% |
| 10,001 -13,397 | 0.0% | 50.0% | 100.0% | 100.0% | |
| Pittsburgh: 39,560 | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 58.2% | 65.4% | 70.2% | 80.6% | 69.1% |

Table 8.7: Percent of Districts Offering Advanced Physics

| Total Enrollment | 1990 Per capita Taxable Income $4,681-$7,500 | $7,501-$9,450 | $9,451-$11,810 | $11,811-$39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 0.0% | 5.6% | 50.0% | 25.0% | 9.1% |
| 1,001 - 1,500 | 18.8% | 6.1% | 22.2% | 50.0% | 16.1% |
| 1,501 - 2,000 | 22.2% | 3.8% | 26.3% | 21.4% | 16.9% |
| 2,001 - 2,500 | 0.0% | 28.6% | 25.9% | 47.1% | 79.2% |
| 2,501 - 3,000 | 14.3% | 36.4% | 20.0% | 50.0% | 34.4% |
| 3,001 - 4,000 | 0.0% | 40.9% | 46.7% | 46.7% | 44.0% |
| 4,001 - 6,000 | 0.0% | 28.6% | 50.0% | 65.0% | 50.0% |
| 6,001 - 8,000 | 33.3% | 100.0% | 66.7% | 85.7% | 73.9% |
| 8,001 -10,001 | 100.0% | 66.7% | 100.0% | 57.1% | 69.2% |
| 10,001 -13,397 | 0.0% | 100.0% | 66.7% | 0.0% | 66.7% |
| Pittsburgh: 39,560 | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 15.4% | 23.9% | 35.5% | 49.2% | 31.5% |

Table 8.8: Percent of Districts Offering Any Calculus

| Total Enrollment | 1990 Per capita Taxable Income $4,681-$7,500 | $7,501-$9,450 | $9,451-$11,810 | $11,811-$39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 55.6% | 77.8% | 100.0% | 100.0% | 72.2% |
| 1,001 - 1,500 | 78.1% | 93.9% | 94.4% | 100.0% | 88.5% |
| 1,501 - 2,000 | 94.4% | 88.5% | 100.0% | 92.9% | 93.5% |
| 2,001 - 2,500 | 100.0% | 90.5% | 96.3% | 94.1% | 94.4% |
| 2,501 - 3,000 | 100.0% | 90.9% | 100.0% | 100.0% | 96.9% |
| 3,001 - 4,000 | 100.0% | 95.5% | 93.3% | 100.0% | 97.1% |
| 4,001 - 6,000 | 66.7% | 100.0% | 100.0% | 100.0% | 97.6% |
| 6,001 - 8,000 | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| 8,001 -10,001 | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| 10,001 -13,397 | 0.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Pittsburgh: 39,560 | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 81.3% | 91.2% | 97.6% | 98.4% | 92.8% |

income districts offer calculus with less frequency. Only 72.2% of the smallest districts offer some form of calculus, while 100% of the districts with enrollments of 6,000 *or more* offer the course. Similarly, 81.3% of the districts in the lowest per capita income group offer some form of calculus, while 98.4% of those districts in the highest per capita income group offer the course.

## 8.5 Access to Secondary Electives: Social Studies

Tables 8.9, 8.10, 8.11, 8.12, 8.13, 8.14, and 8.15 display the percentages of districts which offer respectively, Anthropology, Economics, Geography, Civic/Government, Pennsylvania History, Psychology, and Sociology. The patterns of offerings are similar to those above for advanced placement, science and math courses in that greater fractions of districts offer these courses as one moves across the groups of districts with higher per capita incomes for Anthropology, Economics, Psychology and Sociology (e.g. four of the seven social studies courses measured). On the other hand, the pattern with respect to the scale effect is much more idiosyncratic. Both small and large districts tend not to offer Anthropology, while we find generally increasing frequency of offerings as scale increases for Economics, Geography, Psychology and Sociology.

Table 8.9: Percent of Districts Offering Anthropology

| Total Enrollment | 1990 Per capita Taxable Income $4,681-$7,500 | $7,501-$9,450 | $9,451-$11,810 | $11,811-$39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 0.0% | 0.0% | 0.0% | 0.0% | 0% |
| 1,001 - 1,500 | 6.3% | 6.1% | 16.7% | 25.0% | 9.2% |
| 1,501 - 2,000 | 0.0% | 7.7% | 5.3% | 21.4% | 7.8% |
| 2,001 - 2,500 | 0.0% | 0.0% | 14.8% | 0.0% | 5.6% |
| 2,501 - 3,000 | 14.3% | 4.5% | 26.7% | 35.0% | 20.3% |
| 3,001 - 4,000 | 0.0% | 18.2% | 6.7% | 20.0% | 16.2% |
| 4,001 - 6,000 | 33.3% | 28.6% | 33.3% | 15.0% | 23.8% |
| 6,001 - 8,000 | 0.0% | 0.0% | 11.1% | 28.6% | 13.0% |
| 8,001 -10,001 | 0.0% | 33.3% | 0.0% | 0.0% | 7.0% |
| 10,001 -13,397 | 0.0% | 0.0% | 0.0% | 100.0% | 16.7% |
| Pittsburgh: 39,560 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 5.5% | 7.5% | 14.5% | 18.5% | 11.6% |

Table 8.10: Percent of Districts Offering Economics

| Total Enrollment | 1990 Per capita Taxable Income $4,681-$7,500 | $7,501-$9,450 | $9,451-$11,810 | $11,811-$39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 55.6% | 72.2% | 75.0% | 100.0% | 68.2% |
| 1,001 - 1,500 | 43.8% | 72.7% | 61.1% | 100.0% | 60.9% |
| 1,501 - 2,000 | 72.2% | 65.4% | 47.4% | 78.6% | 64.9% |
| 2,001 - 2,500 | 85.7% | 76.2% | 74.1% | 82.4% | 77.8% |
| 2,501 - 3,000 | 57.1% | 59.1% | 73.3% | 90.0% | 71.9% |
| 3,001 - 4,000 | 100.0% | 81.8% | 73.3% | 83.3% | 80.9% |
| 4,001 - 6,000 | 100.0% | 85.7% | 83.3% | 90.0% | 88.1% |
| 6,001 - 8,000 | 100.0% | 50.0% | 77.8% | 85.7% | 78.3% |
| 8,001 -10,001 | 100.0% | 66.7% | 100.0% | 71.4% | 76.9% |
| 10,001 -13,397 | 0.0% | 100.0% | 66.7% | 100.0% | 83.3% |
| Pittsburgh: 39,560 | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 61.5% | 71.7% | 69.4% | 85.7% | 72.7% |

Table 8.11: Percent of Districts Offering Geography

| Total Enrollment | 1990 Per capita Taxable Income $4,681- $7,500 | $7,501- $9,450 | $9,451- $11,810 | $11,811- $39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 77.8% | 83.3% | 75.0% | 75.0% | 79.5% |
| 1,001 - 1,500 | 68.8% | 81.8% | 77.8% | 25.0% | 73.6% |
| 1,501 - 2,000 | 88.9% | 76.9% | 84.2% | 71.4% | 80.5% |
| 2,001 - 2,500 | 71.4% | 71.4% | 63.0% | 82.4% | 70.8% |
| 2,501 - 3,000 | 57.1% | 63.6% | 80.0% | 80.0% | 71.9% |
| 3,001 - 4,000 | 100.0% | 86.4% | 66.7% | 73.3% | 76.5% |
| 4,001 - 6,000 | 33.3% | 85.7% | 91.7% | 65.0% | 73.8% |
| 6,001 - 8,000 | 66.7% | 100.0% | 88.9% | 42.9% | 73.9% |
| 8,001 -10,001 | 100.0% | 66.7% | 50.0% | 100.0% | 84.6% |
| 10,001 -13,397 | 0.0% | 100.0% | 100.0% | 0.0% | 83.3% |
| Pittsburgh: 39,560 | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 73.6% | 78.6% | 76.6% | 71.8% | 75.5% |

Table 8.12: Percent of Districts Offering Civics/Government

| Total Enrollment | 1990 Per capita Taxable Income $4,681- $7,500 | $7,501- $9,450 | $9,451- $11,810 | $11,811- $39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 88.9% | 88.9% | 75.0% | 75.0% | 86.4% |
| 1,001 - 1,500 | 93.8% | 97.0% | 94.4% | 75.0% | 94.3% |
| 1,501 - 2,000 | 100.0% | 88.5% | 89.5% | 71.4% | 88.3% |
| 2,001 - 2,500 | 85.7% | 95.2% | 88.9% | 94.1% | 91.7% |
| 2,501 - 3,000 | 100.0% | 90.9% | 93.3% | 95.0% | 93.8% |
| 3,001 - 4,000 | 100.0% | 86.4% | 93.3% | 90.0% | 89.7% |
| 4,001 - 6,000 | 100.0% | 85.7% | 91.7% | 90.0% | 90.5% |
| 6,001 - 8,000 | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| 8,001 -10,001 | 100.0% | 100.0% | 50.0% | 100.0% | 92.3% |
| 10,001 -13,397 | 0.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Pittsburgh: 39,560 | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 94.5% | 91.8% | 91.1% | 89.5% | 91.5% |

Table 8.13: Percent of Districts Offering Pennsylvania History

| Total Enrollment | 1990 Per capita Taxable Income $4,681- $7,500 | $7,501- $9,450 | $9,451- $11,810 | $11,811- $39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 66.7% | 61.1% | 75.0% | 25.0% | 61.4% |
| 1,001 - 1,500 | 50.0% | 72.7% | 44.4% | 25.0% | 56.3% |
| 1,501 - 2,000 | 66.7% | 61.5% | 36.8% | 42.9% | 53.2% |
| 2,001 - 2,500 | 42.9% | 47.6% | 37.0% | 11.8% | 34.7% |
| 2,501 - 3,000 | 71.4% | 50.0% | 53.3% | 30.0% | 46.9% |
| 3,001 - 4,000 | 0.0% | 63.6% | 46.7% | 26.7% | 42.6% |
| 4,001 - 6,000 | 33.3% | 57.1% | 50.0% | 40.0% | 45.2% |
| 6,001 - 8,000 | 33.3% | 0.0% | 22.2% | 0.0% | 13.0% |
| 8,001 -10,001 | 0.0% | 100.0% | 0.0% | 14.3% | 30.8% |
| 10,001 -13,397 | 0.0% | 0.0% | 0.0% | 100.0% | 16.7% |
| Pittsburgh: 39,560 | 0.0% | 0.0% | 0.0% | 0.0% | 0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 56.0% | 58.5% | 41.1% | 27.4% | 46.0% |

Table 8.14: Percent of Districts Offering Psychology

| Total Enrollment | 1990 Per capita Taxable Income $4,681- $7,500 | $7,501- $9,450 | $9,451- $11,810 | $11,811- $39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 16.7% | 22.2% | 50.0% | 75.0% | 27.3% |
| 1,001 - 1,500 | 34.4% | 45.5% | 33.3% | 75.0% | 40.2% |
| 1,501 - 2,000 | 22.2% | 61.5% | 57.9% | 57.1% | 50.6% |
| 2,001 - 2,500 | 85.7% | 66.7% | 70.4% | 70.6% | 70.8% |
| 2,501 - 3,000 | 71.4% | 68.2% | 66.7% | 70.0% | 68.8% |
| 3,001 - 4,000 | 100.0% | 63.6% | 66.7% | 86.7% | 75.0% |
| 4,001 - 6,000 | 66.7% | 85.7% | 83.3% | 90.0% | 85.7% |
| 6,001 - 8,000 | 66.7% | 75.0% | 100.0% | 71.4% | 82.6% |
| 8,001 -10,001 | 100.0% | 66.7% | 100.0% | 42.9% | 61.5% |
| 10,001 -13,397 | 0.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Pittsburgh: 39,560 | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 39.6% | 57.9% | 66.1% | 75.0% | 60.8% |

Table 8.15: Percent of Districts Offering Sociology

| Total Enrollment | 1990 Per capita Taxable Income $4,681- $7,500 | $7,501- $9,450 | $9,451- $11,810 | $11,811- $39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 38.9% | 33.3% | 75.0% | 75.0% | 43.2% |
| 1,001 - 1,500 | 28.1% | 45.5% | 61.1% | 50.0% | 42.5% |
| 1,501 - 2,000 | 50.0% | 53.8% | 78.9% | 50.0% | 58.4% |
| 2,001 - 2,500 | 57.1% | 57.1% | 63.0% | 70.6% | 62.5% |
| 2,501 - 3,000 | 57.1% | 54.5% | 80.0% | 60.0% | 62.5% |
| 3,001 - 4,000 | 100.0% | 72.7% | 66.7% | 66.7% | 69.1% |
| 4,001 - 6,000 | 100.0% | 100.0% | 83.3% | 95.0% | 92.9% |
| 6,001 - 8,000 | 100.0% | 100.0% | 66.7% | 71.4% | 78.3% |
| 8,001 -10,001 | 100.0% | 33.3% | 50.0% | 100.0% | 76.9% |
| 10,001 -13,397 | 0.0% | 50.0% | 100.0% | 100.0% | 83.3% |
| Pittsburgh: 39,560 | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 46.2% | 56.0% | 71.0% | 71.0% | 61.6% |

## 8.6 Spatial Aspects of Access

Having analyzed the availability of advanced science and math courses by district enrollment and per capita income characteristics, we now examine the spatial aspects of access to these courses. Table 8.16 displays the fraction of districts by MSA which offer any Advanced Placement course. It is evident that there are wide spatial differences in the extent to which districts offer such courses. Overall, 49.8% of the districts offered some form of an AP course; however in the Erie MSA, only 15.4% of the districts did so, while in the Philadelphia MSA, 80.7% of the districts offered an AP course. Note also that in the Beaver MSA, only 14.3% of the districts offered an AP course. Furthermore, only 30.2% of the rural districts in Pennsylvania offered an AP course.

If we weight these percentages by the number of high school students in each district, we may calculate the fraction of high school students in the MSA's districts who have "potential" access to an AP course. Again, the figures for Erie and Beaver are quite low, although we observe that 33.6% of Erie's high school students have potential access to an AP course. This suggests that the number of districts which do not offer AP in that MSA must be small. On the other hand, only 18% of the high school students in the Beaver MSA's have potential access to an AP course; Sharon and Johnstown's figures are also quite low at 45.2% and 48.7% respectively.

Table 8.17 shows by MSA the fraction of districts which offer the four types of advanced courses. It is clear that there are significant spatial differences across MSA's for a particular course, and within an MSA across types of advanced courses. For example, the four districts in State College MSA offer advanced biology, while only 30% of the districts in the Johnstown MSA offer such a course. On the other hand, only one of the four districts within State College MSA offers advanced physics, while only four of Johnstown's 23 districts, or 17.3%, offer advanced physics. Only one of Sharon's 12 districts offers advanced physics (See columns [3], [4], [5] and [6] of Table 8.17).

The fraction of high school students who have potential access to such courses across metropolitan areas, is shown in columns [8] through [11] of Table 8.17. Again, there are wide variations in this measure of access across MSA's for a given advanced science or math course, and within MSA's across these courses. We see that 35% of Johnstown's high school students are in districts which

Table 8.16: Percent of Districts and Students in MSAs Offering Any Advanced Placement Courses

| MSA | Dists. | % AP | HS Students | % with AP |
|---|---|---|---|---|
| Allentown | 22 | 40.9% | 24,021 | 62.6% |
| Altoona | 7 | 42.9% | 6,443 | 73.7% |
| Erie | 13 | 15.4% | 12,832 | 33.6% |
| Harrisburg | 29 | 62.1% | 26,791 | 74.4% |
| Johnstown | 23 | 34.8% | 11,141 | 48.7% |
| Lancaster | 16 | 81.3% | 16,507 | 88.7% |
| Scranton | 33 | 57.6% | 29,168 | 65.0% |
| Philadelphia | 62 | 80.7% | 130,745 | 94.9% |
| Pittsburgh | 80 | 65.0% | 84,792 | 74.2% |
| Reading | 18 | 55.6% | 14,456 | 61.2% |
| Sharon | 12 | 33.3% | 5,901 | 45.2% |
| State College | 4 | 50.0% | 3,889 | 58.5% |
| Williamsport | 8 | 50.0% | 5,694 | 71.1% |
| York | 21 | 52.4% | 16,676 | 55.0% |
| Beaver | 14 | 14.3% | 8,675 | 18.0% |
| Non-MSA | 136 | 30.2% | 86,891 | 43.8% |
| Total | 498 | 49.8% | 484,622 | 68.7% |

offer advanced biology, but only 24.5% of the high school students in Johnstown's districts have potential access to advanced physics. In Sharon, only 12.4% of the high school students have potential access to this course. Contrast these figures with Williamsport: 75.9% of the high school students have potential access to advanced biology, 80.5% have potential access to advanced chemistry and 70% have potential access to advanced physics.

Table 8.17: Percentage of Districts Offering Science and Math Electives by MSA: 1988/9

| MSA | No. of Dists. | % SDs with Adv. Biology | % SDs with Adv. Chemistry | % SDs with Adv. Physics | % SDs with Adv. Calculus | No. of HS Students | % Students with Access Adv Bio. | % Students with Access Adv Chem. | % Students with Access Adv Phys. | % Students with Access Any Calc. |
|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] |
| Allentown | 22 | 68.2% | 63.6% | 27.3% | 100.0% | 24,021 | 81.4% | 78.0% | 48.8% | 100.0% |
| Altoona | 7 | 57.1% | 57.1% | 28.6% | 85.7% | 6,443 | 74.1% | 77.9% | 63.1% | 96.7% |
| Erie | 13 | 53.9% | 69.2% | 30.8% | 76.9% | 12,832 | 72.1% | 83.6% | 55.4% | 83.7% |
| Harrisburg | 29 | 86.2% | 69.0% | 37.9% | 96.6% | 26,791 | 85.4% | 78.5% | 41.2% | 98.6% |
| Johnstown | 23 | 30.4% | 65.2% | 17.4% | 87.0% | 11,141 | 35.0% | 74.5% | 24.5% | 93.5% |
| Lancaster | 16 | 62.5% | 81.3% | 43.8% | 93.8% | 16,507 | 68.1% | 87.6% | 42.5% | 96.4% |
| Scranton | 33 | 84.9% | 72.7% | 27.3% | 90.9% | 29,168 | 87.3% | 81.7% | 43.2% | 94.1% |
| Philadelphia | 62 | 90.3% | 71.0% | 41.9% | 98.4% | 130,745 | 96.5% | 88.2% | 70.5% | 99.5% |
| Pittsburgh | 80 | 86.3% | 85.0% | 43.8% | 93.8% | 84,792 | 88.3% | 86.2% | 57.7% | 97.3% |
| Reading | 18 | 94.4% | 77.8% | 38.9% | 100.0% | 14,456 | 80.1% | 67.9% | 45.9% | 100.0% |
| Sharon | 12 | 75.0% | 16.7% | 8.3% | 100.0% | 5,901 | 79.0% | 15.5% | 12.4% | 100.0% |
| State College | 4 | 100.0% | 50.0% | 25.0% | 75.0% | 3,889 | 100.0% | 58.5% | 44.2% | 80.3% |
| Williamsport | 8 | 75.0% | 62.5% | 62.5% | 87.5% | 5,694 | 75.9% | 80.5% | 70.0% | 94.3% |
| York | 21 | 85.7% | 81.0% | 47.6% | 100.0% | 16,676 | 84.8% | 77.1% | 51.8% | 100.0% |
| Beaver | 14 | 85.7% | 78.6% | 28.6% | 100.0% | 8,675 | 92.3% | 87.5% | 40.5% | 100.0% |
| Non-MSA | 136 | 78.7% | 60.3% | 18.4% | 88.2% | 86,891 | 85.7% | 71.7% | 30.3% | 92.7% |

As noted in Chapter 7, school districts are required to offer several foreign languages. The Department of Education collects enrollment data by level of course, e.g. French 1 (first year French), French 2 (second year French), etc.. We differentiate between a first year course and an advanced course; here, "advanced" means the presence of enrollment in a 4th or 5th year course and/or enrollment in the AP language which is advanced.

Table 8.18 displays the percentage of districts which offer initial and advanced French, German, Italian, Latin, Russian and Spanish by MSA. Spanish is by far the most prevalent basic language offered; 100% of 3/4 of the MSA districts offer it. French is the next most prevalent basic language offered; 100% of 1/4 of the MSA districts offer it, and better than 70% of the districts in each of the other MSA's offer French. The pattern of advanced courses is much more diverse. Districts in the Altoona, Erie, Johnstown, Reading, and Sharon MSA's, and the Non-MSA part of the State generally do not offer advanced language courses. For example, while 84.6% of Erie's districts offer basic French, only 7.7% of the districts offer advanced French. The pattern persists across the other languages: German, Italian, Latin, Russian, and Spanish. In each of these languages, fewer than 10% of Erie's districts offer advanced versions of the course.

Table 8.18: Percentage of Districts Offering Basic and Advanced Languages by MSA: 1988/9

| MSA | % Dist French | % Dist AdvFr | % Dist German | % Dist AdvGer | % Dist Italian | % Dist AdvItal | % Dist Latin | % Dist AdvLat | % Dist Russian | % Dist AdvRuss | % Dist Spanish | % Dist AdvSpan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Allentown | 81.8% | 31.8% | 95.5% | 27.3% | 9.1% | 4.6% | 27.3% | 9.1% | 0.0% | 0.0% | 90.9% | 27.3% |
| Altoona | 100.0% | 14.3% | 28.6% | 14.3% | 0.0% | 0.0% | 28.6% | 14.3% | 0.0% | 0.0% | 100.0% | 28.6% |
| Erie | 84.6% | 7.7% | 38.5% | 0.0% | 7.7% | 0.0% | 23.1% | 0.0% | 7.7% | 0.0% | 92.3% | 7.7% |
| Harrisburg | 93.1% | 27.6% | 62.1% | 17.2% | 0.0% | 0.0% | 55.2% | 31.0% | 3.5% | 0.0% | 100.0% | 24.1% |
| Johnstown | 78.3% | 4.4% | 13.0% | 4.4% | 0.0% | 0.0% | 0.0% | 0.0% | 4.4% | 0.0% | 100.0% | 4.4% |
| Lancaster | 68.8% | 25.0% | 100.0% | 31.3% | 6.3% | 0.0% | 37.5% | 6.3% | 12.5% | 0.0% | 100.0% | 31.3% |
| Scranton | 97.0% | 18.2% | 42.4% | 6.1% | 6.1% | 3.0% | 27.3% | 6.1% | 6.0% | 0.0% | 100.0% | 21.2% |
| Philadelphia | 100.0% | 56.5% | 83.9% | 27.4% | 9.7% | 9.7% | 46.8% | 29.0% | 9.7% | 1.6% | 100.0% | 50.0% |
| Pittsburgh | 97.5% | 32.5% | 58.8% | 13.8% | 3.8% | 1.3% | 36.3% | 12.5% | 10.0% | 1.3% | 100.0% | 35.0% |
| Reading | 77.8% | 11.1% | 100.0% | 16.7% | 5.6% | 0.0% | 50.0% | 11.1% | 5.6% | 0.0% | 100.0% | 16.7% |
| Sharon | 75.0% | 8.3% | 41.7% | 8.3% | 0.0% | 0.0% | 50.0% | 16.7% | 0.0% | 0.0% | 100.0% | 0.0% |
| State College | 100.0% | 75.0% | 50.0% | 25.0% | 0.0% | 0.0% | 50.0% | 0.0% | 25.0% | 0.0% | 100.0% | 75.0% |
| Williamsport | 100.0% | 25.0% | 50.0% | 12.5% | 0.0% | 0.0% | 25.0% | 12.5% | 0.0% | 0.0% | 100.0% | 37.5% |
| York | 100.0% | 19.1% | 66.7% | 14.3% | 0.0% | 0.0% | 42.9% | 14.3% | 4.8% | 0.0% | 95.2% | 9.5% |
| Beaver | 100.0% | 14.3% | 42.9% | 0.0% | 7.1% | 0.0% | 42.9% | 21.4% | 0.0% | 0.0% | 100.0% | 21.4% |
| Non-MSA | 89.0% | 7.4% | 41.2% | 2.9% | 0.7% | 0.0% | 23.5% | 8.1% | 4.4% | 0.7% | 91.9% | 11.0% |

If we weight the percentages in Table 8.18 by the number of high school students in the districts by MSA (see Table 8.19), the same general pattern emerges. Now, 92.1% of Erie's high school students have access to basic French, but only 28.9% have access to advanced French. Also note that the weighted advanced figures for Johnstown, Sharon, Beaver and the non-MSA districts are all under 25%.

Table 8.19: Percentage of Students in Districts Offering Basic and Advanced Languages by MSA: 1988/9

| MSA | % Stud. French | % Stud. AdvFr | % Stud. German | % Stud. AdvGer | % Stud. Italian | % Stud. AdvItal | % Stud. Latin | % Stud. AdvLat | % Stud. Russian | % Stud. AdvRuss | % Stud. Spanish | % Stud. AdvSpan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] |
| Allentown | 90.6% | 52.0% | 97.8% | 49.6% | 22.8% | 7.5% | 55.3% | 22.8% | 0.0% | 0.0% | 94.1% | 49.6% |
| Altoona | 100.0% | 42.9% | 63.1% | 42.9% | 0.0% | 0.0% | 30.8% | 10.6% | 0.0% | 0.0% | 100.0% | 53.6% |
| Erie | 92.1% | 28.9% | 63.1% | 0.0% | 28.9% | 0.0% | 50.2% | 0.0% | 16.6% | 0.0% | 95.3% | 28.9% |
| Harrisburg | 95.9% | 35.9% | 69.9% | 18.5% | 0.0% | 0.0% | 62.3% | 44.5% | 1.7% | 0.0% | 100.0% | 31.1% |
| Johnstown | 91.2% | 8.8% | 23.5% | 8.8% | 0.0% | 0.0% | 0.0% | 0.0% | 4.0% | 0.0% | 100.0% | 8.8% |
| Lancaster | 74.5% | 37.7% | 100.0% | 43.2% | 7.9% | 0.0% | 45.0% | 7.1% | 15.5% | 0.0% | 100.0% | 45.6% |
| Scranton | 98.2% | 20.6% | 59.6% | 8.1% | 11.1% | 2.5% | 47.0% | 14.2% | 9.1% | 0.0% | 100.0% | 23.3% |
| Philadelphia | 100.0% | 77.6% | 94.9% | 61.0% | 48.5% | 48.5% | 70.0% | 58.7% | 47.1% | 42.1% | 100.0% | 74.2% |
| Pittsburgh | 99.0% | 50.9% | 75.8% | 30.5% | 5.4% | 2.7% | 50.9% | 26.6% | 22.5% | 14.0% | 100.0% | 50.5% |
| Reading | 84.0% | 11.1% | 100.0% | 31.1% | 3.3% | 0.0% | 55.9% | 8.2% | 19.9% | 0.0% | 100.0% | 14.6% |
| Sharon | 76.6% | 12.4% | 43.4% | 8.5% | 0.0% | 0.0% | 52.8% | 16.6% | 0.0% | 0.0% | 100.0% | 0.0% |
| State College | 100.0% | 80.3% | 66.0% | 44.2% | 0.0% | 0.0% | 66.0% | 0.0% | 44.2% | 0.0% | 100.0% | 80.3% |
| Williamsport | 100.0% | 43.9% | 71.1% | 34.1% | 0.0% | 0.0% | 41.0% | 34.1% | 0.0% | 0.0% | 100.0% | 50.3% |
| York | 100.0% | 18.6% | 66.9% | 11.7% | 0.0% | 0.0% | 50.7% | 16.2% | 3.8% | 0.0% | 96.2% | 7.9% |
| Beaver | 100.0% | 11.6% | 56.5% | 0.0% | 12.7% | 0.0% | 48.2% | 24.2% | 0.0% | 0.0% | 100.0% | 16.8% |
| Non-MSA | 91.9% | 14.5% | 56.5% | 6.1% | 1.2% | 0.0% | 31.5% | 13.0% | 7.9% | 0.3% | 95.8% | 17.8% |

## 8.7 The Effects of Curricula Access and other Factors on Post-secondary Educational Plans

This review of secondary electives in the areas of science, math, social studies, and languages indicates that differential access exists in many disciplines by size and per capita income of districts. Both economies of scale and the financial position of districts affect the availability of science, math and some social studies coursework. We have also noted substantial spatial variation in the availability of these courses.

We examine here whether availability of such curricula, along with other measures of educational resources, affect educational outcomes. In particular, we explore the relationship between the pursuit of post-secondary education by high school graduates, a measure of educational outcome, and various input measures. Each Spring, guidance counselors throughout the State interview graduating high school seniors, and obtain information regarding students' post-secondary plans. Extensive information is collected about planned employment and occupation, and planned post-secondary educational pursuits. Here, we shall explore the percentage of graduating seniors who indicated that they would be going on to some form of post-secondary education.[3]

It should be noted that the evidence on significant, positive relations between school expenditures and educational outcomes, e.g. test scores, is infrequent. Hanushek(1986) and (1989) provide extensive reviews of the literature which reaches a generally pessimistic conclusion about the existence of a predictable link between greater school spending and student performance. Strauss(1986) reports a significant relationship in North Carolina between teacher quality as measured by National Teacher Exam scores and student competency examinations; Ferguson(1991) reports similar results for Texas. On the other hand, Altonji(1992) finds little additional economic return to taking academic electives in high school viz a viz higher lifetime salaries.

We conjecture that interest in post-secondary educational pursuits depends on: student academic and social characteristics, teacher characteristics, and curricula offerings. Total spending, *per se*, does not directly effect outcomes, but affects the size of the budget which in turn is transformed into curricula and teacher characteristics. Because we are measuring the uses of the budget, entering expenditures per pupil into a regression equation would amount to entering school resources twice on the right hand side of the equations.

[3]We hope to explore in subsequent research the relation between school resources and plans for attending 2 year, 4 year, community and vocational schools.

Student academic and social characteristics are measured at the district level by:

- the average of the percentage of 8th grade students who score below the math and reading cutscore in the 1989 TELLS test administered by the Pennsylvania Department of Education; and,
- the percentage of students from AFDC families.

Teacher characteristics are measured at the district level by:

- the percentage of teachers from each type of teacher certification program in 1988/9; and,
- the ratio of 1989/90 secondary students to 1989/90 secondary teachers;

Curricula characteristics are measured at the district level for 1988/9 by:

- dummy variables for the presence or absence of advanced science, math, and social studies courses as previously defined; and,
- dummy variables by district for 1988/9 for the presence or absence of basic and advanced languages.

Examination of several years of data for these factors indicated that they were extremely correlated. We examined their effects on three years of the most recently available data, 1987/8, 1988/9, and 1989/90 on the dependent variable, the percentage of graduating high school students planning to pursue post-secondary education.

We expect that the less prepared students are in a district, e.g. the *higher* the TELLS score, the smaller the proportion of high school graduates who will pursue post-secondary education. (That is, we expect a **negative** relationship between the TELLS score and the proportion of high school graduates pursuing post-secondary education.)We also expect that the higher the fraction of students in AFDC families, the lower the proportion of students going on to pursue post-secondary education. This may reflect financial limitations and/or lack of information or knowledge about the subsequent economic benefits of post-secondary education.

With respect to teacher background, we found in Chapter 5, Table 5.38 the unexpected negative correlation between post-secondary education pursuits and the institutional background of teachers. Recall that we observed a -.45 correlation across districts between the fraction of high school graduates indicating post-secondary educational plans, and the fraction of teachers in the district who were certificated by the 14 public universities. At the other extreme, we observed a +.35 correlation across districts between the fraction of high school students indicating post-secondary educational plans and the fraction of teachers who were certificated from private colleges and universities in the State. Of immediate interest is whether these patterns of correlation are maintained when a more complex model is estimated, and for three years of data on post-secondary educational plans.

We expect that higher student-teacher ratios, a measure of factor intensity, will be inversely related with post-secondary plans; however, we are aware that such measures have generally been unsuccessful in explaining educational outcomes.

Finally, we have no well formed hypotheses about how the various curricula measures might relate to post-secondary plans, given that student and teacher characteristics are already accounted for in the model. Certainly, students who take advanced courses, such as advanced math and science, are more prepared for college than those who do not, and their records will be more attractive to college admissions officers.

Since the dependent variable in our model is a *proportion or percentage*, we may use the binomial logit model to model the proportions. [4] Our model is:

% PostSec, % No PostSec = f(student, teacher, curricula characteristics)

Table 8.20 displays the logit coefficients and t-ratios from the analysis of the three years of data:

Table 8.20: Logistic Models of Postsecondary Educational Pursuits: 1988-90

| | 1988 | | 1989 | | 1990 | |
|---|---|---|---|---|---|---|
| | $\beta$ | t-ratio | $\beta$ | t-ratio | $\beta$ | t-ratio |
| Constant | 0.7693 | 8.16 | 1.3618 | 13.87 | 1.0835 | 10.66 |
| Avg of 8th Grade Tells Score | -0.0254 | -19.69 | -0.0274 | -20.60 | -0.0246 | -17.70 |
| % Students from AFDC Familie | -0.0035 | -3.00 | -0.0010 | -0.84 | -0.0043 | -3.44 |
| % Teach State U | -0.3877 | -4.42 | -0.9332 | -10.21 | -0.5116 | -5.33 |
| % Teach State Rel | 1.3704 | 10.97 | 0.7881 | 6.04 | 1.1399 | 8.38 |
| % Teach Priv-State Rel | 2.9924 | 5.34 | 4.7554 | 7.69 | 3.4353 | 5.35 |
| % Teach Private | 1.1479 | 10.81 | 0.8098 | 7.25 | 1.6163 | 13.64 |
| Secondary sch kids/teacher | -0.0187 | -11.69 | -0.0146 | -8.74 | -0.0089 | -5.06 |
| Math Dummy: Any Calculus | 0.0668 | 1.67 | 0.0580 | 1.69 | 0.0960 | 2.66 |
| Sci Dummy: Adv Biology | 0.0636 | 3.33 | 0.1306 | 6.70 | 0.1204 | 5.93 |
| Sci Dummy: Adv Chem | 0.0270 | 1.61 | 0.0380 | 2.18 | 0.0346 | 1.91 |
| Sci Dummy: Adv Physics | 0.0213 | 1.48 | 0.0136 | 0.91 | 0.0340 | 2.15 |
| Lang Dummy: French | 0.1000 | 3.37 | 0.0215 | 0.71 | 0.0393 | 1.25 |
| Lang Dummy: Adv French | 0.0952 | 4.05 | 0.0538 | 2.21 | 0.0089 | 0.36 |
| Lang Dummy: German | -0.0075 | -0.46 | 0.0506 | 3.01 | 0.0283 | 1.62 |
| Lang Dummy: Adv German | 0.0419 | 1.93 | -0.0390 | -1.70 | 0.0106 | 0.45 |
| Lang Dummy: Italian | -0.0362 | -1.02 | -0.0976 | -2.67 | -0.1642 | -4.32 |
| Lang Dummy: Adv Italian | 0.3829 | 7.83 | 0.3045 | 5.92 | 0.6135 | 11.20 |
| Lang Dummy: Latin | 0.0384 | 2.36 | 0.0350 | 2.05 | 0.0770 | 4.30 |
| Lang Dummy: Adv Latin | 0.1175 | 5.76 | 0.0503 | 2.33 | 0.0508 | 2.25 |
| Lang Dummy: Russian | 0.0054 | 0.22 | 0.0718 | 2.77 | 0.0260 | 0.96 |
| Lang Dummy: Adv Russian | 0.0974 | 1.69 | 0.2236 | 3.71 | 0.1278 | 2.03 |
| Lang Dummy: Spanish | -0.0388 | -0.73 | -0.2571 | -4.57 | -0.3312 | -5.78 |
| Lang Dummy: Adv Spanish | 0.1074 | 4.65 | 0.1015 | 4.26 | 0.1280 | 5.18 |
| Soc Studies Dummy: Anthropology | 0.0660 | 3.53 | 0.0143 | 0.72 | -0.0138 | -0.67 |
| Soc Studies Dummy: Economics | 0.0758 | 4.83 | 0.1071 | 6.57 | 0.1311 | 7.71 |
| Soc Studies Dummy: Geography | -0.1110 | -7.07 | -0.0140 | -0.85 | -0.1180 | -6.86 |
| Soc Studies Dummy: Civics/Go | -0.2289 | -9.16 | -0.1119 | -4.34 | -0.0732 | -2.75 |
| Soc Studies Dummy: Pa Histor | -0.0589 | -4.33 | -0.0575 | -4.02 | -0.0526 | -3.53 |
| Soc Studies Dummy: Psycholog | -0.0006 | -0.04 | -0.0035 | -0.22 | -0.0721 | -4.34 |
| Soc Studies Dummy: Sociology | 0.0785 | 5.45 | 0.0585 | 3.90 | 0.0077 | 0.49 |

Note: dependent variable is percentage of high school graduates pursuing post-secondary education relative to the proportion not pursuing post-secondary education in the respective year per district
Source: Analysis of various Pennsylvania Department of Education data files

In all three years, the measure of student preparation, the TELLS score, is negatively related to post-secondary educational pursuits; in each year, the t-ratio is over 15.0. In all three years, the AFDC measure is also negatively related to post-secondary educational plans, and is statistically significant in two of the three years.

The various teacher measures are quite statistically significant (note that the proportion of teachers from out-of-state is the omitted category), and support the simple correlation results in Table 5.38. In each of the three years, as the fraction of teachers from public universities rises, the proportion of students with post-secondary educational plans falls, while the effects of teachers trained at other types of certificating institutions on such plans are always positive. In every instance, the t-ratio is in excess of 4.0 which indicates that the statistical results are highly significant.

We find that higher secondary student-teacher ratios are inversely related to the proportion of students with post-secondary educational plans; the t ratios are in each case over 7.0.

Let us now turn to the curricula results in Table 8.20. With respect to math and science electives, we find that the four variables, across the three years, are always positively related to the proportion of students with post-secondary education plans, but the pattern of significance varies. The presence of any calculus course and advanced physics is statistically significant only in 1990;

[4] See Henri Theil, *Statistical Decomposition Analysis*, 1974 for an early application; also see Greene (1990), Chapter 20 for an elaboration on this technique.

The presence of advanced biology is statistically significant in all three years, and the presence of advanced chemistry is statistically significant in two of the three years.

With respect to languages, the presence of advanced Italian and advanced Spanish is *positively* related to higher proportion of students pursuing post-secondary education. In all three years, the presence of basic and advance Latin is associated with greater proportions of graduating high school students pursuing post-secondary education. In two of three years, we find that the presence of advanced French is associated with higher proportions of graduating students pursuing post-secondary education.

The results for various social studies electives are somewhat mixed. The presence of economics and sociology (two of three years) in a district is significantly associated with a greater proportion of high school graduates pursuing post-secondary education. The presence of civics/government and geography (two of three years) and Pennsylvania History are always inversely and significantly related to a smaller proportion of high school graduates pursuing post-secondary education. The signs of anthropology and psychology are unstable, and they are generally not statistically significant.

Having noted the direction and statistical significance of student, teacher and curricula effects on post-secondary educational plans, we next examine the size of these various effects. As with the use of the logit model to predict the probability of retiring and quitting compared to working, we can restate the statistical model in terms of the absolute proportion of students who are predicted to pursue post-secondary education, given characteristics of the x's, and predict for a district with a given set of characteristics on the proportion of students who indicate post-secondary educational plans. Then, the proportion with post-secondary educational plans is:

$$Proportion_{Post.Sec.} = \frac{e^{x\beta_{Post,Sec.}}}{1 + e^{x\beta_{Post.Sec.}}} \tag{8.1}$$

$$Proportion_{No.Post.Sec.} = \frac{1}{1 + e^{x\beta_{Post.Sec.}}} \tag{8.2}$$

Table 8.21 displays the implications of varying the teacher, curricula and student characteristics of a hypothetical district with the use of Equation 8.2 to predict the fraction of the hypothetical district's students who would plan some form of post-secondary educational pursuits. Twelve scenarios are worked through; note at the outset that the proportion of students with such plans increased from 55.5% in 1988 to 63.2% in 1990. Note also that if we take the means of the various independent variables in the estimated model, the predicted average is quite close to the actual for each year.

If we form a hypothetical district composed of a variety of teachers, (e.g. 42.6% from public universities, 9.7% from State related universities, .58% from private state related, and 15.3% from private colleges and universities), students with a TELLS average of 15.96, 7.44% from AFDC families and a student-teacher ratio of 17.69, we have a district at what is described in Table 8.21 as @ Means. Scenario 1 calculates the proportion of students who would pursue post-secondary education were all electives offered. This contrasts with the base case when the electives are measured at the state-wide means as fractions of courses. We find that the proportion of students with post-secondary educational interests increases by 15 to 18 **percentage points.**

Since forecasting from fractional values of the dummy variables may be somewhat misleading, compare the results of Scenario 1 with Scenario 2 when all electives are dropped, e.g. the dummy

variables are now made entirely zeros. Again, the range of the effect of removing, and then providing elective courses is quite large, ranging from 13 to 20 percentage points increase in the percentage of students interested in pursuing post-secondary education. Scenario 3 adds the four elective science and math courses to the hypothetical district in Scenario 2, and the fraction of students with post-secondary educational interests rises between four and six percentage points.

Scenario 4 returns the hypothetical district to the base case in terms of all factors but the nature of the teaching force. Now, all teachers are assumed to be from public universities. The percentage of high school students with predicted interests in going on to post-secondary education varies, depending on the year in question from 42.1% to 47.2%.; these should be compared to base case figures of between 74.5% and 79.8%. We find that changing the teaching force from one that is distributed across the various types of certificating institutions to just public universities reduces the fraction of students with post-secondary education plans by anywhere from 25% to 43%.

Scenario 5 performs the same experiment as Scenario 4, but now assumes that all teachers are from private colleges and universities. The proportion of students with post-secondary educational interests varies now from 77.2% to 88.2%. More remarkable yet is Scenario 7 which replaces all teachers with those from private-state related universities, essentially the University of Pennsylvania. Now, the fraction of students with post-secondary education plans is between 95% and 99%!

The remaining scenarios, 8-12, examine the effects of changing student characteristics. Each of these scenarios **triples** the TELLS and AFDC means to 47.8% and 22.3% respectively. That is, in this hypothetical district, almost 1/2 of the 8th grade students were below the cutoff for reading and math scores, and 22.3% were from AFDC families. The model indicates that in this circumstance, with all other factors at their means, between 34% and 42.8% of the students would be interested in pursuing post-secondary education. Scenario 8 changes the teacher certification assumption to only private colleges and universities; the fraction of students with post-secondary educational interests jumps to between 58.8% and 76.2%; that is, there is a 24 to 33% higher proportion of students with post-secondary educational interest. Scenario 9 adds all elective courses and the model predicts that the fraction of students with post-secondary educational plans rises to between 76.8% and 87.8%, depending on the year in question.

Finally, when the student-teacher ratio in the hypothetical district of Scenario 10 is reduced by 25%, post-secondary educational plans increase only marginally. It should be remembered that such a reduction would likely increase the instructional budget of the hypothetical district by 25%, so it is evident that changing this factor would not be a cost effective way to increase students' post-secondary educational interests.

Table 8.21: Predicted % Planning Post-Secondary Education under Alternative Teacher, Student, and Curricula Assumptions

| Scenario Number | Scenario Description | 1988 % PostSecond | 1989 % PostSecond | 1990 % PostSecond |
|---|---|---|---|---|
| | [2] | [3] | [4] | [5] |
| | Base Case @ Means<br>Actual Mean % | 55.8%<br>55.5% | 62.4%<br>61.6% | 63.6%<br>63.2% |
| 1 | Base Case @ Means<br>All Curricula=1 | 74.5% | 77.6% | 79.8% |
| 2 | Base Case @ Means<br>All Curricula=0 | 54.2% | 62.0% | 66.0% |
| 3 | Base Case @Means<br>Only Sci-Math=1 | 58.6% | 67.5% | 72.1% |
| 4 | Base Case @Means<br>Only Public Univ Teacher | 42.1% | 43.6% | 47.2% |
| 5 | Base Case @Means<br>Only Private Teachers | 77.2% | 81.6% | 88.2% |
| 6 | Base Case @Means<br>Out of State Teachers | 51.8% | 66.3% | 59.8% |
| 7 | Base Case @Means<br>Only U of Penn. Teachers | 95.0% | 99.6% | 97.9% |
| 8 | Base Case @Means<br>Triple: TELLS and % AFDC | 34.7% | 40.5% | 42.8% |
| 9 | Base Case @Means<br>Triple: TELLS and % AFDC<br>Only Private Teachers | 58.8% | 64.5% | 76.2% |
| 10 | Base Case @Means<br>Triple: TELLS and % AFDC<br>Only Private Teachers<br>All Electives=1 | 76.8% | 79.1% | 87.8% |
| 11 | Base Case @Means<br>Triple: TELLS and % AFDC<br>Only Private Teachers<br>All Electives=1<br>Reduce Pupil/Teacher 25% | 78.2% | 80.2% | 88.3% |

## 8.8 Summary

We have sought in this chapter to explore differential access to secondary school course electives, and to ascertain the impact of such courses, teacher characteristics and student characteristics on graduating high school students' post-secondary educational plans.

In the areas of advanced placement and elective math and science courses (biology, chemistry, and physics), we show that larger school districts and school districts of higher average per capita incomes tended to increasingly offer such courses. The pattern for social studies courses was more varied; however, the pattern for anthropology, economics, psychology and sociology were similar to those for advanced placement, math and science electives.

Significant spatial differences in student access were also found for these courses as well as various language courses. Students in a variety of MSAs, such as Erie, Johnstown, Sharon and

Beaver tended not to have access to advanced placement, elective science and some languages to the same extent as the rest of the State.

When we statistically examined the impact of curricula, teachers and student characteristics on post-secondary educational plans of graduating high school students, we found that all factors play a role in impacting these plans. However, some are far more important than others. First, the student-teacher ratio, while statistically significant, has very little predicted effect on the post-secondary plans of students. On the other hand, the absence or presence of the various course electives discussed above are predicted to increase post-secondary plans by between 13 to 20 percentage points. These are not relative effects, they are **absolute** effects.

Easily the most startling statistical finding is that the educational background of the teachers in a district has a large effect on graduating seniors' post-secondary educational plans. The inverse relation between having more teachers from public universities and such educational plans, reported in Chapter 5, was confirmed with a more sophisticated statistical model. Changing a district's teaching force from one composed of teachers from public universities to one composed of teachers from the University of Pennsylvania is predicted to **double** the fraction of students with post-secondary educational plans.

Undoubtedly, this finding of differential teacher effects is likely to be controversial, and requires further scrutiny and investigation. Some may observe that there are so few teaching graduates each year from the University of Pennsylvania, that the experiment performed with the logistic model is unrealistic. Others may comment that while such graduates are quite select, having gained admission to this university with higher SAT scores than most of their counterparts at other, public institutions, they tend to be hired in a few, select places, such as wealthy suburbs outside of Philadelphia. Such districts tend to have better TELLS scores, smaller class size, and fewer families in poverty.

From a statistical point of view, if these factors were so inter-related, then the correlations among the variables on the right hand side of the logistic model should have caused the coefficients to be statistically insignificant; however, they are all statistically significant.

Others may observe that a causal interpretation implied by the experiments in Table 8.21 is not warranted, because what is being observed is statistical association. The figures in Table 8.21 do not reflect actual experiments; they are merely "as-if" calculations. Some may also observe that districts whose students aspire to college tend to offer elective courses, and tend to hire teachers from private colleges and universities, and that what one is observing from the statistical analysis is actually reverse causality. Yet, if this is true, it suggests that districts which seek to raise the proportion of their students who go on to post-secondary education would do well to fashion their curricula and teaching force after those whose students already go on to college.

Perhaps the most puzzling aspect of the empirical findings here involves the underlying explanation of why or how the fraction of teachers certificated at public universities is inversely related to graduating seniors' post-secondary education plans. Data were simply not available to the project on the measured skills of teachers, such as scores on the National Teacher Exam (NTE), which could be related to student outcome measures. Nor was data on the personal expectations of teachers for their students and their own self-esteem. These esteem factors, or underlying skills, could easily provide a more complete picture of how and why the institutional source of teachers seems to be so related to such an important student outcome measure as post-secondary educational plans.

A more complete statistical model of the educational process would relate community income and wealth to the determination of the size of school budgets and the transformation of the budget from dollars to choices of teachers and curricula. The access analysis reported above indicates clearly that the size and per capita income of a district affect the nature of secondary school course

electives; the statistical analysis of the effects of such curricula simply take its presence or absence as given. This analysis indicates that curricula and the institutional source of teachers seems to matter a great deal.

The development of a fuller understanding of why and how such resources affect this important measure of a school's output deserves further research.

# Chapter 9

# Summary and Policy Recommendations

## 9.1 Pennsylvania's Classroom Teachers

During the 1980's there were approximately 97,000 classroom teachers in Pennsylvania's 501 school districts. Classroom teachers numbered 94,246 in 1983/4, and grew to 99,238 by 1989/90. The majority, 63%, are women, and the vast majority, 92.9%, are white. A little over half, 53.3%, hold bachelors degrees, 45.7% hold masters degrees, and .7% hold Ph.d's.

In 1990/1, the median salary of these teachers was $35,425. In the 1980's, average, inflation-adjusted teacher salaries grew by 2.78%. The median teacher was 45 years old, had 17 years of service in his/her district, and 19 years of teaching service overall.

Over the past decade, on average, 3.2% of the classroom teachers left their school district for a number of reasons while an additional 1.7% retired. During the 1980's, Pennsylvania's school districts, in the aggregate, hired about 2,500 newly trained teachers from within and without Pennsylvania, and hired another 1,900 experienced teachers per year. The hiring rate for newly trained teachers was about 2.6% of the teacher inventory, and the hiring rate for experienced teachers was about 1.9%. Since the hiring rate was generally greater than the combination of the retirement and quit rate, the inventory of classroom teachers was larger at the end of the 1980's than at the beginning.

Over the last quarter century, the number of Pennsylvania's newly trained teachers has varied widely. Between 1965 and 1972, the number of newly trained teachers in Pennsylvania grew from 12,254 to 19,453 or by 59%, undoubtedly to take advantage of draft deferments during the build-up to the Vietnam War. By 1985, the number of newly trained teachers, 5,987, was 55% below the 1965 level. By 1989/90, 8,092 teachers were trained, still well below the 12,254 in 1965.was in the primary teacher certification area.

## 9.2 Pennsylvania's Public School Enrollment

Over the same period, 1965-1991, Pennsylvania's public school enrollment peaked at 2.414 million students in 1972, and bottomed to 1.621 million in 1988/9. By the turn of the next century, Pennsylvania's public school enrollment is expected to grow modestly to 1.779 million. During the decade of the 1990's, virtually all of the growth, 109,000, will occur in the secondary grades (7-12). Four Metropolitan Statistical Areas or MSA's (Johnstown, Sharon, Beaver, and Williamsport) will

continue to experience overall enrollment declines, from -2% to -11% for the balance of this decade, while another four MSA's (Altoona, Erie, Harrisburg, and Pittsburgh) will experience positive growth but less than 10%.

The non-metropolitan part of the State, which encompasses 35 of Pennsylvania's counties and about 285,000 public school students, will experience enrollment growth of only 2%. Seven MSA's (Allentown, Lancaster, Scranton, Philadelphia, Reading, State College, and York) will experience enrollment growth in excess of 10%, ranging from 13% to 23%.

There is significant variation in the fraction of Pennsylvania's school district's population enrolled in public education: in 1990 it varied from 5% to 23%. Statewide, the overall figure is 13%; compared to other states, Pennsylvania has relatively few public school students, and relatively more elderly. When a very small fraction of the population is enrolled in public education, there may be weaker political support for greater local aid to education, although there is often the ability to do so.

## 9.3 Demand and Supply of Pennsylvania's Teachers in the 1980's

Over the past decade, Pennsylvania's 80+ certificate granting institutions trained annually between a low of 5,900 to a high of 8,100 certificated teachers. In view of the fact that total annual hiring, by school districts, intermediate units, and vocational-technical training institutions, has been on the order of 3,000 to 5,600 per year, well below the numbers trained annually, there did not seem to be any evidence, from the available data, of a tight labor market in the 1980's.

When we examine the employment rates of Pennsylvania's newly trained teachers in various areas of certification, we find that the employment rates have been less than 50% over the past 6 or 7 years, peaked in 1985-6 at an overall employment rate of 45.3%, and are now about 34%.[1]

Also, the employment rates vary considerably by type of certificating institution. Private colleges and universities had a much better employment record than did public certificate granting institutions. Of course, this may reflect a wide variety of factors: personal tastes, information about opportunities, and other factors. (See Table 9.1.)

Table 9.1: Employment Rates by Type of Certificating Institution

| Year | Type of Certificating Institution | Total Trained | PA Hired | PA Empl. Rate | Total Hired | Total Empl. Rate | 1983/84 Tuitions |
|---|---|---|---|---|---|---|---|
| | | [3] | [4] | [5] | [6] | [7] | [8] |
| 88/89 | State Universities[14] | 4,116 | 880 | .214 | 1,216 | .295 | $1,644 |
| | State Related Commonwealth Universities[6] | 1,230 | 128 | .104 | 172 | .140 | $2,382 |
| | Private State-Aided Institutions[3] | 97 | 37 | .381 | 53 | .546 | $7,052 |
| | Private Colleges and Universities[60] | 2,649 | 1,057 | .400 | 1,319 | .498 | $5,229 |
| | Total[83] | 8,092 | 2,102 | .260 | 2,760 | .341 | |
| 89/90 | State Universities | 3,804 | 908 | .239 | 1,258 | .331 | $1,644 |
| | State Related Commonwealth Universities | 1,214 | 186 | .153 | 216 | .178 | $2,382 |
| | Private State-Aided Institutions | 81 | 19 | .235 | 34 | .420 | $7,052 |
| | Private Colleges and Universities | 2,819 | 837 | .382 | 1,247 | .570 | $5,229 |
| | Total | 7,918 | 1,950 | .246 | 2,755 | .348 | |

Source: Tabulations of unpublished Pennsylvania Department of Education
reports on employment and graduations at certificate granting institutions for 1988/89 and 1989/90
[8] 1983/84 Tuitions from NCES Education Directory

[1] In the mid-1960's, employment rates for teachers from all types of institutions were much higher. In 1965, fully 82% of the graduates from public universities obtained teaching positions inside and outside Pennsylvania; however, by 1973, only 45% obtained teaching positions, as reported by the Pennsylvania Department of Education's 1975 *Our Colleges and Universities Today*, XII, 5.

## 9.4 Demand and Supply of Pennsylvania's Teachers in the 1990's

Given that there are many teachers in the current inventory who will attain age 65, and even more who will have accumulated 30 years of service by the turn of the century, and given there will be a growth in secondary school enrollment in the balance of the decade, the question arises whether or not there will be sufficient numbers of certificated teachers to respond to these demographic changes.

To analyze the issue of the demand and supply of teachers through the end of this decade, two research strategies were pursued :

- the construction of a series of demographic simulation models that analyze the dynamics of teacher and student demography **at the school district level**; and,
- the construction of behavioral models **at the state level** of the decision to earn a Pennsylvania teaching degree at a Pennsylvania certificating institution, and of the decision to retire or quit teaching employment;

### Demographic Simulation Model Assumptions and Results

The demographic models take into account current state regulations governing teacher assignment and their certification at all grade levels, state curricula requirements for graduation, and the patterns of observed secondary school curricula electives. The results of these simulation models have been aggregated from each school district to the county, MSA, and state levels.

The demographic models also take into account historical quit behavior, and the implications for teacher demand and supply of possible movement by Pennsylvania's school districts to "best practice" secondary school curricula offerings.

The key assumptions in both the demographic and behavioral modeling efforts are that future student-teacher ratios will be kept at current levels, and that curricula offerings observed in 1988-9 will also be maintained through the balance of this decade. That is, we assume that these measures of resource intensity will be maintained through the balance of the decade.

In the demographic models of the retirement decision, three different retirement assumptions have been entertained:

1. teachers retire at age 65;
2. teachers retire when they reach 30 years of total teaching experience;
3. teachers retire when they reach 27 years of total teaching experience;

Given we model 8 years into the future, we also add to the calculation of hiring needs the impact of historical quits based on the 1982-9 quit experience noted above.

The results of these demographic and behavioral simulations were compared to the historical hiring which districts accomplished in the 1980's.

Application of the demographic models leads to the following conclusions:

- Under the low retirement assumption, Pennsylvania's school districts will need to hire 21,693 classroom teachers between 1992/3 and the end of the decade to maintain student-teacher ratios and historical curricula patterns; 55% of the replacement teachers will be needed due to enrollment growth, and 45% will be due solely to teacher retirements;

- Under the medium retirement assumption, Pennsylvania's school districts will need to hire 43,045 classroom teachers between 1992/3 and the end of the decade to maintain student-teacher ratios and historical curricula patterns; 25% of the replacement teachers will be needed due to enrollment growth, and 75% will be due solely to teacher retirements;
- Under the high retirement assumption, Pennsylvania's school districts will need to hire 53,565 teachers with better than 80% being hired due solely to teacher retirements at 27 years of service;
- Under the assumption that quit behavior in the 1980's will persist in the 1990's, an additional 25,000 to 27,000 classroom teachers will need to be hired beyond the range of 20,918 to 53,565 replacement hires, to maintain student-teacher ratios and historical curricula patterns. Overall, the demographic models predict Pennsylvania's school districts will need to hire between 46,000 and 80,000 classroom teachers over the balance of the decade, compared to the 1990/1 inventory of 98,000 classroom teachers;
- This turnover of between 44 to 88% of the classroom teacher inventory is far larger than the 35% turnover actually experienced in the 1980's;
- If we compare the predicted needs of classroom teachers, under the retirement at age 65 assumption, by area of certification to the numbers annually trained in the 1980's, we find that the historical, average annual production of primary teachers will be about twice the numbers needed/year; however, the projected number of secondary teachers needed/year will be 30% *more than* the historical rate of production/year. Under the assumption of retirement at 30 years of experience, we find that the numbers of primary school teachers will balance, but that there will be 72%/year more secondary teachers needed than historically produced/year. (See Table 9.2).

Table 9.2: Hiring Needs based on Historical Quits and Demographic Models of Teacher Retirement and Student Demographics Compared to Number of New Pennsylvania Teaching Graduates, 1981/2-1989/90

| Code | Prim. Assignment | 1990/1 Tch. [3] | Pred. Quits [4] | Pred. $H^a$ [5] | Pred. $H^e$ [6] | Pred. $H^m$ [7] | Tch 1982/9 [8] | Ave Tch [9] | Quits $+H^a$/ Tch [10] | Quits $+H^e$/ Tch [11] | Quits $+H^m$/ Tch [12] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1200 | Agriculture | 188 | 113 | 25 | 43 | 48 | 164 | 18.2 | 84.3% | 95.2% | 98.3% |
| 2300 | Art | 3,058 | 1,105 | 343 | 517 | 572 | 1,468 | 163.1 | 98.6% | 110.5% | 114.2% |
| 8410 | Biology | 1,835 | 481 | 543 | 986 | 1,029 | 1,618 | 179.8 | 63.3% | 90.7% | 93.3% |
| 1600 | Business Ed | 2,443 | 877 | 623 | 869 | 959 | 1,325 | 147.2 | 113.2% | 131.8% | 138.6% |
| 8420 | Chemistry | 935 | 282 | 264 | 373 | 367 | 553 | 61.4 | 98.7% | 118.4% | 117.3% |
| 5200 | Driver Ed | 397 | 60 | 84 | 73 | 63 | na | na | na | na | na |
| 8430 | Earth/Space | 697 | 229 | 125 | 217 | 204 | 330 | 36.7 | 107.3% | 135.2% | 131.3% |
| 3200 | English | 7,157 | 2,124 | 2,323 | 4,419 | 5,393 | 2,571 | 285.7 | 173.0% | 254.5% | 292.4% |
| 4410 | French | 886 | 394 | 233 | 373 | 407 | 332 | 36.9 | 189.0% | 231.1% | 241.4% |
| 2810 | Gen Elem.&Ear.Ch. | 39,554 | 8,267 | 6,344 | 16,646 | 23,279 | 25,410 | 2823.0 | 57.5% | 98.0% | 124.1% |
| 8450 | General Science | 2,227 | 585 | 721 | 1,236 | 1,347 | 428 | 47.6 | 305.0% | 425.4% | 451.3% |
| 4420 | German | 430 | 168 | 119 | 157 | 158 | 136 | 15.1 | 211.1% | 239.1% | 239.8% |
| 9210 | Gifted | 619 | 204 | 56 | 90 | 88 | na | na | na | na | na |
| 4800 | Health/Phys Ed | 5,908 | 1,463 | 1,306 | 2,718 | 3,085 | 3,654 | 406.0 | 75.8% | 114.4% | 124.5% |
| 9200 | Hearing Impaired | 77 | 10 | 28 | 29 | 39 | 336 | 37.3 | 11.3% | 11.6% | 14.6% |
| 5600 | Home Economics | 1,981 | 906 | 619 | 811 | 1,013 | 351 | 39.0 | 434.5% | 489.2% | 546.8% |
| 6000 | Industrial Arts | 2,345 | 641 | 588 | 879 | 984 | 989 | 109.9 | 124.3% | 153.7% | 164.3% |
| 6800 | Mathematics | 6,388 | 1,732 | 1,890 | 4,118 | 4,819 | 2,993 | 332.6 | 121.0% | 195.5% | 218.9% |
| 9230 | Mental/Phys Hand | 6,718 | 2,588 | 1,571 | 1,941 | 2,548 | 6,709 | 745.4 | 62.0% | 67.5% | 76.6% |
| 7200 | Music | 4,254 | 1,686 | 865 | 1,452 | 1,668 | 2,679 | 297.7 | 95.2% | 117.1% | 125.2% |
| 4490 | Other Languages | 229 | 183 | 53 | 53 | 68 | 84 | 9.3 | 281.5% | 281.5% | 299.4% |
| 8490 | Other Science | 45 | 22 | 8 | 13 | 17 | na | na | na | na | na |
| 8470 | Physics | 496 | 73 | 111 | 139 | 147 | 215 | 23.9 | 85.7% | 98.7% | 102.4% |
| 8800 | Social Studies | 6,256 | 2,337 | 2,119 | 3,905 | 4,151 | 3,302 | 366.9 | 135.0% | 189.0% | 196.5% |
| 4430 | Spanish | 1,342 | 299 | 361 | 567 | 652 | 524 | 58.2 | 126.0% | 165.3% | 181.5% |
| 9270 | Speech/Lang Impa | 394 | 151 | 79 | 106 | 135 | 1,480 | 164.4 | 15.5% | 17.3% | 19.3% |
| 9280 | Visually Impaire | 37 | 13 | 10 | 13 | 17 | 213 | 23.7 | 10.9% | 12.3% | 14.2% |
| 2000 | Vocational Ed | 746 | 186 | 246 | 232 | 259 | 859 | 107.4 | 50.3% | 48.6% | 51.8% |
| 2200 | Vocational Health | 36 | 13 | 13 | 6 | 10 | na | na | na | na | na |
| 2100 | Vocational Tech | 123 | 48 | 14 | 25 | 30 | na | na | na | na | na |
| 9900 | Not Listed Elsew | 66 | 23 | 9 | 9 | 9 | na | na | na | na | na |
| | Total Primary | 39,554 | 8,267 | 6,344 | 16,646 | 23,279 | 25,410 | 2,823.0 | 57.5% | 98.0% | 124.1% |
| | Total Secondary | 58,313 | 18,998 | 15,349 | 26,399 | 30,286 | 26,398 | 2,933.1 | 130.1% | 172.0% | 186.7% |
| | Total | 97,867 | 27,265 | 21,693 | 43,045 | 53,565 | 58,723 | 6524.8 | 83.4% | 119.7% | 137.6% |

Source: Analysis of PED files.
Definitions:
[3] 1990/1 inventory of classroom teachers.
[4] Predicted quits based on historical quit rates by primary assignment area during 1982-9 applied to 1990/1 inventory.
[5] $H^a$: replacement hires due to retirements at age 65 and student demographics, 1992-1999
[6] $H^e$: replacement hires due to retirements at 30 years of service and student demographics,1992-1999
[7] $H^m$: replacement hires due to retirements at 27 years of service and student demographics, 1992-1999
[8] Total number of teaching graduates during 1981/2-1989/90 from Pennsylvania certificating institutions.
[10] Demand/Supply, age 65 retirement assumption and student demographics; ([4] + [5]) / [8].
[11] Demand/Supply, 30 years of experience retirement assumption and student demographics; ([4] + [6]) / [8].
[12] Demand/Supply, 27 years of experience retirement assumption and student demographics; ([4] + [7]) / [8].

The areas of Art, Business Education, Chemistry, Earth and Space Science, English, General Science, Mathematics, Social Studies, German, Spanish, and a variety of other secondary certifications are predicted by the demographic models and historical graduation rates to be in excess demand for teachers. (See Table 9.2.)

## Behavioral Model Assumptions and Results

In the behavioral model of the decision to earn a teaching degree, we assume that real salaries will grow at 2.78%/year or less; in the behavioral model of the retirement decision, we assume that salaries will grow in the future at 5.5%/year.

- The behavioral models of teacher supply indicate that rising real wages will encourage more college sophomores to pursue teaching, and meet the aggregate excess demand predicted by the demographic models and historical figures on teacher supply. However, the long-run supply curves suggest that the imbalance between primary and secondary school teachers will not be met. Growing real wages will tend to develop more primary school teachers than secondary school teachers.

- The behavioral models of the teacher retirement and quit decision lend support to the medium teacher replacement scenario developed by the demographic models: teacher retirements of 24,500 through the balance of the decade seem quite likely, as do quits of 25,000 to 27,000.

  Combining the projections of retirement and the student demographic projections with the long-run behavioral supply projections suggests that the aggregate supply of newly trained secondary teachers from Pennsylvania's certificating institutions may be less than that needed under medium and high (pessimistic or very pessimistic) retirement and quit assumptions. (See Table 9.3).

Table 9.3: Comparison of Long-Run Supply of New Pennsylvania Teachers and Demand for Teachers Under Alternative Assumptions: 1992/3-2000/1

| | Optimistic | Pessimistic | Very Pessimistic |
|---|---|---|---|
| | [2] | [3] | [4] |
| Total Teachers | | | |
| Projected Supply | 91,260 | 80,382 | 74,749 |
| Projected Demand | 48,958 | 70,310 | 80,830 |
| Supply/Demand % | 186 % | 114 % | 92 % |
| Primary Teachers | | | |
| Projected Supply | 50,029 | 41,607 | 37,243 |
| Projected Demand | 14,611 | 24,913 | 31,546 |
| Supply/Demand % | 342 % | 167 % | 118 % |
| Secondary Teachers | | | |
| Projected Supply | 41,231 | 38,775 | 37,506 |
| Projected Demand | 34,347 | 45,397 | 49,284 |
| Supply/Demand % | 120 % | 85 % | 76.1 % |

Source: Supply model contained in Table 7.1.
Demand Projections from Table 6.1.
Definitions:
[2]: Optimistic supply based on 2.78 % real growth/year in average teacher salary (1990s average);
Optimistic demand based on $H^a$(Retirement at age 65 assumption) + Predicted Quits.
[3]: Pessimistic supply based on 1 % real growth/year in average teacher salary;
Pessimistic demand based on $H^e$ (Retirement with 30 years experience assumption) + Predicted Quits.
[4]: Very pessimistic supply based on constant real and relative wages, with only student enrollment growth;
Very pessimistic demand based on $H^m$ (Retirement with 27 years experience) + Predicted Quits.
All Projections assume constant relative wages.

## 9.5 Geographic Patterns of Predicted Classroom Teacher Needs

While the State overall is predicted to need to hire between 44% and 88% of its current inventory of classroom teachers, compared to a 35% hiring rate in the 1980's, there is significant geographic variation in this hiring problem which regions of the State must solve. For example, the Allentown MSA is predicted to need to hire 75% of its 1990/1 classroom teacher inventory, while the Johnstown MSA is predicted to need to hire 48% of it's 1990/1 classroom teacher inventory in order to maintain assumed student-teacher and curricula levels.

Fully 1/3 of the total predicted hires, under the early retirement assumption, must be made in the Philadelphia metropolitan area, and the vast bulk are in the area surrounding Philadelphia proper. The Philadelphia MSA is predicted to need to hire 73% of its 1990/1 teacher inventory. (See Table 9.4.)

Table 9.4: Historical & Predicted Teacher Hires & Quits for Pennsylvania MSA's

| Metropolitan Statistical Area | 1990 Population | 1989-90 Enrollment | 1990-1 Teachers | 1982-89 Hires | 1992-99 *Hires*[a] | 1982-9 Quit | Total *Hires*[a] | 1992-9 *Hires*[e] | Total *Hires*[e] |
|---|---|---|---|---|---|---|---|---|---|
| Allentown-Bethlehem MSA (3) | 596,054 | 81,472 | 4,665 | 1,763 | 1,297 | 1,108 | 2,405 | 2,385 | 3,493 |
| Altoona MSA (1) | 134,811 | 21,043 | 1,111 | 389 | 189 | 286 | 475 | 446 | 732 |
| Erie MSA (1) | 281,987 | 41,726 | 2,329 | 869 | 428 | 629 | 1,057 | 896 | 1,525 |
| Harrisburg-Lebanon MSA (4) | 613,795 | 91,187 | 5,889 | 2,246 | 1,157 | 1,799 | 2,956 | 2,376 | 4,175 |
| Johnstown MSA (1) | 238,978 | 35,816 | 1,994 | 632 | 27 | 513 | 540 | 450 | 963 |
| Lancaster MSA (1) | 419,065 | 58,907 | 3,548 | 1,590 | 1,141 | 1,084 | 2,225 | 1,879 | 2,963 |
| Scranton-Wilkes-Barre MSA (4) | 747,381 | 97,080 | 5,758 | 1,593 | 1,507 | 1,305 | 2,812 | 2,941 | 4,246 |
| Philadelphia MSA (5) | 3,709,469 | 450,691 | 28,927 | 12,578 | 8,195 | 7,249 | 15,444 | 13,765 | 21,014 |
| Pittsburgh MSA (4) | 2,055,914 | 265,966 | 16,005 | 2,867 | 2,351 | 3,486 | 5,837 | 6,986 | 10,472 |
| Reading MSA (1) | 357,727 | 51,125 | 2,972 | 1,051 | 985 | 734 | 1,719 | 1,639 | 2,373 |
| Sharon MSA (1) | 121,093 | 18,844 | 1,140 | 381 | 69 | 325 | 394 | 312 | 637 |
| State College MSA (1) | 113,912 | 12,576 | 815 | 352 | 193 | 274 | 467 | 320 | 594 |
| Williamsport MSA (2) | 119,904 | 19,622 | 1,155 | 423 | 162 | 263 | 425 | 444 | 707 |
| York MSA (2) | 395,011 | 59,333 | 3,569 | 1,643 | 1,078 | 1,111 | 2,189 | 1,784 | 2,895 |
| Beaver MSA (1) | 183,127 | 27,955 | 1,525 | 412 | 171 | 365 | 536 | 541 | 906 |
| Non-MSA Pa (35) | 1,789,013 | 287,928 | 16,837 | 5,842 | 1,968 | 4,716 | 6,684 | 5,657 | 10,373 |
| Total | 11,877,241 | 1,621,271 | 98,239 | 34,631 | 20,918 | 25,247 | 46,165 | 42,821 | 68,068 |

*Hires*[a]: due to retirements at age 65 and student demographics
*Hires*[e]: due to retirements at 30 years of service and student demographics

## 9.6 Other Sources of Teacher Supply

If we expand the analysis of the supply of certificated teachers to include retired teachers who live in Pennsylvania and are under the age of 65, we find that there are currently another 11,460 certificated teachers who might be available during part of the decade to teach. More importantly, the Pennsylvania Department of Education reports that, since it began the computerization of its certification files in 1965, some 434,000 individuals have become certificated teachers. At least 316,000 are not currently classroom teachers, and 263,400, including the 11,460 retired teachers just noted, are under age 65 today.

When we relate these two latent supplies of certificated teachers to the various projections of possible demand, it is difficult to conclude that there is going to be a shortage of teachers as long as funding is available, and information and advertising take place to encourage those who pursued other careers to reconsider teaching. The ratio of certificated, non-teachers to the total number of current teachers is anywhere from 2:1 to 10:1, depending on the area of certification in question.

## 9.7 Classroom Teacher Needs to Achieve A "Best Practice" Curricula

In the course of examining current curricula offerings to build the simulation models, it became evident that there is wide variation in secondary curricula offerings among Pennsylvania's 500 school districts. Many academic and vocational course electives are not available for may of the State's students.. It is evident, for example, that larger school districts are able to offer more electives, as are districts which are composed of higher income families.

Table 9.5: Percent of Districts Offering Any Advanced Placement Courses

| Total Enrollment | 1990 Per capita Taxable Income $4,681-$7,500 | $7,501-$9,450 | $9,451-$11,810 | $11,811-$39,560 | Total |
|---|---|---|---|---|---|
| 255 - 1,000 | 16.7% | 11.1% | 25.0% | 25.0% | 15.9% |
| 1,001 - 1,500 | 15.6% | 9.1% | 38.9% | 75.0% | 20.7% |
| 1,501 - 2,000 | 16.7% | 30.8% | 52.6% | 78.6% | 41.6% |
| 2,001 - 2,500 | 28.6% | 47.6% | 48.1% | 58.8% | 48.6% |
| 2,501 - 3,000 | 14.3% | 45.5% | 53.3% | 85.0% | 56.3% |
| 3,001 - 4,000 | 100.0% | 59.1% | 73.3% | 83.3% | 73.5% |
| 4,001 - 6,000 | 100.0% | 57.1% | 91.7% | 70.0% | 76.2% |
| 6,001 - 8,000 | 33.3% | 50.0% | 100.0% | 85.7% | 78.3% |
| 8,001 -10,001 | 100.0% | 100.0% | 100.0% | 85.7% | 92.3% |
| 10,001 -13,397 | 0.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Pittsburgh: 39,560 | 0.0% | 100.0% | 0.0% | 0.0% | 100.0% |
| Philadelphia: 191,632 | 100.0% | 0.0% | 0.0% | 0.0% | 100.0% |
| Total | 23.1% | 36.5% | 60.5% | 75.8% | 49.8% |

Table 9.5 shows the percentage of districts, classified by their overall enrollment size and per community income, which offered any Advanced Placement course in 1988/9. It is evident that both scale and community income plan an important role in the availability of such courses. There is also considerable evidence that student access to may electives varies dramatically across metropolitan areas. (See Table 9.6.)

Table 9.6: Percent of Districts and Students in MSAs Offering Any Advanced Placement Courses

| MSA | Dists. | % AP | HS Students | % with AP |
|---|---|---|---|---|
| Allentown | 22 | 40.9% | 24,021 | 62.6% |
| Altoona | 7 | 42.9% | 6,443 | 73.7% |
| Erie | 13 | 15.4% | 12,832 | 33.6% |
| Harrisburg | 29 | 62.1% | 26,791 | 74.4% |
| Johnstown | 23 | 34.8% | 11,141 | 48.7% |
| Lancaster | 16 | 81.3% | 16,507 | 88.7% |
| Scranton | 33 | 57.6% | 29,168 | 65.0% |
| Philadelphia | 62 | 80.7% | 130,745 | 94.9% |
| Pittsburgh | 80 | 65.0% | 84,792 | 74.2% |
| Reading | 18 | 55.6% | 14,456 | 61.2% |
| Sharon | 12 | 33.3% | 5,901 | 45.2% |
| State College | 4 | 50.0% | 3,889 | 58.5% |
| Williamsport | 8 | 50.0% | 5,694 | 71.1% |
| York | 21 | 52.4% | 16,676 | 55.0% |
| Beaver | 14 | 14.3% | 8,675 | 18.0% |
| Non-MSA | 136 | 30.2% | 86,891 | 43.8% |
| Total | 498 | 49.8% | 484,622 | 68.7% |

The demographic simulation models were amended to consider the implications of school districts offering electives, which they currently do not offer, at the **median enrollment rate** of those districts which do offer such electives. We set a minimum class size of 5, and a maximum class size of 25.

For example, we found just in the assignment area of calculus that of the 155 districts which do not offer a calculus course, *per se*, moving to the median enrollment rate would allow 4,609 students to take this course, which would require, in turn, 37 additional teachers statewide. With respect to advanced physics which 377 districts currently do not offer, offering a "best practice" curricula would result in 5,109 students taking the course which in turn would require 41 additional teachers statewide.

Overall, better than 6,400 teachers in a variety of academic and specialty courses would be needed were all districts to move to the best practice curricula. The smallest number of additional sections of the various electives examined in a district was 16, and the largest number was 1,219, implying additional teachers being hired, respectively, of 3 and 244. In many smaller districts, there were fewer than five sections of a particular course predicted by this methodology, so that teachers with dual or three certification areas would have to be identified in order for them to teach five contact sections per day.

Undoubtedly this definition of educational reform would be prohibitively expensive; however, it is useful to examine the staffing implications of moving all school districts' curricula beyond those needed to deal with student enrollment, teacher retirements and quits.

## 9.8 Determinants of Student Post-secondary Educational Plans

The study found that students in districts which offer elective science and math courses tend to have much greater post-secondary educational plans than students in districts which did not offer such elective courses. Students in districts whose teachers were trained at the State public

universities tended not to have post-secondary educational plans, compared to students in districts from other types of teacher training institutions.

Multivariate analysis of the determinants of graduating high school seniors' post-secondary educational plans indicated that student characteristics, curricula offerings, and teacher characteristics all have statistically significant effects on such plans. Generally, student characteristics, and student teacher ratios had relatively small effects on post-secondary educational plans, while teacher characteristics and curricula had sizeable effects on post-secondary educational plans.

The earlier inverse effect of public university trained teachers on post-secondary educational plans was confirmed in the multivariate setting. Remarkably, if a district offered all electives, had students with average Tells scores and average pupil-teacher ratios, and all of its teachers were from public universities, the analysis predicts that only 42% of graduating seniors would desire to go on to post-secondary education. Were all other factors the same, but the teachers were trained at private colleges and universities, the analysis predicts that 77.2% of the students would desire to go on to post-secondary education.

This result was found, after holding constant Tells scores, the fraction of students in AFDC families, student-teacher ratios, and the aforementioned curricula effects.

## 9.9 Public Policy Implications

We predict that districts, to maintain current student-teacher ratios and maintain current curricula, will engage in significantly more hiring in the balance of this decade than they did in the previous decade. The aging of Pennsylvania's teachers, and the modest growth in enrollment in the remainder of this decade pose both a challenge and an opportunity. If one believes that the quality of our children's classroom experience is impacted by the quality and preparation of classroom teachers, then Pennsylvania, with a relatively old teacher population, faces a remarkable opportunity to improve its education and curricula as districts move to find replacement teachers.

While certain certification areas may become difficult to staff out of the annual graduating classes from Pennsylvania's certificate granting institutions, it would appear that there are many certificated teachers, not now teaching, who could be located and potentially attracted back to teaching to meet projected needs.

Whether the increased secondary school enrollment and simultaneous wave of retirements will in fact be met by new hires, in a difficult economic and fiscal environment, is difficult to predict. Hard pressed districts may simply allow class size to increase again to the level of the early 1980's, and reduce their secondary elective offerings with a likely concomitant decline in the quality of education. Also, the recently enacted elimination of historical course graduation requirements, to be replaced by tests devised by the districts, may simply encourage districts to drop many academic offerings to meet increasingly tight budgets. Under this scenario, it is difficult to imagine that districts whose students do not pass the planned achievement examinations will face adverse consequences.

The study does indicate, however, that the wholesale elimination of secondary school electives could easily reduce the percentage of Pennsylvania's high school graduates planning to pursue post-secondary education by 13 to 20 percentage points each year.

The prediction that large numbers of current classroom teachers will retire in the balance of the decade may have several different fiscal effects on local school districts and the State. On the one hand, the retirement of large numbers of the most highly compensated classroom teachers and their replacement by younger and therefore less costly classroom teachers should provide significant

budgetary savings to local districts. Undoubtedly this will create, in turn, greater pressures for more generous collective bargaining settlements. On the other hand, to the extent that these additional retirements have not been properly taken into account by the actuaries of the School Employees' Retirement System, the unfunded liability of the System could dramatically increase.

If state and local funding for public education are not a problem, and the state were to pursue a policy of moving districts' curricula towards "best practice" curricula, in the sense that all districts should offer a broad array of academic courses such as advanced placement science courses, then many more new teachers would have to be hired beyond those predicted by teacher and student demographics. Under the best-practice scenario, as many as 50,000 new course sections would have to be offered annually. This may imply the addition of about 6,500 teachers to the 21,000 to 43,000 needed to replace retirements and meet enrollment growth, and in addition to the likely 25,000 quits we expect to occur in the balance of the decade. The study indicates, however, that merely hiring teachers without regard to their background, will not ensure improved quality education.

These findings have several implications for the State should it wish to take a more activist role in the planning of teacher preparation, and take a more activist role in providing guidance to local districts with regard to their future staffing needs.

- First, the projections of retirements and quits by district suggest that the college and universities offering teacher certification programs and the State Department of Education would do well to coordinate systematically their efforts. It seems quite likely that the differentially greater secondary teaching needs found by this study are not well understood by the certificating institutions and their students.

  The current practice of each district acting in isolation to meet its teaching needs, and each teacher certification institution training in any certification area without regard to likely future specialized needs is wasteful, and can be readily improved through the publication of:

  - a statewide list of openings by certification area and district, and
  - the publication of a statewide list of new graduates, their certification areas, and how they can be contacted.
  - the statewide or regional publication of the list of names and location of certificated, but not teaching, persons so districts can know whom to contact as they seek to fill their teaching needs in the future.

- Second, the documented high rates of unemployment of newly trained teachers requires further examination, especially the differentially worse employment experience of graduates of the public university teacher preparation programs. The publicly supported certification programs graduate about half of all newly certificated teachers each year; however, these graduates have an employment rate which is about one half that of those who graduate from private certification preparation.
- Third, the statistically significant, inverse relation between the percentage of teachers trained at public university in a school district and percentage of high school students in a district with post-secondary educational plans needs to be further researched. The mechanisms by which this statistical regularity occurs needs to be understood better.
- Fourth, there is merit in the continuation of such demographically driven studies of teacher demand and supply, and the further study of the relationship between the fiscal implications of the predicted additional hiring that will need to take place in the balance of the decade and the ultimate quality of Pennsylvania's *system* of public education.

## 9.10 Some Caveats and Limitations of the Study

Several caveats are in order with regard to the above findings and policy recommendations. As is evident from Table 5.31, we now know, as did most districts at the beginning of the 1980's, that enrollment would severely decline throughout the decade. Clearly, if a student teacher ratio of 19.0 had been acceptable at the end of the decade, when enrollment had dropped by 240,000 or 13%, we might have expected to find 13% fewer teachers employed at the end of the decade than at the beginning of the 1980's. In fact, the reverse occurred– many more teachers were hired due to growing state aid, a desire to address those districts whose TELLS test results indicated special needs, and in some cases a growing local tax base. As is evident from Table 5.31 the student teacher ratio dropped from a high of 19.3 to a low of 16.3.

Now, the demographics for the balance of the decade of the 1990's are moving in the opposite direction. There will be a steady increase in enrollment for the rest of the decade, with enrollment growth at the secondary school level. What we have documented is what will be necessary should districts wish to maintain both their current curricula offerings and current student-teacher ratios.

Beyond these caveats, we should comment that this study does not directly address a number of emerging changes in the market for teachers services. First, we are unable to address the implications of the changes in funding of special education recently put in place . Second, while we make projections about the needs for teachers of various types, and have found statistically significant relationships between student post-secondary plans, curricula, and where the student's teachers were trained, we do not know precisely how differential curricula and teachers get transformed into encouraging and/or ensuring that high school graduates go on to further education.

These issues remain for future research.

# Chapter 10

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