THE ECONOMICS OF
EQUAL EDUCATION OPPORTUNITY

by

Wangdali C. Bacdayan

**A thesis submitted to
the faculty of the Department of Economics
in candidacy for the degree of
Bachelor of Arts in Economics, with honors**

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On my honor, I acknowledge aid to the following people:

Philip Cline and John Winfrey,
for editing, criticism, and general advising;

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My father,
for always pointing me in the right direction.

Wangdali Covar Bacdayan

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CHAPTER I

Introduction

The importance of education to the individual and to society has been well-known since the "days of old." Adam Smith believed that without education, working people would be so alienated from society that the principle of "division of labor" would be threatened; Alfred Marshall held that education allowed individuals to improve their lives within their social class but also served as a buffer between classes; and Thomas Malthus thought of education as a worthy investment to help prevent his theorized population explosion.[1] While many of these past theories have long withered away, analysis of education's effects on human behavior still interests many economists. Since our meritocratic society requires learning performance to be measured in classrooms and businesses every day, investigating how individuals master a given task should be of great importance. Fortunately, economic analysis provides a vehicle by which inferences concerning input-output relationships in the learning process may be made.

Supply-demand schedules, production possibilities frontiers, and cost curves are a few of the models which economists employ to make rough approximations of economic activity. Economists use utility functions and production functions to analyze the allocation decisions made by consumers and firms. A utility function represents an array of combinations of commodities which yield a particular level of satisfaction to the consumer. A production function describes quantities of output that can be produced from various levels of inputs. However, as we suggested

earlier, the application of these models is not reserved solely for the "business" world. Economic ideas such as production functions and utility maximization can be applied to "non-business" problems and processes. One such application is employing the theories of the firm and of the consumer to individual learning behavior. The theory and analysis in this paper takes both of these microeconomic concepts and applies them to the learning process.

The history of economic education research begins over twenty-five years ago with the United States Office of Education's release of its monumental analysis of elementary and secondary education, Equality of Educational Opportunity.[1] Its primary finding was that "variations in the level of students' achievements bore little or no relationship to the resources or programs of their schools."[2] This result surprised many who felt that improving the quality and equality of learning conditions, primarily for black students, within our school system could be achieved by simply spending more money in resource-deficient schools. Subsequent analyses, based on the Coleman Report data and upon smaller, nonrepresentative samples, have been unable to contradict the Coleman Report's finding. Therefore, economic education analyses must now originate from the empirical evidence which shows that the expenditure-achievement nexus is, at best, of secondary importance among the factors affecting learning outcomes.[3]

This counter-intuitive result has fortunately inspired further economic education research. The economic education research that

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[1]Referred to as "The Coleman Report" or as "The Report."

followed Coleman, though, typically employed the production function technique using aggregate cross-sectional observations at the national, state, and school-district levels. However, criticism has surfaced in recent literature as to whether aggregative data studies are able to disentangle and capture the important relationships of the educational process. This has been the most common explanation for the failure of aggregative studies to demonstrate a significant and consistent link between school resources and achievement.[4] Now educational research is focusing more on identification of the factors which encourage advancement of the learning process.[2]

Since the Coleman Report's release, parents, courts, and legislatures have struggled to define what is meant by the term equal education opportunity since the Coleman Report was released. At the same time, educators, economists, and psychologists have labored to identify which combination of school inputs is required for each student to best equip him or her for educational growth.[5] In the midst of this struggle, the need for serious educational reform has grown over the past decade. Ronald Reagan's National Commission on Excellence in Education decried the "rising tide of

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[2]An important methodological change, proposed by Benjamin S. Bloom, is a move away from studies of static variables to variables that are alterable either before the teaching and learning processes begin or as a part of these processes. The term "alterable variables" was given by Bloom to this class of variables which are being studied increasingly in economic education research. Bloom states that the study of this type of variable will enable researchers to move from an emphasis on prediction and classification to an emphasis on causality and relationships between the inputs and outputs associated with the learning process.

mediocrity" eroding the nation's schools.[6] The commission trumpeted a variety of reforms aimed at increasing the time spent in school on basic subjects and at improving the quality of teaching. These issues take on greater importance when one realizes that much of education's contribution to post-World War II productivity growth was through increasing the proportion of the work-force holding a high school diploma. Now that most of the labor force has reached this level of educational attainment, productivity growth from education is likely to depend more and more on raising the quality of schooling.

There are four primary objectives for this thesis. First, an economic model of learning behavior is developed combining micro-economic theories with economist Gary Becker's theory on the allocation of time. The economic model argues that the student is a utility-maximizing agent who is both a consumer and producer of various commodities. This approach is significant from past approaches in that it views the student, not the school, as the producer of learning performance.

Second, the economic model works well to criticize and expose the shortcomings of our current method of schooling. Our model highlights the need to move away from the conventional lecture method used in classrooms which fixes the levels of educational resources that students can use--a change which Bloom suggested many years ago with his mastery learning model. Without such types of changes, the thesis suggests that brighter students will continue to find their achievement gains restricted while slower

students will not be awarded an opportunity to overcome their learning deficiencies.

Third, the economic model serves as an expository vehicle which helps to interpret confounding, historic school data. Over the past three decades, governments' constant dollar per pupil expenditures on elementary and secondary education have nearly tripled and yet the levels of achievement test scores have remained fairly constant. All things considered, including the rising costs of educational inputs, these expenditures have still hired more and better experienced teachers and reduced the average class size for today's schools. Our economic model suggests that these sheer increases in expenditure levels could never have generated meaningful increases in learning performance. The key to successful education reforms is not whether or not you spend more money on education but that you spend the money on increasingly effective (more time-intensive) educational resources.

And finally, the economic model assists in the evaluation of public policies designed to provide individuals with equal education opportunities. Two major education reforms, school desegregation and equal financing, are taken through the model and their effects are analyzed. The model implies that while these reforms guaranteed the legal rights of individuals to equal education opportunity they did not guarantee individuals full access to the realization of equal education opportunity.

CHAPTER II

The Costs and Benefits of Education

A. Introduction

We begin our analysis by making two casual observations. First, there is little uncertainty that those individuals who have obtained education differ from those who have not. Second, the learning process that occurs in our educational system takes place over time. These two simple observations often get lost in the empirical analysis of educational benefits and so it is important to understand the issues these observations address. The observations lead to an array of questions concerning the benefits of education. How well does educational attainment account for differences in earnings? What can we do through society's institutions to provide everyone greater opportunities for learning? What are the rates of return, private and social, from education? Throughout this analysis, it is important to keep these observations in mind as we work toward the conclusions drawn from the model presented later.

To help answer these questions, we begin by looking closer at the public and private benefits of education as an economic good. We consider a few of the reasons why so many people believe that education is so important to the welfare of our society, and then consider the nature of the costs which constrain our society's choices in providing education. We probe primarily into questions concerning the determination of the distribution of learning outcomes. Questions of policy which are related to the first

observation above are then taken up in subsequent chapters of the thesis.

B. Education as an Economic Good

The United States' public education system links together two fundamental rights of our society. First, our society has the right, as does any other democratic society, to insure, through its policies and institutions, that it will continue to survive, exist, and prosper for generations to come. Second, our Bill of Rights implicitly guarantees the right of individuals to choose the experience to which they will be exposed. These two rights often oppose each other. This is the case when an individual views a particular influence as appropriate while the rest of society does not--e.g. the cacophony of voices calling for legalization of marijuana. Clearly, we cannot endure a situation where individuals simply acted as they wished--this type of situation would be harmful to the general welfare of our society. On the other hand, we cannot allow society's interests to select the influences which it deems appropriate without regard for individual beliefs. So individuals and society must work together, ironing out differences over what kind and how much, to determine the appropriate quality and levels of education which we desire and can provide. Fortunately, solving these problems may be easier if we cast them in terms of economics: Education is an economic good whose value to society is determined by the benefits it generates and the costs it requires.

C. The Benefits of Education

Past economic analysis that evaluated the benefits of education primarily focused on the contribution of education to earnings. Studies on the relationship between individual background characteristics and occupational attainment (earnings) have invariably indicated that while much of the variance in earnings remains unexplained, the "largest single indicator is education."[7] However, as we present in this section, increased earnings and income are only part of the benefits which education can provide.

Identification of education's benefits is difficult because economists can classify them as either "consumption" or "investment" returns. Recall that a pure consumption good is a commodity whose use yields utility in a single, time period and a pure investment good is a commodity whose use yields utility in future time periods. Education is a good which possesses characteristics of both types of goods.[8]

As a consumption good, individuals often derive some level of satisfaction from attending school. Even a child who is forced by law to attend school derives utility from education. The child may claim that he hates going to school, but when compared with the alternatives (e.g. working as a ditch-digger) the child would probably rather go to school.[9] As an investment good, an individual derives satisfaction in the future due to the increased individual productivity and earnings which he hopes to enjoy. This results from his increased trainability, health, efficiency in

production, access to information, and a wide variety of other private well-being aspects. An individual also benefits from a "financial option return."[10] This return accounts for the opportunity to continue his learning at the next higher level. Unfortunately, for policy-makers in particular, it is difficult to categorize the benefits as an entirely homogeneous group. A student may or may not enter the classroom with a variety of attributes which foster the learning process. Consequently, one cannot discuss the benefits of education without accounting for differences in the capacity of individuals to realize them.

Another problem of benefit analysis arises since emphasis on the marginal effects of education on earnings ignores many of the external effects it creates. Schooling benefits many others apart from the student actually sitting inside the classroom. A student's family, friends, and country all benefit from his choice to obtain education. Schooling is a means to impart "acceptable social values and behavior norms in the community children and by providing children with alternatives to unsupervised activities which may have anti-social consequences."[11] These external benefits of schooling are gained by society above and beyond the private returns realized by the individual learner.

Despite the problems inherent in economic education research, the fact that educational benefits spill over to others who do not directly engage in the formal learning process offered in schools is the principal reason why society takes such great interest in its provision. Educators and economists will claim that education

contributes to such things as "political participation" and the "inculcation of civic values."[12] Schools also help to create a common set of values and knowledge which a democratic society needs to transcend the social, economic, and political differences which exist within it. Schooling provides society with the literate, resourceful, and productive work-force required for sustained economic growth. In summary, schooling plays a leading role in contributing to the cultural and scientific strength of a nation as well as supporting economic growth and full employment within a nation.

D. The Costs of Education

"If education were free, people presumably would 'consume' it until they were satiated, and they would 'invest' in it until the return to education was zero."[13] However, attending school is not free in any sense of the word. We can divide the costs of schooling into two different categories: explicit and implicit costs. Monetary expenditures, either by governments, parents, or the students themselves, are explicit costs easily associated with obtaining education. Tuition, room, board, books, fees, etc. are items that can be easily assigned an explicit cost. What cannot be easily measured is the opportunity cost of time spent in school. Students forego earnings that they could have earned by offering their labor services in exchange for a money wage. Obviously, a student hopes that his decision to attend school will result in higher wages in the future--wages sufficient to cover the costs, monetary and psychological, which he incurred by going to school;

however, there is no guarantee that this will occur. By choosing to attend school, individuals also decide to put off current consumption in the hopes of being able to consume more at a later date. Psychological costs such as the nuisance of having to sit in a classroom on a beautiful day are also included when computing the total costs of education.

The most common method of calculating the costs of schooling involves the measurement of school expenditures. Most economic education studies, including the Coleman Report, require the collection of statistics assessing the operating expenses of a school--its "capital outlays for land, buildings, equipment, and then a list of auxiliary items that have little to do with schooling."[14] Unfortunately, this method does not approach an accurate measurement of schooling costs. It ignores, in particular, those costs borne, primarily through tuition payments, by the student and his family as well as those costs borne, through similar taxes and tuition payments, by other students and families. If these studies hope to provide an accurate assessment of the schooling costs, their goal must be a method which identifies and accounts for all of the input factors entering into schooling. T.W. Schultz refers to this concept as the "total factor costs" of schooling since it measures all the schooling costs in an economy.

While the nature of explicit payments is self-explanatory, what constitutes an implicit payment is not entirely obvious. Implicit payments include the opportunity cost of leisure time, foregone earnings, as well as the taxes which families pay to their

governments if their child attends a public school.[3] We include taxes as an implicit cost since individual's do not often associate them with the explicit costs they incur from schooling. The loss of leisure time extracts payments from the student as well. While many students may, in fact, enjoy schooling, many would rather spend a greater part of their time engaged in other activities. Also included in the calculation of implicit costs are the foregone earnings incurred by a student. At the bare minimum, individuals who choose to attend school give up earned income equal to the hourly wage multiplied by the number of hours they spend in school. However, the cost of foregone earnings is not just the wages which he loses from not participating in the labor force. Foregone earnings also include the increased wages the individual might receive in the future from the learning and training (conventionally thought of as an apprentice period) he received from his participation in the labor force--i.e., the present value of the stream of future earnings. However, current research estimates of earnings foregone based on the earnings of those youths who are not in school tend to understate the earnings foregone for those students attending school.[15] Therefore we have yet been able to calculated the true cost of an individual's schooling. We now turn to, in Chapter III, a discussion of the goals and purposes of schooling.

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[3]In a public school, the cost of the education a student receives is paid by not only the student and his family but also the other citizens of his community through the levying of taxes.

CHAPTER III

Equal Education Opportunity

A. The Coleman Report

In response to a provision in the Civil Rights Act of 1964, the United States Office of Education issued a report in July 1966 titled "Equality of Educational Opportunity." The Office of Education's expressed objective was to obtain an unequivocal answer to the question of discrimination against racial and other groups in the provision of public education. The Office of Education had expected to find gross inequalities in the educational resources employed by predominantly black and white schools and then use this finding as a mandate for finance reforms. Unfortunately, the findings of the Report did not confirm the initial suspicions of public policy-makers and educators. Subsequently, the Report has inspired further debate and research in this field.

The Coleman Report, itself, is comprised of 9 sections--sections 2-8 deal with various aspects of educational opportunity, section 9 includes technical appendices, and section 1 is a summary of the Report. Sections 2 and 3 are seen as the most relevant to questions concerning the equality of educational opportunity and public policy. These sections outline the procedures of a national survey which covered nearly 4000 elementary and secondary schools and sought to identify the basis of inequality of educational opportunity among six racial and ethnic groups (blacks, Puerto Ricans, American Indians, Mexican Americans, Oriental Americans, and whites).[16] The Report's conclusions on the relationships

between school characteristics and achievement have produced the greatest portion of controversy surrounding the Report since they cast serious doubts upon the effectiveness of public policies to increase non-personal resources within the school.

While the Coleman Report did not fully meet its expectations, it was able to reach four clear conclusions from its survey.[17]

> 1. Most black and white Americans attended different schools.
>
> 2. Despite popular impressions to the contrary, the physical facilities, the formal curriculums, and most of the measurable characteristics of teachers in black and white schools were quite similar.
>
> 3. Despite popular impressions to the contrary, measured differences in schools' physical facilities, formal curriculums, and teacher characteristics had very little effect on either black or white students' performance on standardized tests.
>
> 4. The only school characteristic that showed a consistent relationship to test scores was the school characteristic to which most poor black children had been denied access: classmates from affluent homes.

In other words, the Report found that differences in the educational resources between predominantly black and white schools did little to explain differences in achievement across minority groups. It also found that the gap between the achievement scores of black and white children existed already at the first grade and that the gap widened as the children moved through the schooling process. The Report concluded that factors such as family background and peer influences explained more of the variation in educational achievement than differences within the school itself.

These conclusions suggest that the Court vindicated itself by rescinding the "separate but equal" doctrine, that it had endorsed

in their 1896 Plessy v Ferguson decision, with their ruling in 1954 Brown v. Board of Education. The conclusion also supported many blacks' claims that separate educational facilities made the array of opportunities available to them smaller than that available to whites. Integration, although not strongly endorsed by the Report, then became the popular public policy measure to correct this inequity.

While Congress simply asked the Office of Education to assess the "lack of equality of educational opportunity" among certain groups of our society, they, nor the Executive Branch, gave any explanation of the concept. Congress left the matter of defining the concept of equality of educational opportunity up to the authors of the Report. The authors chose, in essence, two different interpretations. First, they considered equality of educational resources or inputs. Second, they considered equality of educational achievement from the education process (The results of any research will depend entirely upon which of these two perspectives it chooses).

We now attempt to do what Congress did not do some 30 years ago. That is, we consider the definition of the concept of equality of educational opportunity--tracing the historical development of the concept and stating our own working definition.

B. Defining the Concept of Equality of Education Opportunity[18]

Traditionally, the role of education has been to broaden an individual's range of opportunities for productive, active, and rewarding participation in our society.[19] Interest in equality of

educational opportunity was spurred on largely by the civil rights movement of the 1950s and 1960s since many regarded the concept as the basis for "all the rights, privileges, and responsibilities of membership" in our modern democratic society.[20] For this reason, defining the scope of this concept is of great importance. Attempting to define the concept of equality of educational opportunity, however, is a task which must begin long before the Civil Rights Act of 1964. We start by looking at the economic structure of pre-industrialized societies; when schools, in the context we think of today, did not even exist. In pre-industrial Europe, the family functioned as the primary economic unit. The family economic unit maintained complete control over and held complete responsibility for its children. It carried responsibility for its members' welfare from cradle to grave. Thus, interest in whether or not an individual became more productive was solely that of the individual's family--there was little interest whether someone in another family became more productive. The key result of this societal structure was that a child's opportunities were strictly limited by his father's station in life. If his father was a serf, he too was likely to be a serf. The fact that a child was a part of his family's productive enterprise and would likely remain within this enterprise throughout his life further shortened the horizons of all children. In addition, the arrangement did not expire once the child reached adulthood since he would simply continue the practice of this economic unit structure, passing it down to his own children. For

the most part, sons were left to accomplish little more than their fathers since "the general pattern was family continuity through this patriarchal kinship system."[21]

The concept of equality of educational opportunity had very little relevance in this societal structure. Growing up as a part of an economic unit of production provided an appropriate and sufficient learning context for individuals to reach their pre-determined station in life. For example, working in his father's carpenter shop represented proper schooling for a son and working in her mother's kitchen represented proper schooling for a daughter. To these sons and daughters, opportunity, let alone equality of opportunity, had no meaning since their positions in society were given and their training and education were simply whatever was necessary to maintain production in the family unit.

With the beginning of the Industrial Revolution, however, the family economic unit lost its role as a self-perpetuating economic unit and training ground. Mobility to occupations outside of the household greatly expanded the opportunities available to all children. Thus families were no longer needed as sources of economic production or providers of welfare--these responsibilities now fell to the community. The training and education which a child received became the interest of the entire community, since they, and not just his immediate family, were now his potential employers or his potential economic supporters. As more and more men moved outside of their family economic units to offer their labor services, the need for public education arose since sons

could now choose an occupation different from their father's trade. "Families needed a context with which their children could learn some general skills which would be useful for gaining work outside the family; and men of influence in the community began to be interested in the potential productivity of other men's children."[22]

Thus public education, through open schools, began to appear in England and in the United States during the early nineteenth century. Before this time, the only context in which education had flourished was within the mercantilist class who both needed and were able to provide training of general skills which would be useful in securing professional occupations. In the mid-nineteenth century United States, society's view of who was entitled to education extended to everyone except slaves. The Civil War brought an end to the practice of slavery and signalled the movement of former slaves into the general labor force. This movement, coupled with the commencement of the Industrial Revolution, gradually forced increased, and nearly universal, access to public education.

The Industrial Revolution served as an economic impetus for general public education. Public education also grew out of the class structure, or the birth of a differentiated class structure, emerging in nineteenth century United States. The ex-slaves and uneducated poor whites, who formed a new class in U.S. society, lobbied for open schooling as the vehicle for their own advancement.[23] Many saw open schooling as an opportunity to

provide a common learning experience to representatives of all classes. Yet they also feared that the school might soon become a method of training children in the interest of developing the industrial subordinacy relationships that were emerging during this time. These early schools helped initiate the evolution of the debate of educational opportunity. It is a debate which has always centered around the idea of equality. This notion of equality, Coleman summarizes, is embodied in the objectives of these early open schools:

> 1. Providing a free education up to a given level which constituted the principal entry point to the labor force.
>
> 2. Providing a common curriculum for all children, regardless of background.
>
> 3. Partly by design and partly because of low population density, providing that children from diverse backgrounds attend the same school.
>
> 4. Providing equality within a given locality, since local taxes provided the source of support for schools.

While these four elements are widely accepted by most people as appropriate tenets for defining the concept of equality of educational opportunity, they minimally serve as a starting point for defining the concept. To see this, suppose that we have a free public school system in which all students, from varying social backgrounds, attend the same school for the same amount of time each day and learn from the same curriculum. This situation easily satisfies the criteria above as a minimum standard for equality of educational opportunity. However, it should be clear that this situation falls short of equality. Individuals from the middle- and upper-classes are privy to additional resources outside of this

school system which other children are not. Access to these additional resources would undoubtedly enhance the achievement of these more fortunate individuals. What would result, in essence, is a situation where students leave the school system in the same relative position to their peers as they were when they entered the school system. The fact that this criteria for equality of educational opportunity is a de minimis definition of the concept did not become readily apparent until the mid-twentieth century. By analyzing each of the four elements in turn, we can trace the development of the concept of equality of educational opportunity to its present interpretation.

The first element in the criteria above is limited by the assumption it implicitly makes that by simply providing free schools to individuals we eliminate all economic sources of inequality. This assumption is far from true. It is true that provision of free schools erases the inequality of explicit costs which individuals might bear in attending school. However, as any economist will say, it is not true that free schooling eliminates the inequality of implicit costs, opportunity costs, which are incurred by attending school. There are distinct opportunity costs paid by the child and his family: the child loses the skilled, occupational training he would have received at home and his family loses a measurable contribution to its product. As a result, inequality of educational opportunity results since only wealthier families, families who can afford to surrender their children's productive contribution to the family's economic unit, are capable

of paying the indirect costs associated with sending their children to school.

The second element incorrectly assumes that equality of educational opportunity results merely from **exposure** to a given curriculum. Under this assumption, the school functions as an universal menu of opportunity from which all individuals are equally free to choose. Whether or not individuals choose something depends entirely on the individual--the responsibility of achievement resides with the individual. However, as it became clear that only the middle- and upper-classes were able to afford the indirect costs of sending their children to school, the state quickly insured that this choice would no longer rest in the hands of the individual. States quickly enacted compulsory attendance laws, requiring individuals to attend school until a certain age, and thus turned the school's role from a passive to an active one. Now schools simply could not say that their mere existence provided educational opportunity to individuals--changes within the operation of the school were now required to give substance to the school's objectives.

Another challenge to this second element surfaced in a report of the National Education Association in 1918. The report focused largely on the fact that the standard curriculum offered in secondary education was intended for those individuals seeking college entrance. Before the report, the arguments for a common curriculum had never addressed the inequality it inherently created. Common curriculum advocates assume that a secondary school

student's path led to a college education. However, a large inflow of non-college bound individuals into secondary schools during the early part of this century made it clear that the common curriculum was not providing equal educational opportunity.[24] Schools took two different routes to remedy this problem. Some schools opted for greater diversification in their curriculum. This measure was, in some sense, a step backward since the new curriculum catered neither to the college nor to the non-college bound. Other schools opted to differentiate their curriculums; providing at least two tracks, college preparatory and non-college preparatory, from which individuals could choose. While this option certainly provided an enlarged array of educational opportunity than the single curriculum, it fell short of any desired notion of equality of educational opportunity since it **pre-determined** an individual's array of career possibilities.

Development of government policies in the past 100 years further dismantled the idea that equality of educational opportunity simply resided in equal exposure to educational resources. This evolution supports the inclusion of element three in this concept's criteria--that equality of educational opportunity inherently requires that children from diverse backgrounds attend the same school.[4] Government involvement can be traced back to the passage of the Fourteenth Amendment which guaranteed everyone "equal protection of the laws." Several

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[4]One of the objectives of the open school was: Partly by design and partly because of low population density, providing that children from diverse backgrounds attend the same school.

states, mostly southern ones, tacitly challenged the Fourteenth Amendment by enacting legislation which sanctioned segregation through the provision of separate facilities for blacks and whites. The Supreme Court ruled on this issue in their Plessy v. Ferguson (1896) decision that upheld the "separate but equal" doctrine practiced by the southern states. By adopting this doctrine, the Supreme Court endorsed the exposure focus on the equality of educational opportunity.

The Supreme Court's support of this doctrine ended in 1954 with its Brown v. Board of Education decision. In an unanimous opinion, the Court ruled that segregation by race in public schools violates the Fourteenth Amendment. The Justices identified education as a powerful tool "in awakening the child to cultural values, in preparing him for later professional training, and in helping him to adjust normally to his environment."[25] And by separating children solely on the basis of their race "generates a feeling of inferiority as to their status in the community that may affect their minds and hearts in a way unlikely ever to be undone."[26] The Brown decision marked a turning point in the evolution of the concept of equality of educational opportunity. Before the decision, the "underlying idea was that opportunity resided in exposure to a curriculum; the community's responsibility was to provide that exposure, the child's responsibility was to take advantage of it."[27] Brown suggested, for the first time, that the focus of the equality debate should be toward the effects and results produced by schooling. Before Brown, equality of

educational opportunity was measured strictly in terms of school inputs. By introducing the questions of outcomes and effects of schooling, the Court unknowingly opened up a Pandora's Box of approaches to defining the implicit and explicit goals of equality of educational opportunity.

The shortcomings of the fourth element remained hidden until July 1966 when the U.S. Office of Education issued a report titled "Equality of Educational Opportunity" fulfilling the provision of the 1964 Civil Rights Act which read:

> The Commissioner shall conduct a survey and make a report to the President and Congress, within two years of the enactment of this title, concerning the lack of availability of equal educational opportunities for individuals by reason of race, color, religion, or national origin in public educational institutions at all levels in the United States, its territories and possessions, and the District of Columbia.

One can clearly see that the explicit task thrust before the Department of Education left plenty of room for individual interpretation. Moreover, the conceptual clutter surrounding the idea of equality of educational opportunity made successful completion of this task exceedingly difficult. From a policy standpoint, the Report offered statistical support for integration and busing policies while helping to strike down some of the arguments for equal financing reforms.

C. Our Working Definition of Equality of Education Opportunity

The development of the equal education opportunity concept described above indicates that an universal definition may be impossible. However, there are basic elements of the concept which most people can agree on. The definition of equality of

educational opportunity which we will use through the remainder of this thesis refers specifically to the context of schooling, public and private. We are quite aware of the fact that education does occur outside of the school environment. However, the thesis' intent is to investigate institutional deficiencies within our current schooling system which now makes serious education reform necessary. Therefore, our discussion of equal educational opportunity strictly considers the school environment.

Our definition employs several of the ideas mentioned above. First, we hold that equality of educational opportunity is indeed a fundamental right of all members of our society. This right cannot be denied and governmental institutions must take the appropriate steps to provide free schooling to its citizens. Second, equality does not lie entirely within common exposure. We should realize that any two individuals are different and that the difference must be accounted for inside of the classroom. Third, "an individual's opportunity to attain an **optimal** level of achievement" defines our use of the term "equality." This is done so that society does not stifle the educational development of bright students in order to raise the levels of others. Instead, this definition hopes to raise everyone up to some minimum, acceptable level of achievement. Our school system should strive to insure that all individuals are presented with a satisfactory array of career opportunities.

We do not seek a society where everyone is a doctor or a lawyer, one where there is no distinction between any two

individual's station in life. If this were the case, then we would have essentially taken away the incentive to acquire such an occupation. We certainly are not proposing to eliminate the meritocratic feature of our society. The situation we seek, in a micro-economic respect, establishes some "satisficing" level of educational opportunity for all. Maximizing learning outcomes or minimizing educational expenditures is not the primary concern. This situation gives everyone the full opportunity to achieve an optimum level of learning performance and where any action by society and its institutions will not cause anyone else to be made worse off. That is, an individual operates along his highest possible personal utility curve defined by his own ability, motivation, and personal preferences, while attempting to reach the satisficing level. We take this situation to hold for all individuals, regardless of the social group to which that individual might belong.

The situation described above is indeed an idealistic one. We do realize that our definition of equality of educational opportunity may be as ambiguous as the one understood by the authors of the Coleman Report. However, it is the perspective in which I have chosen to look at equality of educational opportunity. In order to evaluate the concept of equality of educational opportunity, as well as our working definition of the concept, with respect to historical public policy, we now turn to the development of an economic model of learning behavior.

CHAPTER IV

The Economic Model

A. Introduction

The model presented here takes the view that individuals, as members of the traditional economic unit--households, function as both producers and consumers when they engage in the learning process. Economists model consumer behavior as if consumers maximize a utility function subject to a constraint. On the other hand, economists model producer behavior as if producers minimize a cost function obtained from the set of all possible combinations of inputs and their price ratios to produce a target level of output. While economists traditionally divorce these two aspects in their studies, the two processes are closely married in the context of learning behavior. As we will show here, the thread of this marriage depends entirely on a theory of the allocation of time.

Given a specific time period, individuals have an array of options from which to choose how to allocate their time. Some will choose to work; some will choose to sleep; some will choose to play athletic games; etc. An individual allocates time so that consumption of these types of goods generates some level of satisfaction. At the same time, individuals allocate time to produce goods as well. These goods that they produce are similar to the goods that they consume--except in the context of learning behavior we look at the psychological, physical, and monetary benefits which these activities generate.

For this thesis, we assume that individuals devote their own time to the production and consumption of only two varieties of goods: learning and non-learning. We consider, more specifically, the consumption good "attending school" and the production good "learning performance." From this perspective, we develop a model of learning behavior which proves useful in evaluating the concept of equal educational opportunity outlined in Chapter III.

B. A Brief Summary of a Theory on the Allocation of Time

When Gary Becker presented his "Theory of the Allocation of Time" in September 1965, he set out to develop a general theory on the allocation of an individual's time in non-work activities. Up to this point, studies of the allocation of time focused only on the time devoted to participation in the labor force. These studies worked well to describe the economic situation of countries before the Industrial Revolution. With families serving as self-sufficient economic units, the contribution of an individual's time to the aggregate product in an economy could be considered zero since the outputs of his labor services directly supported his own family economic unit. Individuals merely worked from dawn to dusk, combining their own labor with raw materials, to produce what was necessary to keep the family unit functioning. The Industrial Revolution brought laborers out of their homes and into factories where they labored for fixed-time periods in exchange for wages. These wages were presumably sufficient to purchase the products which the family economic units had previously made for themselves. This movement of labor out of the home reduced the work-day for

most laborers since they no longer chose to spend every waking moment working for their family economic unit. Consequently, the allocation and efficiency of non-working time became increasingly important.

Becker's theory and the economic model presented in this chapter depend on the assumption that individuals are producers as well as consumers. Individuals "produce commodities by combining the inputs of goods and time according to the cost-minimization rules of the traditional theory of the firm."[28] In the context of learning, students combine school inputs with their own time to produce some measure of learning performance. The cost-minimization assumption does not really apply here since it is not always the case that students consciously attempt to minimize their time spent learning. Nonetheless, economic education studies have consistently found that more time on a subject does increase learning.[29] Even if there were an absence of empirical research, it should be quite plausible to expect that the more exposure students have to instruction, the more they will learn. This argument, though, has been strengthened by the fact that recent research has concluded that time is a "potent lever" for improving student achievement.[30]

Our use of Becker's theory of time accommodates allocation of time toward the consumption of learning and non-learning goods. Individuals are able to choose from a menu of educational commodities and other types of commodities. They are presumed to be utility maximizers subject to a time-cost constraint defined by

the length of the time period of interest. The equilibrium resulting from the individual's consumption decisions directly affects his capacity to produce learning performance. We now turn to a discussion of how the learning process functions under a theory of the allocation of time.

C. Determination of Learning Outcomes: The Consumption Side

Consumer behavior and the theory of households lie at the base of our model of learning behavior. We reiterate the assumption that an individual acts as both a producer and a consumer in the process of generating a learning outcome. The equilibrium established by the consumer is paramount in determining learning outcomes since we will show that this equilibrium directly affects the position of the consumer's educational production function--i.e., it determines his learning outcome.

The function of consumers is to use, for their own purposes, certain goods and services (commodities) produced by firms in an economy. Any one consumer has many commodities from which he or she can choose. Usually the types and quantities of commodities he chooses is subject to a constraint, namely his disposable income. The theory of consumer demand explores the determination of a consumer's equilibrium choice and how this equilibrium reacts to changes in particular economic factors. In our model, we focus on the determination of a student's allocation of time toward learning.

Economists assume that an individual chooses to purchase a vector of commodities $\mathbf{y} = (y_1, y_2, \ldots, y_n)$, from a set Y of all

available commodities, which represents his "best choice from the set of vectors feasible to him."[31] Feasibility is defined in terms of the physical and economic constraints under which the individual is subject. The consumer's problem of utility maximization and the feasible set from which he must choose are constructed under certain axioms and assumptions:[32]

> i. The vector $\mathbf{y}$ must belong to a set $\mathbf{Y}$ called the consumption possibility set which is given a priori and depends on the individual consumer under consideration.
>
> ii. The consumer has a limited income, I, and must act within the market where each commodity y_i has a well-defined price p_i.
>
> iii. The consumer's preferences amongst the vectors in Y are defined by a real-valued function $U(y_1,y_2,\ldots,y_n)$ called the utility function, whose domain is the set Y. Given a utility level $\underline{U}$, the set $\underline{I} = \{ \mathbf{y} \mid U(\mathbf{y}) = \underline{U} \}$ defines an indifference locus or curve. The set of all indifference curves, corresponding to the different possible utility levels, defines a consumer's indifference map.
>
> iv. The set Y is closed, convex and bounded from below and contains the null vector. That is, if it contains a vector $\mathbf{y}^1$, it also contains another vector $\mathbf{y}^2$ such that $y_i^2 \geq y_i^1$ for $i = 1,2,\ldots,n$.
>
> v. The utility function $U(\mathbf{y})$ defined on Y is continuous, increasing and twice differentiable. The second property implies that the gain in utility following a small increase in the quantity of commodity y_i, its marginal utility, is positive for all i.
>
> vi. The utility function $U(\mathbf{y})$ is 'strictly quasi-concave' in the sense that if $U(\mathbf{y}^1) \geq U(\mathbf{y}^2)$ for two vectors $\mathbf{y}^1$ and $\mathbf{y}^2$, then for every vector $\mathbf{y}$ in the line segment $(\mathbf{y}^1,\mathbf{y}^2)$, $U(\mathbf{y}) > U(\mathbf{y}^1)$. In other words, the consumer will prefer an intermediate position to either of two extreme positions although he may be indifferent between these extreme positions.

According to traditional microeconomic theory, households maximize utility functions of the form:

(4.1) $$U = f(y_1, y_2, \ldots, y_n)$$

where U is a psychological unit which called "utility" and y_i are the commodities which the consumer has chosen to purchase at their market prices p_i.[33] Household equilibrium is subject to its disposable income constraint which must satisfy:

(4.2) $$I = \Sigma\ p_i y_i$$

where we define I to be an individual's money income, y_i represents the i^{th} commodity, and p_i are the commodity's market prices. Since utility is a subjective quantity which cannot be measured in a cardinal manner, we evaluate utility ordinally. That is, given any two vectors representing different market baskets of goods, Y^j and Y^k, we assume that the consumer can rank his preference of the two baskets.

As this section's introduction suggests, this is where we shall depart from traditional economic theory. In our model of learning behavior, an individual's primary objective as a consumer still is to maximize his utility function but instead of measuring the cost of commodities in terms of monetary units we will express cost as units of time. Everyone easily understands that there are explicit costs of obtaining goods and services such as the price of a movie ticket or the price of a carton of milk. Yet there are also implicit costs which should factor into the determination of the true cost of that commodity. In the case of education, for example, an individual's time spent in school is equivalently time spent away from the labor force and is measured by economists as foregone earnings--the money wage per unit time multiplied by the

amount of time an individual spends away from the labor force. Several studies have shown that foregone earnings is the dominant private and an important social cost of both high-school and college education in the United States.[34] Therefore, given a money wage, $\hat{w}$, when individuals select the basket of commodities which maximizes their utility function, they not only work within a monetary income constraint but also within a time constraint. One should see that these two constraints represent nearly the same thing since individual's wages, and thus their income, directly depend on the amount of time they spend on the job. Thus, for a given time period T, we can write our budget constraint:

$$I = \hat{w} \left(\Sigma\ y_i t_i\right) \tag{4.3}$$

where I is disposable income and t_i is a measure of the time required to earn a wage sufficient to purchase some quantity of the i^{th} commodity, y_i. This condition involving t_i unambiguously reflects the actual time spent earning income. However, to account for the opportunity costs incurred by the individual due to his choice of commodity vectors, we write our time-cost constraint:

$$T = \left(\Sigma\ t_i\right) + V \tag{4.4}$$

where T is the total time budget and V represents the time opportunity costs paid by the individual and is a separate term in (4.4) since V does not directly generate a wage return. As a result, T in (4.4) gives the accurate time cost required to purchase the i^{th} commodity.

If the consumer meets his objective, then we assume that he is choosing the 'best' consumption vector subject to the physical and

economic constraints indicated by (4.4). Therefore, in equilibrium, a consumer purchases a vector of commodities $y^* = (Y_{1*}, Y_{2*}, \ldots, Y_{n*})$ which maximizes his utility function U(y) subject to the constraint given in (4.3) and $y^* \in Y$, the consumption possibility set. Consider the traditional case of a consumer who must choose between n = 2 commodities. Graphically, this can be seen in Figure (4.1) where the indifference curve I^* illustrates a fixed level of utility derived from different combinations of the two commodities X and Y. The theory of consumer demand prescribes that the combination of X and Y "that will maximize the consumer's utility is the one on the budget line that is on his or her highest indifference curve."[35] For this example, the curve I^* represents the highest possible level of satisfaction this particular consumer can achieve given the budget constraint.

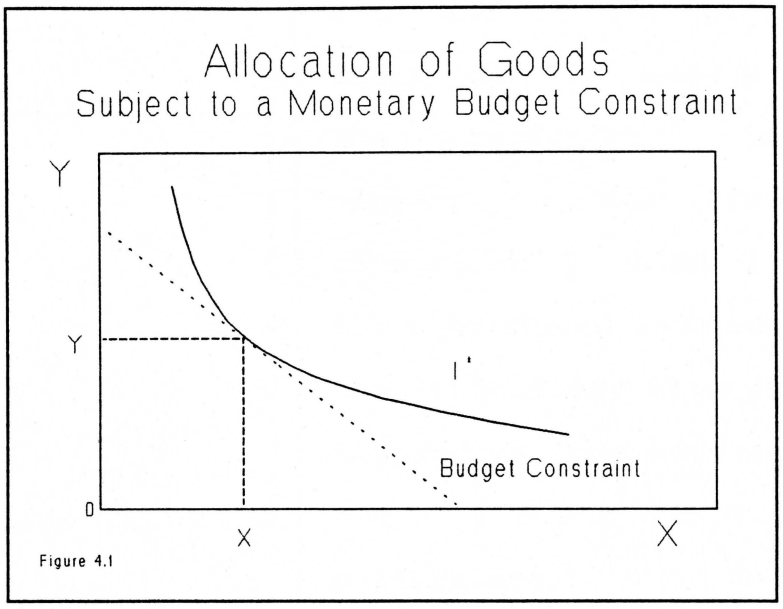

Figure 4.1

If we change our income constraint to a time-cost constraint, T, we can derive the optimal amount of time which this individual will devote to obtaining educational commodities--i.e. the time he will spend learning. In Figure (4.2) note that the axes of the graph have been re-labeled with T- (non-learning time) on the y-

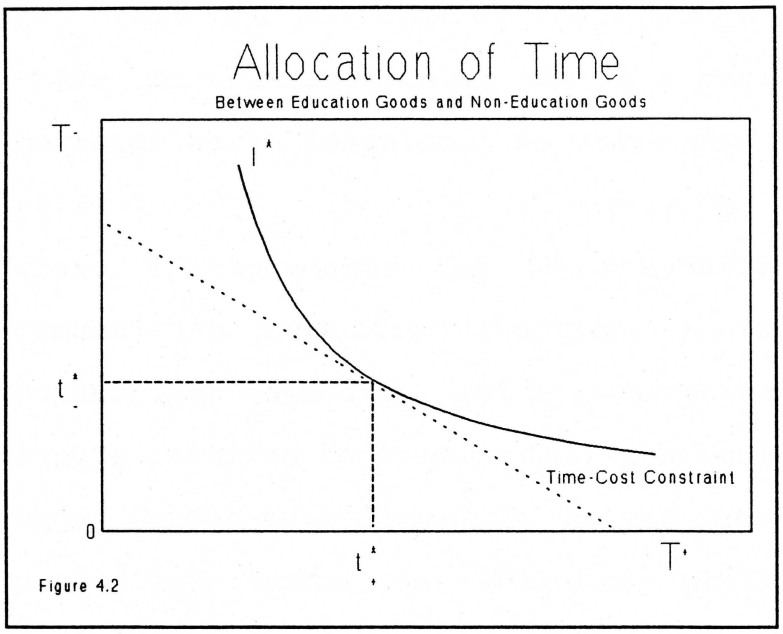

Figure 4.2

axis and T+ (learning time) on the x-axis. The individual is subject to the time constraint T which is the time period in which the student may attempt to produce some measure of learning performance.[5] For example, within the current structure of the school year, the typical time period (inside of the classroom) for an elementary school student is roughly (8 hours/day) x (5 days/week) x (180 days/year). In equilibrium, we find that the individual chooses to allocate $t+^*$ amount of time toward consuming educational commodities.

So how does a consumer's utility-maximizing choice influence his production of household goods? The theory of the household assumes that individuals combine their own time with the market goods they purchase to produce other commodities which influence

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[5]The time-cost constraint shown in Figure (4.2) is specified by:

(4.4a) $$\text{Time-Cost} = (t+)\ P_E + (t-)\ \hat{w}$$

where $\hat{w}$ is the given money wage, P_E is the present value of the future stream of earnings generated per unit time by the "purchase" of t+ time units of educational goods, t+ is the amount of time spent to purchase education goods, and t- is the amount of time spent to purchase non-education goods.

the shape and position of their utility functions. Examples of these commodities include seeing a movie, sleeping, and, for the purposes here, learning. We write their production functions as:

$$Z_i = g_i(y_i, T_i) \tag{4.5}$$

where Z_i represents the i^{th} household product, g_i is the i^{th} commodity's production function, y_i is the quantity of the i^{th} consumption commodity, and T_i is a vector measuring the total time-inputs required to produce this particular commodity given a money wage. Under this framework, we can show that individuals are both production units as well as utility-maximizing consumers. Individuals "combine time and market goods via the 'production functions,' g_i, to produce basic products Z_i" subject to maximization of their own utility function.[36]

The synthesis of production and consumption might seem awkward to economists who are so accustomed to separating the two processes. However, this problem should not be difficult to overcome. A household is truly a small firm which combines capital goods, raw materials, and labor to function daily. Separation of production and consumption is done for no other apparent reason than to make things easier for the people who study the two processes. By separating the two processes, economists give producers "indirect control" over the market basket of goods consumed and "direct control" over inputs into their production process. If the situation were reversed and firms were given "direct control" over the market basket of goods consumed and "indirect control" over the inputs into the production process,

then the separation would quickly diminish in both theory and practice. The key to separating the two processes in the context of our model is understanding that the utility-maximizing choice of the individual consumer determines how he will distribute his time toward learning and non-learning activities. The equilibrium allocation of time to learning then establishes a maximum limit on the level of learning performance he can produce, though, which may or may not be the actual level of learning performance an individual produces. An individual's actual level of learning performance is determined by the fraction of elapsed time the individual is able to apply toward producing achievement gain. We now turn to the production side of learning behavior.

D. Determination of Learning Outcomes: The Production Side

The theory of production can be split into two different branches. First, there is a technical aspect which is concerned with identifying the production possibilities of a firm. Second, there is an objective aspect which studies the feasible choices available to the firm's owners. The economic theory of the firm aims to explain the behavior of the firm given certain conditions. It assumes that the firm is a profit-maximizer operating in a particular market structure. The production function is also assumed to be known by the owners of the firm and thus they are equipped with all the relevant information concerning the production possibilities of their firm. Knowledge of the production function is a positive characteristic since it may motivate the firm's owner to operate in an optimal manner.

Our approach to learning behavior deals with the first branch of production function theory. An educational production function is similar to any other production function. For the firm, a production function is a mathematical relationship describing how its resources can be transformed into outputs. In education, the production function also describes a mathematical relation between how educational resources (inputs) can be combined to produce educational outcomes (outputs).

Traditional educational production function research has attempted to estimate relationships between levels of chosen educational inputs and measures of educational outcomes, controlling for the influence of various background variables. Most studies in the economics of education have incorrectly taken this approach in their attempts to characterize successful schools--analyzing how various school characteristics such as class size, teacher salaries, and number of books in the library produces outputs like standardized verbal or math scores. To the dismay of many researchers, these studies have produced an abundance of inconsistent and insignificant results. These outcomes should not come as a surprise, though, for several reasons.

First, the regression analysis used in these studies makes one common and incorrect assumption: that the average amount of each school input is employed with equal intensity by each student. This, of course, is not true. Students differ in how hard they study and in how intensively they use the educational resources available to them--there are differences in effort and motivation

between students. If there is, in fact, significant variance of input employment use within the classroom or school, the regression equation will be mis-specified and thus the coefficients on school variables are biased toward zero. Therefore this assumption quite easily explains why we should expect a student's socio-economic background variables to account for more variance in learning performance than school variables. Even in this paper, when we use time as an indicator of the utilization rates of educational inputs, we accommodate this fact by pointing out that elapsed learning time is not always equal to effective learning time.

A second, even more basic, incorrect assumption made in these studies is their failure to differentiate between stock and flow variables. We must remind ourselves that production (and with respect to education, learning) is a process which takes place over a period of time. Knowledge of how much of a particular input that a production process employs makes little difference unless we have observations of these amounts for a significant duration of the process. This incorrect assumption can be quite easily repaired if proper data collection techniques are carried out. Such a technique demands that we know where each student stands at the beginning of the process and how they use inputs during the process. Once we know these things, we can evaluate how effective various combinations of educational inputs are to the learning process. In theory, an experiment may be constructed so that student characteristics are measured by an array of proxy measures and that school and socio-economic variables can be considered

relatively constant. Given these procedures, an appropriate instructional method would allow us to chart the dynamic progression of students' learning achievement and the erroneous assumption would be corrected.

The false assumptions described above suggest that past regression analyses provided nothing more than a characterization of an "average" school--it estimated the level of learning performance that an "average" student can produce employing the "average" amount of educational resources with "average" intensity. Unfortunately, producing average schools or average students is not the goal of our educational system. In order to improve learning outcomes and reduce the variance of their distribution, a micro-oriented approach to education, looking at who actually produces the measures of education which we use, is the key. After all, it is the student, not the school, who produces the learning. Individuals each possess their own array of talents and skills which they combine with the school resources in order to "learn." The notion that some individuals learn more quickly than others is widely accepted by educators. Yet the means by which we provide education essentially makes little note of this idea.

The educational production function side of an individual treats the student as a firm who produces an output we will call learning performance (examples of common proxies to measure this output are exam grades, standardized test scores, etc.). While we usually use land, labor, and capital as the factors of economic production functions, these variables must be changed to formulate

an educational production function. Successful estimation of a meaningful educational production function depends on, first, the identification and, second, the gathering of data on the employment of the productive inputs in the learning process. In measuring the actual employment of various resources, we are doing nothing more than measuring the amount of time in which these resources were employed in various ways. Knowing how much time a student spends studying for a test is more enlightening than knowing how many books are in the school's library. It is difficult to gain useful knowledge about how an individual's learning outcome is determined unless we know how much time he spends on the task and with what materials--knowledge of the time input gives some indication of the factor intensities by which other school inputs are employed.

We can express an individual's educational production function, for a specific learning task, in the following form:

$$P_t = f(X_1, X_2, \ldots, X_M, X_N, \ldots, X_V, X_W, \ldots, X_Z) \tag{4.6}$$

where P_t is some measure of learning performance at the end of the time period t--for example a test grade; $X_1, X_2, \ldots, X_M$ are variables measuring individual student attributes such as innate ability, prior learning, and motivation; $X_N, \ldots, X_V$ are variables measuring "external" attributes such as a teacher's experience, style, and method; and $X_W, \ldots, X_Z$ are variables measuring student time.[6]

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[6]Observe that equation (4.6) is simply an expanded version of the production function presented in equation (4.5):

$$Z_i = g_i(y_i, T_i) \tag{4.5}$$

where we now consider the i^{th} good defined as learning performance ($P_t \approx Z_i$) in the time period t.

Modification of the equation begins with what educator Benjamin Bloom describes as a process associated with learning a given task and with what economists Davisson and Bonello propose as a taxonomy for organizing empirical educational production function research. Bloom's proposal starts with instructional and external attributes, similar to those described in the current equation, as given. His claim is that students in a typical classroom are all learning under the same instructional conditions. That is, as long as the teacher is standing before the class and lecturing, everyone who can hear his voice and see what is written on the chalkboard has the same access to educational resources as anyone else in the class. Also, school district lines are often drawn so that students in a classroom typically come from relatively homogeneous socioeconomic backgrounds.[7] Therefore, a class of students in a neighborhood school partitions a sample so that the model may consider "external" resources constant across the group. Davisson and Bonello propose a taxonomy which specifies three categories of inputs which should be included in any educational production function: human capital (innate ability and prior learning), technology (the teacher, teaching method, textbook, etc.) and utilization rate (individual study time and classroom instructional time). If we combine Bloom's assumptions with the Davisson and Bonello taxonomy, our function emerges as:

$$P_t = f(X_i, Y_j, Z_k, T) \tag{4.7}$$

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[7]This observation was particularly true when schools were segregated--an issue we explore further in Chapter VI.

where P_t is a measure of learning performance at the end of time period t, X_i is the vector of individual student attributes, Y_j is the vector of instructional attributes, Z_k is the vector of relevant "external" resources, and T is total elapsed time. Under Bloom's assumptions, we hold Y_j and Z_k fixed and, since this is a particular individual's educational production function, X_i varies.

Now our model, for a specific time period and a particular student, has taken on an estimable form where the dependent variable is achievement gain P_t and the independent variable is time T. One final point must still be made about our educational production function. Recall in Section C of this chapter that we made the assumption that a student has two ways to spend his time. A student may: 1) study and attempt to produce achievement gain, T+, or 2) not study and do something else unrelated to the learning task, T-. Using the same assumption here, we rewrite the individual educational production function as:

$$P_t = f(X_i, Y_j, Z_k, T+) \tag{4.8}$$

where P_t now represents an individual's optimal level of learning performance since T+ illustrates the student's utility-maximizing allocation of time input toward learning. However, since we can construct our sample under Bloom's assumption so that the first two variables are held constant and the individual educational production function takes the form:[8]

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[8]It is important to note here that the time period t denoted in equations (4.6) through (4.9) refer to the "short-run" of the production process. The short-run in this process is defined as that period of time required to complete the learning task, where the vectors X_i, Y_j, and Z_k are held constant. Once a learning task

(4.9) $$P_t = g(X_i, T+)$$

For the time variable T+ it is important to distinguish between effective learning time and elapsed learning time. Elapsed learning time is the amount of clock time spent attempting to learn and produce an achievement gain. Effective learning time is the fraction of elapsed learning time which actually produces an achievement gain. We can express effective learning time by the following relationship:

(4.10) $$t+ = c\ (T+)$$

where T+ is elapsed time and c is a fraction between 0 and 1. For example, if a junior high math student's task is to learn how to solve a simultaneous set of equations and he must spend time consulting an elementary school math text to solve the equation 2+2=? or he spends some of his class-time daydreaming, then effective time is a fraction of elapsed time since not all of the student's time was spent producing the achievement gain. The value of this student's c would be lower than that of another math student who already knew the answer to the equation and could proceed freely toward meeting the learning task.[9]

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is completed, an individual's vector of individual learning characteristics, X_i, may change while the vectors of instructional and "external" characteristics may change depending on the nature of the individual's next learning task. This phenomena of a dynamic individual learning characteristics vector is illustrated, for example, by the mediocre high-school student who goes on to perform well in college; or by the college student who performs poorly in his freshman year but is able to adjust his study habits to perform better in subsequent years.

[9]The achievement gain in this example would be the move from not knowing how to solve a simultaneous system of equations to knowing how to solve them.

However, this specification of an educational production function is not yet complete. As mentioned before, most prior educational production function studies contained results which were produced by analysis performed on observations of "average" school practices. Consequently, these studies only provide evidence on what schools currently produce on average, not on what they could do. Christopher Jencks points out "We have only examined the effects of resource differences among existing public schools. This tells us that if schools continue to use their resources as they do, giving them more resources will not change children's test scores."[37] So in order to make inferences on the production possibilities of schooling for individual learners, one must observe a broad range of input/output combinations over a significant period of time. Clearly, obtaining such a wide, inter-temporal set of data to run an experiment on this type of educational production function is nearly impossible, at least for this study. Even James S. Coleman's 1966 survey "Equality of Educational Opportunity," the most massive aggregate educational production function study to date, does not come close to providing appropriate data for this specification of an educational production function. Therefore, another approach may be helpful.

The approach we propose switches the roles which the variables defined in equation (4.9) play. To the extent that the levels of educational inputs for the learning process are fixed by a budget before the school year begins and, we expect, that individual study-time has minimal effects compared to classroom study-time, an

individual's level of learning performance is essentially pre-determined before he spends one minute in that classroom. The student has no other recourse apart from his initial allocation of time once the learning process has begun. Thus, a student's level of learning achievement is positively influenced by the vector of individual learning characteristics, X_i, in the student's educational production function.[10] Students therefore exit the classroom in the same position relative to their peers as when they entered.

Our new approach seeks to eliminate this "pre-determination" from schools and the individual learning process. The proposal set forth is one where the level of learning achievement is set exogenously by the school. This situation means that we are not fixing the level of time input which a student may choose to employ, from either his personal time reserves or those of the school, for the purpose of producing an achievement gain. Also, by approaching schooling from an outcomes orientation we directly

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[10]It seems logical to expect learning performance to be an increasing function of the individual learning characteristics vector X_i.

(4.10a) $$(dP / dX_i) > 0$$

Given a period of time, a student enjoying a larger stock of prior learning, a higher level of innate ability, and other positive individual learning characteristics should be able to attain a higher level of learning performance than a student who does not enjoy a comparable array of individual learning characteristics--i.e. the magnitude of a quick learner's individual learning vector, $\|X_i\|$, is larger than the magnitude of a slow learner's individual learning vector.

address the problems which conspicuously show up in our schools--the problem of declining educational performance with respect to equal-aged children in other parts of the world. Hanushek has endorsed this approach, calling for a centralized authority to focus on the outcome side of the production function, set minimum standards, and hold constituent units accountable for meeting the standards through a system of incentives. This strategy merits attention since it also circumvents the surrounding ignorance characterizing our knowledge of the underlying production function.

In developing (4.9), we made the assumption that a student does only two things with his time: learning and non-learning. This assumption implies a certain response exercise on the part of the student. That is, the student, once inside of the classroom and presented with the learning task, makes a decision to allocate time in order to complete the task. If we are interested in what schools **could** do in terms of optimizing each student's level of educational achievement, then it might be more convenient to look at the production of achievement gain from a perspective opposite the one described by (4.9). That is, we now follow an outcomes approach to schooling in view of the weakness of inferences drawn from studies using the historical inputs approach.

Instead of looking at educational achievement as the dependent variable, why not set up the model so that educational achievement is pre-determined and then make observations on the resource combinations needed to meet the criterion? This new perspective is expressed in the following form:

(4.11) $T+ = \text{Time to Criterion} = f(X_i, Y_j, Z_k, P_t)$

where X_i is the vector of individual student characteristics, Y_j is the vector of instructional attributes, Z_k is the vector of relevant "external" attributes, P_t is the pre-determined level of achievement associated with a given learning task, and T+ is the amount of elapsed learning time chosen by a given student to reach the given criterion level for a specific learning task.

One might be confused by the fact that, while I still call (4.11) a "production function", it is not time which is being produced. The student is still producing educational achievement. The reader might be more comfortable thinking of (4.11) as the total cost function in terms of units of time derived from the production function (4.9) where the time T+ is the elapsed time-cost required to produce a given level of educational achievement gain. Therefore, I will call this a time-cost function. Equation (4.11) has simply rearranged the variables so that the model is an estimable form--but more importantly, it is a form which allows us to investigate the level of inputs, particularly the time-input, necessary to produce the desired outcome. Making the same assumption we made before to move from (4.8) to (4.9), we can express this individual educational production function as the "time-cost" function:

(4.12) $$T+ = f(X_i, P)$$

where Y_j and Z_k are fixed under Bloom's assumptions and the student's choice of elapsed time T+ is a function of the pre-determined criterion P (note that the subscript t has been omitted

since we are now allowing the student to determine the necessary time period to meet the given achievement criterion). The time T+ denoted here refers to the total elapsed time used in meeting the achievement criterion.[11]

The development leading to (4.12) originates from a learning model proposed by J.B. Carroll in 1963 which was constructed around two concepts: the time needed for learning and the time devoted to learning.[38] Equation (4.12) reflects the latter of the two concepts and serves to reveal the elapsed learning time a student must devote to reach a given level of learning performance, P. Carroll's work influenced Benjamin Bloom to formulate a time-based curriculum called mastery learning. According to Bloom's curriculum, nearly all students could achieve mastery of any task if enough time were permitted and if instruction were organized to reduce the time differential between the fastest and slowest learners. Thus, the view that the time-input is a critical variable of the learning process has been widely accepted for a number of years.

A graphical explanation of this transition is also enlightening. For the purpose of explanation, let's suppose that our individual educational production function is of the form:

(4.13) $$P_t = a\ (t+)^b$$

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[11]We remind the reader that under Bloom's assumptions we hold instructional and external characteristics constant. Bloom's claim is that students in a particular classroom are all learning under the same instructional conditions. Therefore, as long as the teacher is lecturing before the class, everyone who can hear his voice and see what is written on the chalkboard has the same access to these educational inputs as anyone else in the class.

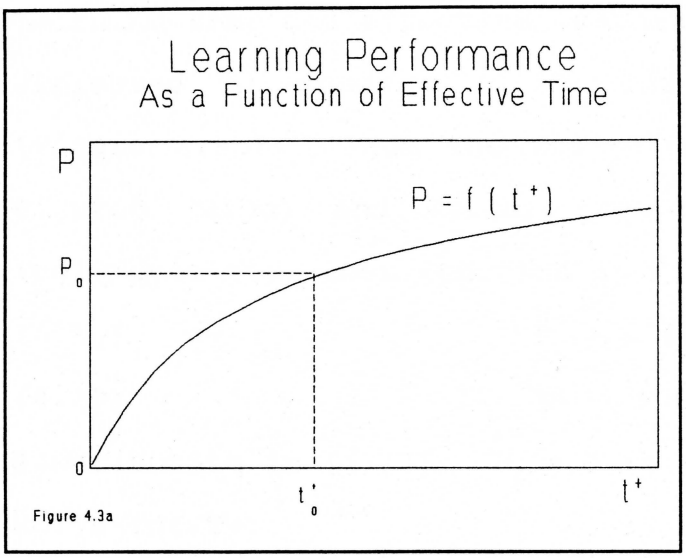

Figure 4.3a

where P_t is a measure of learning performance at the end of the time period t, t+ represents the effective learning time devoted to this learning task, and **a** and **b** are the model's parameters, **a** > 0 and **b** > 0. In the model, the parameter **a** is a measure of the instructional and "external" learning characteristics vectors, Y_j and Z_k, and the parameter **b** represents the learner's performance elasticity of effective study time and reflects the individual learning characteristics vector, X_i.

Figure (4.3a) illustrates equation (4.13) and is drawn so that the learning process initially reflects high, yet diminishing, marginal returns. This phenomena should not surprise the reader. If we assume that a student starts the learning process with little prior knowledge regarding the given task and that he is genuinely interested in learning the task, then one should think that studying longer will increase a student's output at a rate faster than the rate at which elapsed learning time is being increased. Of course, the high initial marginal returns of increased effective learning time will eventually diminish as the student becomes more familiar or possibly bored with producing the achievement gain. Recall the distinction that we made earlier between **elapsed**

learning time and effective learning time. This relationship was expressed in equation (4.10) and is presented graphically in (Figure 4.3b). From the following mathematical derivation and Figures (4.3a) and (4.3b), we can derive the graph of our individual time-cost function in Figure (4.3c).

(4.13) $$P_t = a\ (t+)^b$$

(4.10) $$t+ = c\ (T+)$$

Substituting in (4.13): $P_t = a\ (c\ (T+))^b$

Solve for T+:

(4.14) $$T+ = (1/a\ c^b)\ P_t^{1/b}$$

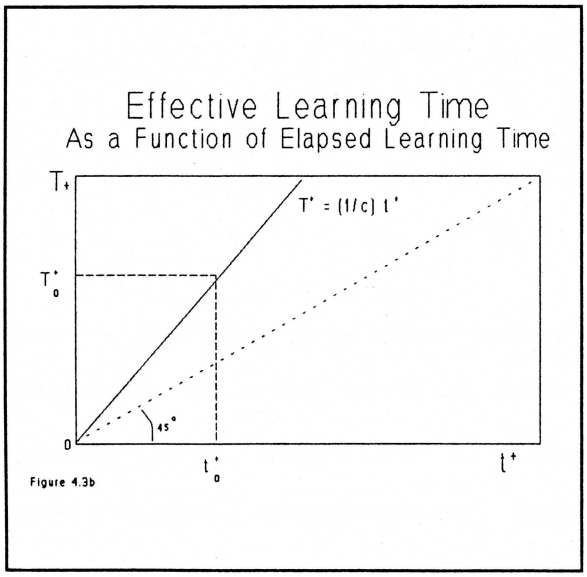

Figure 4.3b

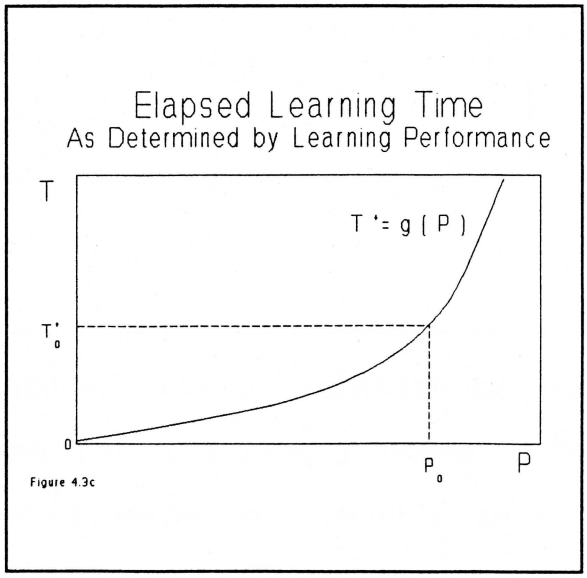

Figure 4.3c

We should note that the exponential function form illustrated above was chosen for expository purposes and is not necessarily the correct form of an educational production function.

E. The Classroom Model

In order to evaluate the concept of equal educational opportunity, we cannot simply consider each student independently.

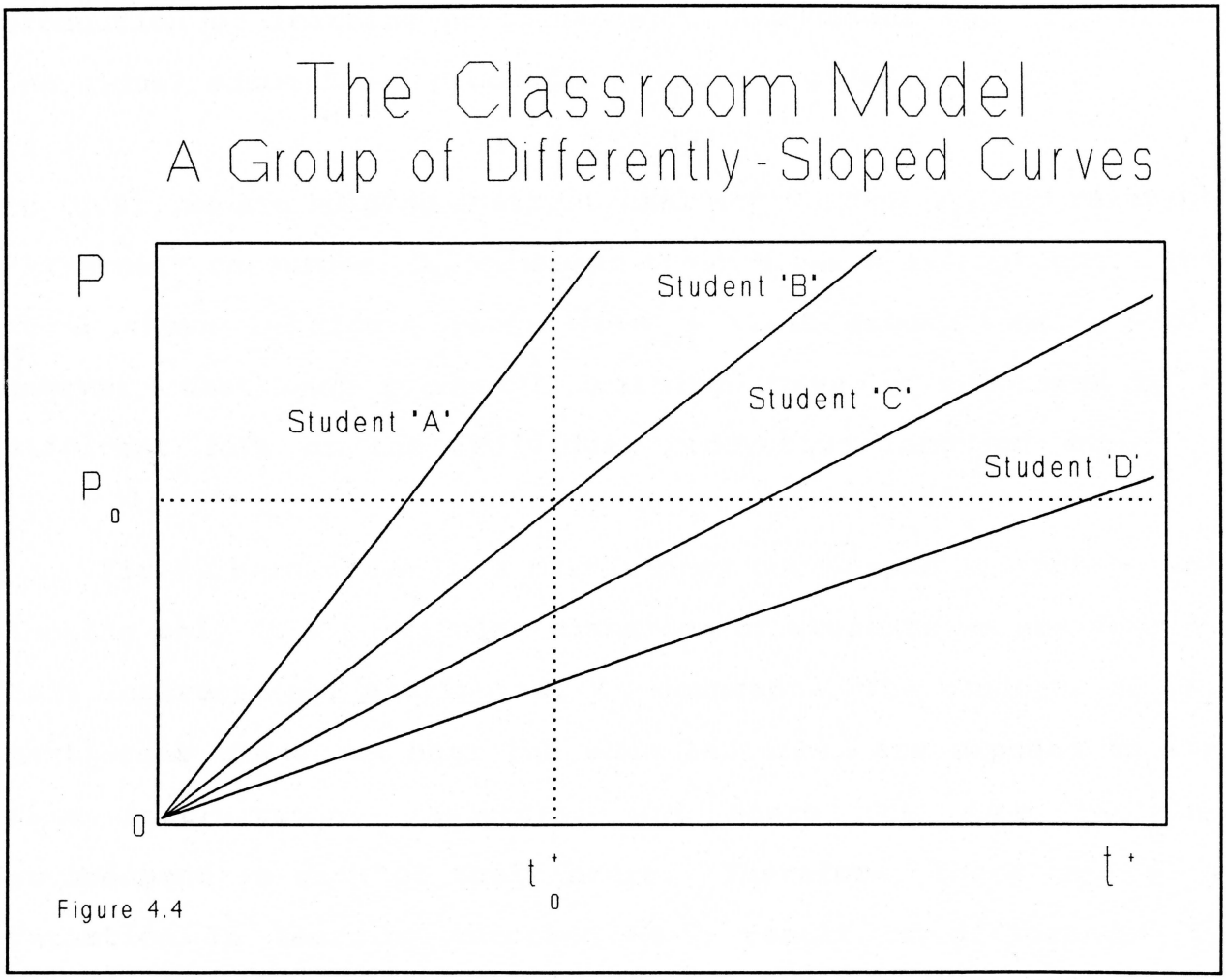

Figure 4.4

Instead, we must look at how each student stands relative to his peers, from start to finish, during the learning process. To achieve this perspective, consider a classroom of students in our evaluation of equal educational opportunity. This idea is best explained graphically in Figure (4.4) where we depict a class of four students--Students A, B, C, and D. Figure (4.4) merges the individual educational production functions of each of these learners onto one graph. The result is a group of differentially-sloped curves, each emanating from the origin, that illustrate the notion that no two learners are exactly the same in their

production of learning performance.[12] Reconsider the form of an individual educational production function given in (4.9).

$$P_t = g(X_i, T+) \tag{4.9}$$

In (4.9), we are holding instructional attributes, Y_j, and relevant "external" resources, Z_k, constant under Bloom's assumptions. The model shown in Figure (4.4) makes similar assumptions. Note, however, that each student's learning curve is generated by a different form of the individual production function shown in (4.9).[13]

First, because we have partitioned our sample so that we are looking only at a particular classroom of students we are able to hold instructional attributes, Y_j, constant. The students in any particular classroom hear the same lectures, are exposed to the same instructional resources, and share the same learning environment as each of their peers. Therefore, there can be no variation in learning outcomes as a result of differences in instructional attributes for a particular classroom of students. Note that I am not speaking to the question of a student's utilization rate of available instructional resources. Matters of factor intensity in the production of learning are taken into account by the parameter **c** in (4.10). The vector which I am

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[12]In Figure (4.4), Student 'A' is shown to be a "brighter" or "more motivated" student than Students 'B', 'C', and 'D'. This results from the observation that it takes Student 'A' less time and, therefore, fewer educational resources to reach any given level of learning achievement.

[13]Since X_i differs for each individual student, P_t will differ for each individual student given any level of elapsed learning time T+.

choosing to consider constant here speaks only to questions of exposure and access.

Second, we hold the vector of "external" resources available to the student, Z_k, constant as well. Since school district lines are often drawn so that students attending a particular school likely live in the same neighborhoods, the school's students should share relatively homogeneous socio-economic backgrounds. There is evidence that "Classmates and schoolmates are usually rather homogeneous in economic and educational backgrounds, especially in large urban areas."[39] While holding these factors constant for schools which service entire communities is quite inappropriate and would provide misleading results, we assume here that: 1) for classrooms in large urban settings "external" resources are relatively equivalent and 2) for classrooms in other types of settings the variations in the slopes of the individual educational production functions are determined by both individual characteristics as well as "external" factors--two variables which are already highly correlated.

Finally, we consider individual student attributes constant for each individual student, but variable over the class of students. Since no two students share exactly the same individual attributes, the condition $[X_i]_A \neq [X_i]_B$ holds for any two students, A and B. This fact is embodied in the slope of the graphs of the individual educational production functions. More-able and better-prepared learners will possess more steeply-sloped production functions than those who are less able and ill prepared.

The curves drawn in Figure (4.4) represent educational production functions of the equational form (4.13). In evaluating the concept of equal educational opportunity, graphical descriptions derived from either this form or of (4.14) are appropriate. However, from a policy standpoint, we will adopt (4.13) as our working equation. This equation generates the maximum amount of learning performance its owner can produce given his level of effective learning time $t+^{*}$. It is important to remember that this $t+^{*}$ incorporates a student's response (his utility-maximizing choice of time allocation) to the educational resources and objectives presented to him--i.e. reflected by the value of his parameter c.

CHAPTER V

The Traditional Schooling Method

A. Introduction

The conventional wisdom about public schools is that they face serious problems in terms of performance and that improving schools requires additional money.[40] Policy-makers have traditionally proposed such costly remedies as reducing class sizes and hiring better-trained teachers. The argument behind the implementation of these reforms stems from the following observations. Large classes prevent teachers from working individually with those students who could benefit most from more intensive instruction and invite disruptions and disciplinary problems. Schools also face problems in attracting the best teachers due to problems within the school and due to the relatively low levels of pay.[41] As a result, school reform has typically pointed toward school finance reforms which simply increase the funding levels within schools.

However, as we pointed out earlier, there is no available evidence to support a relationship between school expenditures and the learning achievement of students. Reports of declines in student test performance, disciplinary problems inside our schools, and functional illiteracy within our society have increased over the past two decades despite the fact that schools have consistently spent more and more on education--resulting in smaller classes and more experienced and better-educated teachers.

From 1960 to 1989, expenditures (in constant 1989-90 dollars) on public and private elementary and secondary schools increased by

Table 1.
Public elementary and secondary school operations, 1960-89

	1960	1970	1980	1989
School Expenditures, in constant 1989-90 dollars ($$$ millions)	72,224	145,155	168,785	210,696
Total	67,471	136,751	158,978	194,142
Public	4,754	8,403	9,807	16,554
Private				
School Enrollment (millions)	32.4	37.1	30.6	32.5
Elementary	10.2	14.7	14.6	12.9
Secondary				
Median School Years Completed	10.6	12.1	12.5	12.7
All Persons	8.0	9.8	12.0	12.4
Black Persons				
Number of Classroom Teachers (thousands)	834	1,109	1,206	1,354
Elementary	521	899	1,005	970
Secondary				
Average Salary of Classroom Teachers ($1000)	4.8	8.4	15.6	29.0
Elementary	5.3	8.9	16.6	30.3
Secondary				
SAT Scores of College-Bound	--	460	424	427
Seniors	--	488	466	476
Verbal				
Math				
ACT Scores of	--	18.6	18.5	18.6
College-Bound	--	17.7	17.8	18.4
Seniors	--	17.6	17.3	17.1

191%, from $72,224 million to $210,696 million.[10] The number of

[10]This increase may result from a combination of the following two observations. First, part of this increase simply reflects the "baby boom." However, over the same time period, elementary and

Table 2
Proficiency Test Scores for Selected Subjects
[Based on The National Assessment of Educational Progress Tests which are administered to a representative sample of students in public and private schools. Test scores range from 0 to 500.]

Subject and Age Group	1979-1980	1983-1984	1987-1988
READING			
9 year olds	215	211	212
13 year olds	259	257	258
17 year olds	286	289	290
MATHEMATICS			
9 year olds	219	219	222
13 year olds	264	269	269
17 year olds	300	299	302
SCIENCE			
9 year olds	220	221	224
13 year olds	247	250	251
17 year olds	290	283	289

Source: U.S. National Center for Education Statistics, Digest of Education Statistics, 1990

classroom teachers in elementary schools increased by 62%, from 834,000 to 1,354,000, and the number of classroom teachers in secondary schools increased by 86%, from 521,000 to 970,000. Also, average salaries of classroom teachers and median school years

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secondary school enrollment remained fairly steady, increasing by a mere 0.3%, from 32.4 million students in 1960 to 32.5 million students in 1989 (Table 1). Therefore, an increase in the school-age population explains only a small portion of the increase in school expenditure levels. Second, the number of median school years completed by Americans rose by 19.8% from 1960 to 1989. In 1989, all persons had completed, on average, 2.1 more years of schooling than their counterparts had completed in 1960. We suspect that this second factor is significant in explaining the observation that school expenditure levels are rising yet student achievement levels are not.

completed by individuals both have shown marked growth over the same time period. In contrast to these changes, one educational statistic has remained fairly constant during this "education expansion"--the level of learning outcomes as measured by achievement test scores. It is therefore difficult to associate any deterioration in school quality with declines in the level of resources available to schools.[42] Clearly, the reforms we are making appear to fall short of their goals and, therefore, we now must attempt new approaches to improve schooling.

B. Fixing the Time Input

The typical reforms described above take the same approach toward improving education. They focus largely on fixing the levels of various educational resources before the actual learning process begins. Measures raising teacher salaries to attract and retain better teachers, providing micro-computers for the classroom, or requiring that classes contain fewer than a certain number of students pre-determine the level of resources available to any student. Annual budgets make it difficult to hire additional teachers, purchase new materials, or reduce the size of classes once the school term has begun. Therefore, disadvantaged students often fall short of more able students' achievement levels because they cannot access the additional resources which they may need once the learning process begins. At the same time, more able students often exhaust the resources available to them and thus their learning achievement gains are limited. Moreover, teachers may divert their attention away from students who have already

reached some level of learning performance to students who are lagging behind.

This thesis maintains that the issue of time lies at the heart of the conflict created by society's pursuit of equal education opportunity and its structure of the school system. Consider the following hypothesis concerning the traditional organization of the current school calendar. Schools throw open their doors for 8 hours per day, 5 days per week, 36 weeks per year. Teachers are assigned to a group of students to aid them in producing learning achievement gain. The conventional instruction method used in nearly all classrooms involves the teacher lecturing to this classroom, or a subset of the classroom, of students. Successful completion of a grade level implies that some amount of achievement gain was produced during that time period. However, unless each grade level is specifically criterion-referenced, advancement from one grade level to another by two separate individuals taught in different classrooms does not guarantee that both students produced nearly equal amounts of achievement gain (even if both received the same grade marking). This consequence is readily seen when one considers the preferential treatment given by college admissions officers to applicants from "better" high schools--due to school-to-school quality variation. Therefore, the school calendar essentially gives students 1440 hours to complete a grade level with no guarantee that average achievement levels will remain

constant.[11] Of course, many might respond to the fixed-time input argument by pointing out that students can allocate time outside of the classroom for individual study. To allow for individual study-time in our educational production function, we can express our individual educational production function (4.13) using a two-input Cobb-Douglas production function:

(5.1)[12] $$P_t = a\ (tc+)^{b1}\ (ts+)^{b2}$$

where P_t is some measure of learning performance at the end of time period t, the value of the parameter a reflects a student's vector of individual learning characteristics X_i, tc+ is the amount of effective learning time spent in the classroom, ts+ is the amount of effective learning time spent outside of the classroom, and b_1 and b_2 are the performance elasticities of their respective time variables, $a > 0$, $b_1 > 0$ and $b_2 > 0$.[13] In this mathematical form,

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[11]A good example of this phenomena is the practice of grading according to the normal distribution. That is, often professors assign grades to students in a class so that they are distributed similarly to the normal random variable distribution. Strict adherence to the normal distribution requires that 68% of the grades fall within one standard deviation of the mean, 95% of the grades fall within two standard deviations from the mean, and 99% of the grades fall within three standard deviations from the mean.

[12]We present an equation in the form of equation (4.9):

(4.9) $$P_t = g(X_i, T+)$$

instead of the desired functional form given by equation (4.12):

(4.12) $$T+ = f(X_i, P)$$

since (5.1) illustrates the effects of the traditional lecture method, where the student's allocation of time is pre-determined.

[13]The time variables ts+ and tc+ represent shares of the effective time variable t+ given in equation (4.10):

we expect that individual study-time will not be as effective in producing achievement gain as time spent inside of the classroom. Almost any teacher will agree with the idea that students who do not attend class will not perform as they well as they could--the magnitude of their parameter **c** in (4.13) (effective learning time becomes a smaller proportion of elapsed learning time) and **a** in (5.1) (the magnitude of the vector of individual learning characteristics represented by X_i is reduced) are lowered if a student does not attend class. Therefore in (5.1), we expect $b_1 > b_2$ under the assumption that a one percent increase of classroom learning-time generates a larger percentage increase in learning performance than a one percent increase of individual learning-time.

In terms of the classroom model, pre-determination of the supplies of schooling inputs and the traditional lecture method fixes the time input associated with the learning process. Under the traditional lecture method, students are herded together into rooms where the teacher lectures and presents the material to them. Restriction of the time input forces many slower learners backward along their educational production function. Many slow learners are therefore unable to continue the learning process for a sufficient amount of time in order to reach their, or own

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(4.10) $t+ = c\ (\ T+\ )$

The sum of the effective classroom learning time and effective individual learning time is equal to the effective learning time variable t+.

(5.1a) $t+ = ts+ + tc+$

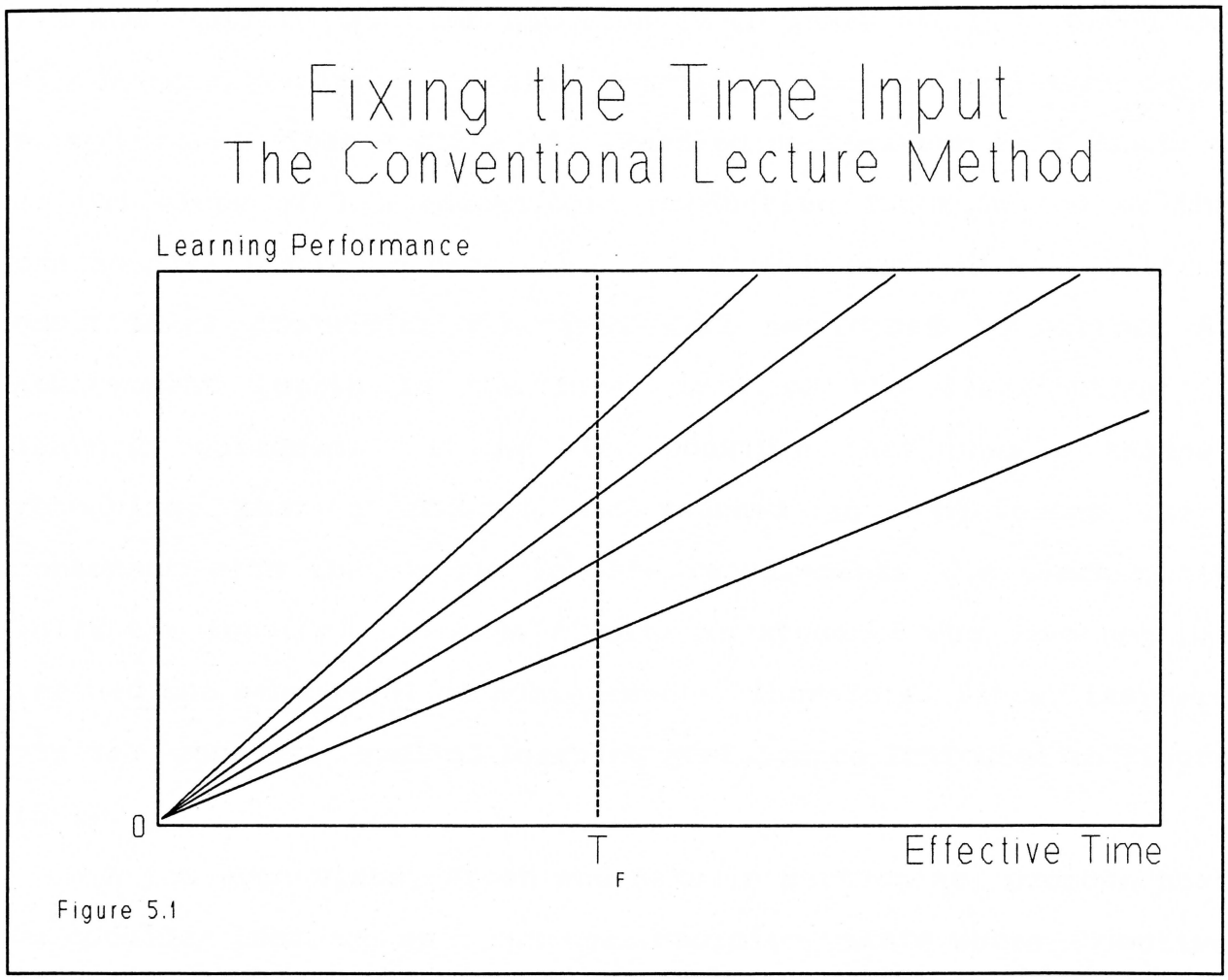

Figure 5.1

society's, optimal level of learning performance. For faster learners, much of the classroom learning-time is wasted once the student produces a sufficient amount of achievement gain. In Figure (5.1), the effect of the traditional lecture method is to

fix and equalize the time opportunity to learn at T_F.[14] Given the differentially-sloped learning functions, the vertical line drawn at T_F suggests that a student's learning performance is a function of the slope of his educational production function and of the characteristics which determine it. Slower learners with flatter educational production functions will be forced to perform at achievement levels in the lower tail of the distribution of learning outcomes. It is also possible that once a teacher recognizes that a student has reached an achievement level consonant with that grade level's requirements the teacher may shift the focus of teaching efforts to students who have not yet reached the same level of achievement. Therefore, faster learners may not reach the level of learning performance indicated in Figure (5.1).

A few economists, Brown and Saks in particular, propose that we consider teachers as a rational decision-makers whose objective is to maximize their utility functions from the achievement of their students subject to the constraint of available teaching technology and the time available to apply that technology. This situation is clearly an ideal. While all teachers may attempt to maximize their utility functions, those functions do not

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[14]Note that the curves shown in Figure (5.1) and Figure (5.2) are still of the equational form (4.13):

$$P_t = a\ (t+)^b \qquad (4.13)$$

where the instructional and external characteristics vectors, Y_j and Z_k, are held constant under Bloom's assumptions (The graphical representation of equation (5.1), the two-input Cobb-Douglas model, can be illustrated by a bell-shaped surface).

necessarily include their students' achievement levels as their main arguments.[43] Yet even if Brown and Saks were true in their hypothesis it should still be clear that the learning time input is strictly limited in our school system under the traditional lecture method regardless if any particular student benefitted from the full devotion of the teacher's time.

However, as we mentioned before, economic education research has now begun to focus on what Bloom calls "alterable variables." These variables are inputs to the learning process which can be changed or "altered" once the learning process has already started. Bloom lists time, cognitive entry characteristics, and testing procedure as examples of alterable variables. The time variable is one which we pay particular attention to in this study due to the widely-held view that more time on a subject does increase learning.[44] For example, summer school, study halls, and Head Start pre-school programs are designed to alter and extend the amount of time students can access to accomplish their learning objective.

In terms of our working definition of equal education opportunity, Figure (5.1) also highlights the need to adopt new instructional techniques designed to equalize educational outcomes. Bloom's mastery learning curriculum argues learning outcomes can be equalized if each individual student is given a sufficient amount of time to reach a pre-determined performance criterion. If this is the case, we can rewrite (5.1) as:

(5.2) $$T+ = f(X_i, 80\%)$$

where T+ is the necessary time to criterion. Figure (5.2) represents Bloom's strategy where the pre-determined performance criterion is set at, say, 80% and the students are each allowed the

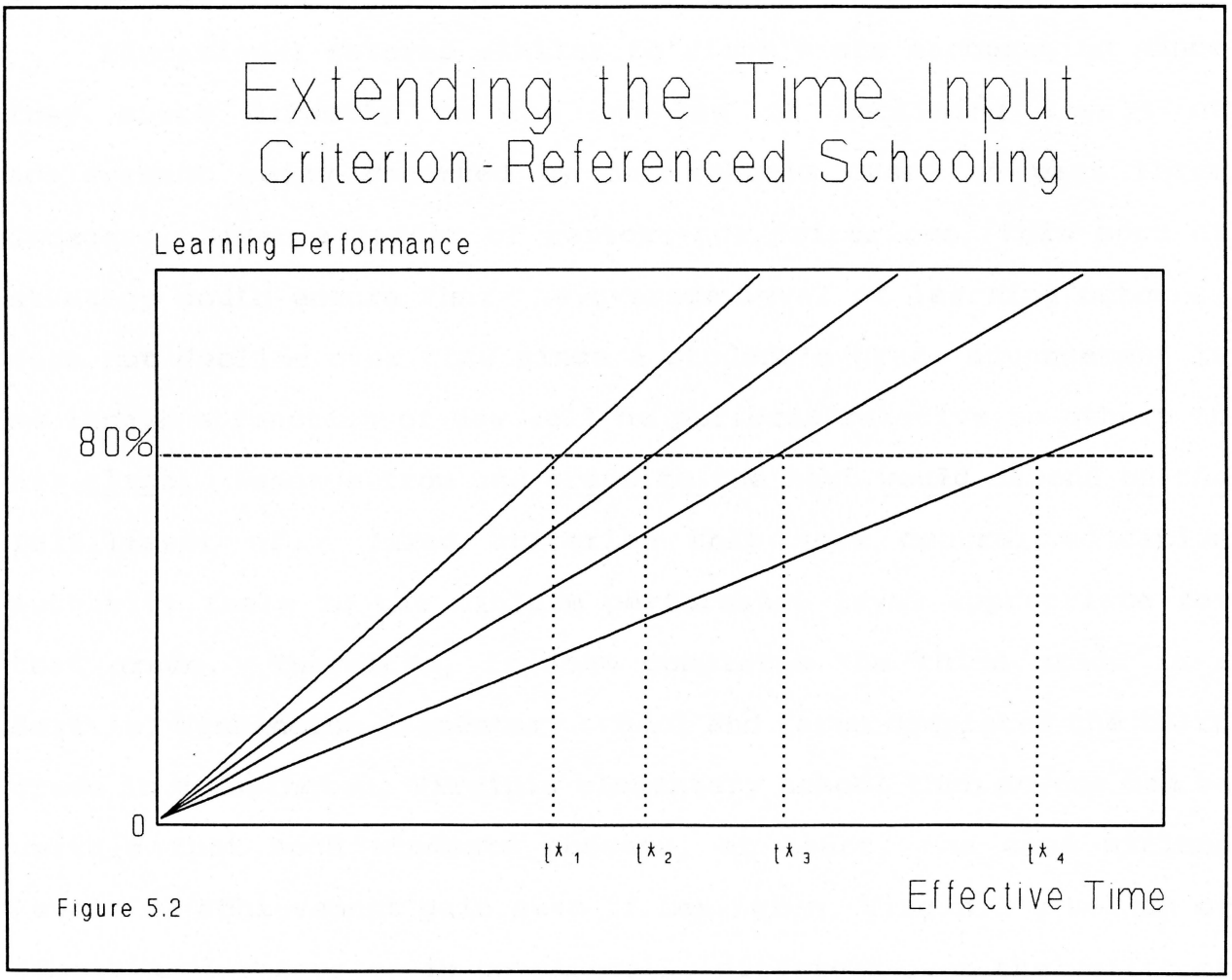

Figure 5.2

time opportunity to satisfy the criterion. The arbitrary level 80% represents a level of proficiency to be demonstrated for a given learning task. This level also functions as the "satisficing" level of achievement which we advocated in our working definition of equal education opportunity in Chapter III, Section D. This type of school system requires that we tailor our instructional

methods and technologies to allow all individuals the full opportunity to reach this "satisficing" criterion level. In Figure (5.2), we allow each student the opportunity to decide their optimal allocation of time necessary to meet the criterion.[15]

Educational reforms similar to Bloom's are encouraging since they speak directly to the problem of declining levels of achievement being reported by our schools over the past three decades. Given a ladder of performance criterions, this sort of strategy could ensure that the average level of learning outcomes does not decline over time since a student's grade advancement is no longer a function of how well he performs relative to others in his class. Passage from one grade to the next would depend on the fulfillment of a fixed criterion that some central education authority feels is the minimum performance level appropriate for that grade. Therefore, if John completes the third grade in a Seattle, Washington elementary school and Karen completes the third grade in a Lexington, Virginia elementary school then anyone can be certain that both students possess, at least, the same minimum levels of achievement gain even if Lexington, Virginia's wealth of educational resources is considerably different from the wealth of educational resources provided in Seattle, Washington. Indeed, this type of criterion-referenced reform was one of the primary

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[15]The approach outlined above is consistent with the arguments made in Chapter IV in deriving equation (4.12):

$$T+ = f(X_i, P) \qquad (4.12)$$

where the student is given the responsibility of determining the necessary elapsed learning time to meet the criterion.

recommendations offered by the National Commission on Excellence in Education in its 1983 report "A Nation at Risk."

CHAPTER VI

Historical Educational Reforms

A. Introduction

The entire body of equal education policy emanates from the Supreme Court's 1954 opinion in Brown v. Board of Education. The Brown mandate, which was quite limited in scope, called for "equal treatment of equals" within our schools. It epitomized a conservative view of equality based on the fundamental protection of basic individual rights and liberties.[45] However, this modest call has created radical changes within our schools.

In this chapter, we will use the classroom model to demonstrate the transformation that has taken place in our schools due to two key equal education reforms. The graphical representation of a class of students given in Figure (4.4) enables us to analyze the effects on our schools due to equal treatment policies enacted by federal and state authorities. First, we consider the earliest of equal education policy measures--school desegregation. Second, we will evaluate the merits of a more recent rage in education reform--equal finance reform.

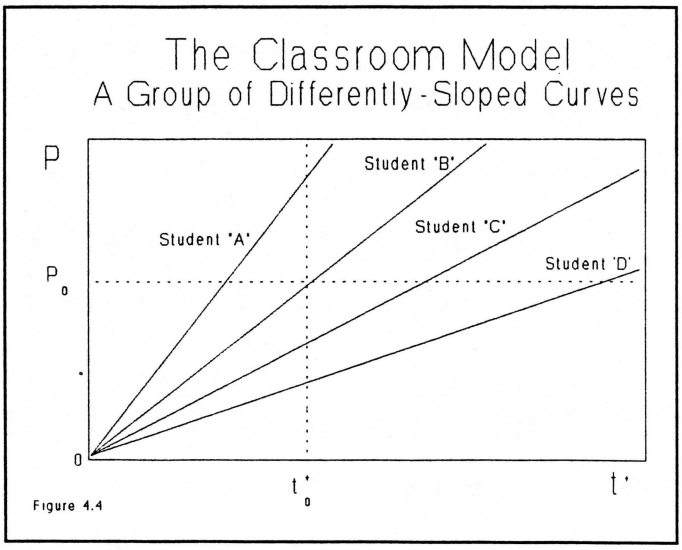

Figure 4.4

B. School Desegregation

Before the Brown decision, practice of the "separate but equal" doctrine created essentially two school systems in the United States. There were schools for the middle and upper classes of our society whose students were almost wholly white (SEA schools); and there were schools for the socio-economically disadvantaged whose students were almost wholly black (SED schools). This situation prompted Congress to order a study which it hoped would "establish once and for all that gross differences in school facilities did exist."[46] The Coleman Report concluded: (1) Minority children have a serious educational deficiency at the start of school, which is obviously not a result of school; and (2) they have an even more serious deficiency at the end of school, which is obviously in part a result of school.[47] However, the Report could not establish any significant relationship between a school's wealth of educational resources and its students' levels of achievement.

The classroom model allows us to represent the situation in our schools before and after Brown. Recall that the slope of an individual's educational production function is a function of individual student characteristics and depends positively on socio-economic background attributes. Therefore, we can characterize classrooms in schools attended by children from the upper and middle classes as having steeper-sloped educational production functions than classrooms in schools attended by children from disadvantaged backgrounds because each type of school services a

socio-economically homogeneous group of learners.[16] Figures (6.1a) and (6.1b) illustrate the differences in the levels of learning performance which students produced within these segregated schools. Note that these illustrations do not suggest that a socio-economically disadvantaged student cannot perform at the level of an advantaged student. They merely report that the level of learning outcomes, on

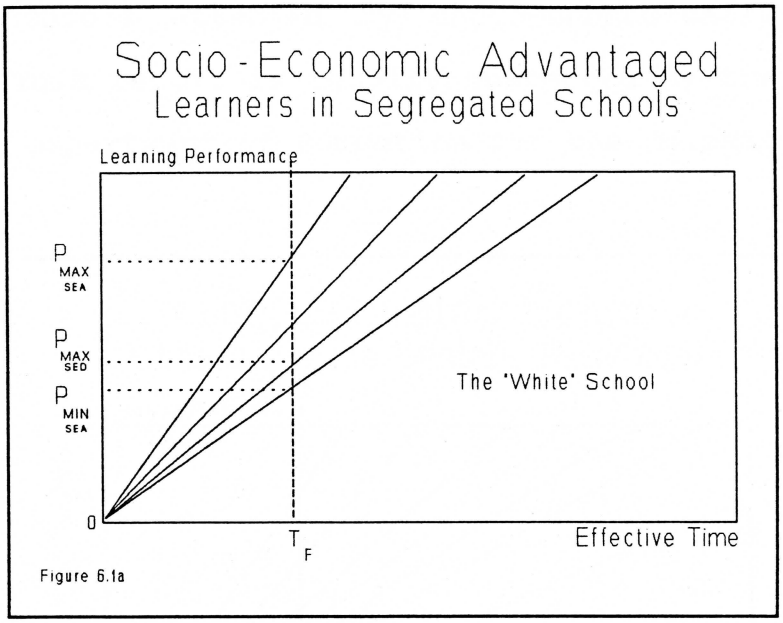

Figure 6.1a

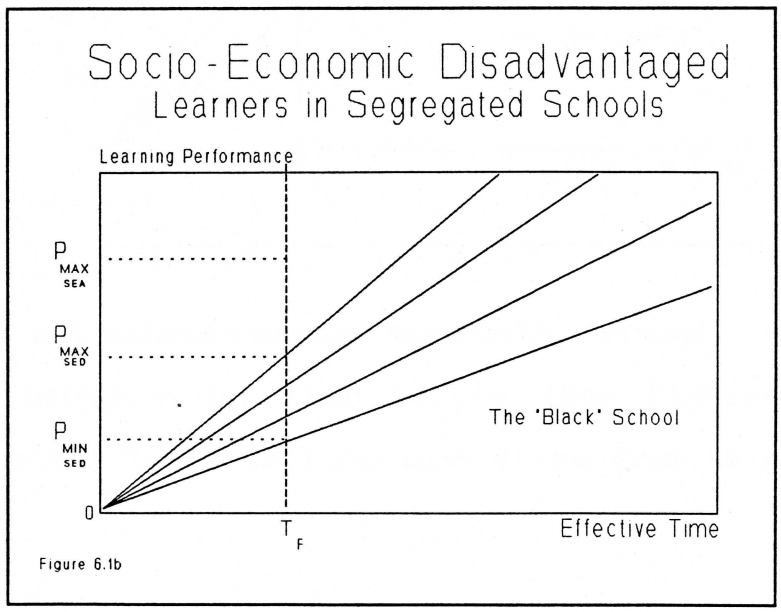

Figure 6.1b

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[16]In Chapter III, Section A, we reported one of the Coleman Report's primary findings as:

> The single school characteristic that showed a consistent relationship to test scores was the school characteristic to which most poor black children had been denied access: classmates from affluent homes.

Figures (6.1a) and (6.1b) provide a graphical representation of this finding in terms of the economic model.

average, was lower in schools attended by socio-economically disadvantaged students. This result is readily supported by the data gathered by the U.S. Department of Education for the Coleman Report.[17]

The move away from the "separate but equal" doctrine to one of equal treatment radically changed the socio-economic composition of schools' populations. As courts ordered schools to integrate and bused students across school district lines, the student populations of all schools became more heterogenous, in terms of socio-economic backgrounds, than before (See Figures (6.2a) and (6.2b)). Two significant implications arise from this transformation.

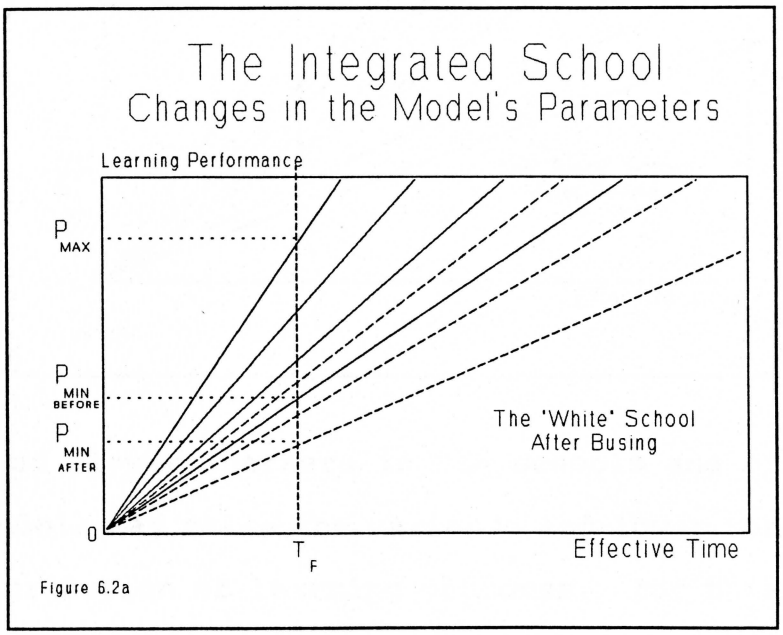

Figure 6.2a

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[17]The Report found that the achievement of the average American Indian, Mexican American, Puerto Rican, and black (in this descending order) was much lower than the average white or Oriental American, at all grade levels. Grade levels of difference range up to 5 years in math achievement or 4 years in reading skills at the twelfth grade level. In terms of probabilities, the amount of difference ranges from about one-half standard deviation at early grade levels to one standard deviation at the twelfth grade level. One standard deviation difference means that about 85% of the minority group children score below the average of the whites whereas if the groups were equal only about 50% would score below this average.

First, given that the conventional instructional method fixes the learning time input, the primary result of desegregation policies strengthens the argument supporting the claim of inequity in the traditional instructional method.

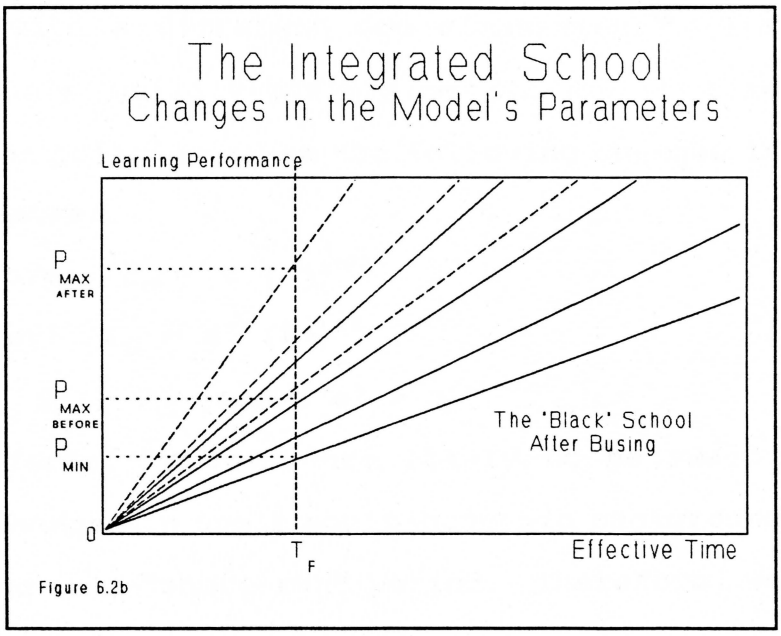

Figure 6.2b

Arguably, the enrollment of slower learners in SEA schools and of faster learners in SED schools may raise the variance and lower the mean of each school's distribution of learning outcomes. For this to occur, the perverse effects of desegregation must outweigh the benefits associated with a more diverse student body. These benefits are primarily psychological effects and we expect them to fall largely to those students who move from socio-economically disadvantaged backgrounds to schools attended largely by students from socio-economically advantaged backgrounds. Students who had attended SEA schools and were then bused to SED schools are unlikely to experience these psychological benefits. These benefits raise the value of the parameter a in (4.13) and (5.1) since one's "external" socio-economic characteristics may change as

a result of associating with a different set classmates.[18] For given individuals and their utility-maximizing choice of time input, school desegregation policies cause the following changes in level of learning performance:

$$\text{Before:} \quad P_{t0} = a\ (t+)^{b1}$$

$$\text{After:} \quad P_{t1} = a'\ (t+)^{b1}$$

$$\text{Result:} \quad P_{t1} > P_{t0} \quad \text{since } a' > a$$

We suspect that these effects, however, are likely to be small. Moreover, the effects of changes in one's socio-economic background are unlikely to be realized in a "short-run" period. Therefore, we expect the difference $|P_{t0} - P_{t1}|$ to be negligible in the time period t.

In terms of perverse effects, students previously unaccustomed to extended bus rides undoubtedly incur some psychological aggravation. Riding for hours on a bus, stopping to pick up other students, and twisting through traffic is hardly the kind of ordeal which would make students mentally prepared to actively engage in the learning process. Also, students possessing bigoted views will also be distracted by the introduction of new classmates. Bused students' level of learning performance may decline if they feel that they are unwelcome among their new classmates. These perverse effects lower the value of the parameter **b** in (4.12) and b_1 in (5.1), the performance elasticity of changes in learning time, indicating that for a given percentage increase in a student's

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[18] (4.13) $P_t = a\ (t+)^b$

(5.1) $P_t = a\ (tc+)^{b1}\ (ts+)^{b2}$

learning-time input he will now experience a smaller percentage increase in learning performance. In terms of an individual's educational production function, the following changes occur:

$$\text{Before:} \quad P_{t0} = a\ (t+)^{b1}$$

$$\text{After:} \quad P_{t1} = a\ (t+)^{b1'}$$

$$\text{Result:} \quad P_{t1} < P_{t0} \quad \text{since } b_1 < b_{1'}.$$

The total effect on learning performance resulting from school desegregation depends on which parameter change, a or b_1, dominates--this thesis hypothesizes that the change in b_1 is greater indicating across-the-board declines in the levels of learning performance.

Second, school desegregation involves the diversion of resources away from instructional inputs used in the learning process. For example, increased busing involves hiring more bus drivers and maintaining larger numbers of buses. This means that fewer resources are available to hire more teachers, buy fewer instructional materials, etc. Thus there is a greater chance that the conventional lecture

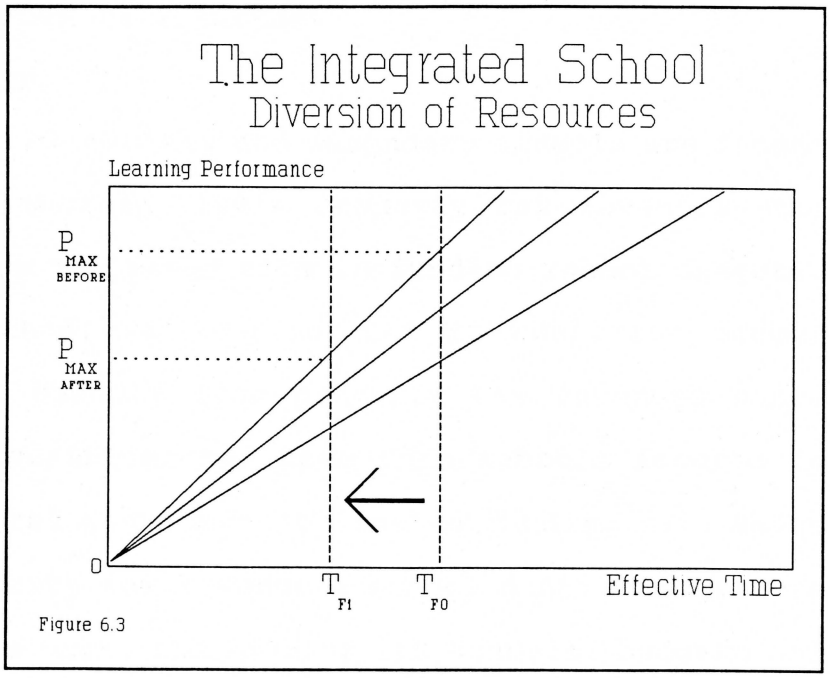

Figure 6.3

method of instruction will remain intact. Teachers will be forced to use the conventional lecture method even more than before since the level of resources favorable to producing effective classroom learning-time has declined. Consequently, schools could possibly witness a leftward shift of the fixed-time input line from T_{F0} to T_{F1} in our classroom model (See Figure (6.3)) and the shift produces an unambiguous decline in the level of learning outcomes (a reduction in the maximum amount of elapsed learning-time implies a reduction in effective learning time, ceteris paribus).

Due to the lack of evidence supporting an expenditure-achievement correlation, we expect the size of this fixed time-input effect to be small if there is no change in the instruction method. Only if the diversion of resources results in less time-intensive methods of instruction will we see the magnitude of this leftward shift of the time-input line increase and the average level of learning outcomes fall further.

C. Equal Finance Reform

Currently, public elementary and secondary schools are funded largely through their municipality's property tax revenues--the federal government plays a limited role in funding school budgets. Under this finance method, schools located in wealthier school districts enjoy larger budgets from property tax revenues since they draw them from a wealthier tax base than schools located in poorer areas. The federal government's limited funding role means that the amount of property tax revenue a school district collects will determine, in large part, the size of its schools' budgets and

the levels of educational inputs a school can offer. It is not difficult to see how this method conflicts with the tenets of equal education opportunity presented in Chapter III.

Equal financing is grounded in the principle of fiscal neutrality which maintains that the quality of education provided by a school should not be a function of the wealth of the local community. Under this type of policy, statewide revenues are redistributed from wealthy to poor school districts according to some formula set by the state's central education authority. The reforms argue from the an ethical stance that states that the principle of fiscal neutrality produces the best climate for promoting equal education opportunity.

Unfortunately, since equal finance systems were first instituted in California in the early 1970s there has been a lack of evidence to support this type of education reform. Yet there are legislators still championing equal finance reforms as the answer to the educational malaise. To see why equal financing might not have worked as well as was hoped, suppose that we have two different schools in separate school districts. One school is located in a wealthy school district and the other is located in a poor school district. The school in the wealthier district is characterized as a group of more steeply-sloped educational production functions and than the school in the poorer district (See Figures (6.4a) and (6.4b)).

The goal of policymakers with their equal finance reforms falls partly in line with our working definition of equal education

opportunity--to lift the level of achievement for all students. Policymakers hoped that, first, a redistribution of funds away from schools operating in the wealthier school districts to schools in poorer school districts would produce unambiguous improvements in achievement levels within the poorer districts. Such improvements would be achieved by either upward rotations in the individual educational production functions of students in poorer schools (positive a effects) or rightward movements in the fixed-time input lines in these schools. These shifts result from the fact that additional funds may be used to hire more and better qualified teachers, improve school facilities, and acquire more and better instructional materials. As described in section B above,

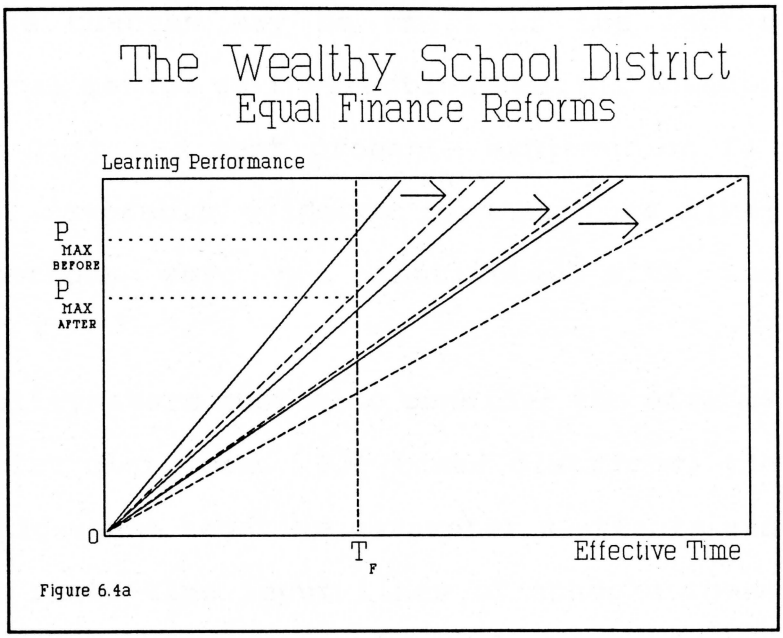

Figure 6.4a

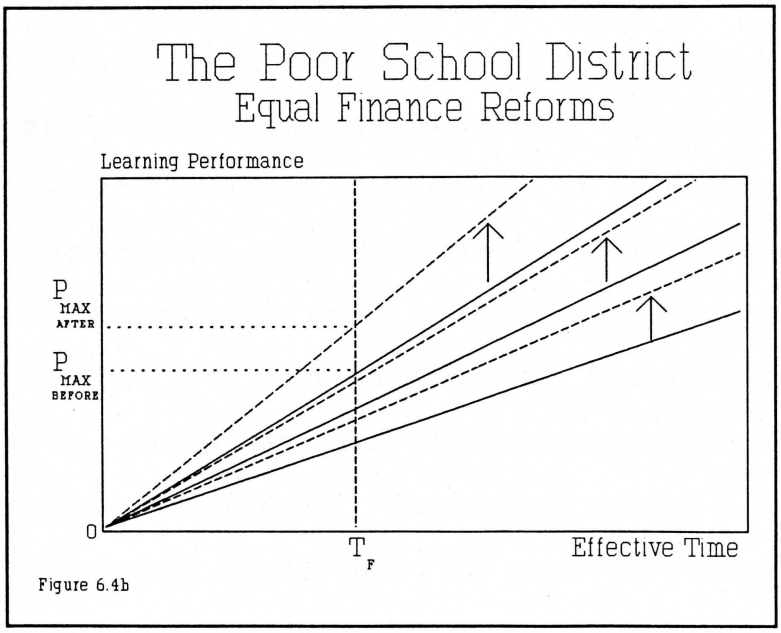

Figure 6.4b

though, the size of these changes may be small if the factor intensity of the conventional method of instruction remains intact. Therefore, we hypothesize that the most probable explanation for equal financing's lack of favorable evidence is that more time-intensive instruction methods were not instituted with the additional funds.

On the other hand, policymakers must also consider the effects of such reforms on wealthier districts. For these districts, the diversion of resources would cause negative parameter a effects and leftward movements in the fixed-time input lines of schools whose funding levels were reduced. Reductions in the quantity, and perhaps the quality, of the educational resources in these schools would cause across-the-board reductions in students' levels of achievement as a result of these changes. However, in the same manner that this reform produced small positive effects, the reform also generates small negative effects--effects which could perhaps be easily overwhelmed by the use of more self-paced, individual study for students. Moreover, these negative effects may even be smaller since one should expect self-paced, individual study for these socio-economically advantaged students to be more effective in encouraging achievement gain since these students will likely encounter more favorable attitudes toward education outside of the classroom.

CHAPTER VII

Final Remarks

A lack of empirical data to test the hypotheses stated in this thesis indicates that the implications drawn must be stated carefully and within the boundaries of the economic model presented. The model presented in Chapter IV results from the standard conceptualization of an educational production function used in previous economic studies. However, the manner in which we apply our educational production function is quite different from that taken before. Therefore, this thesis is significant for three reasons.

First, our approach to learning behavior addresses the most recent and notable criticism of ineffective educational production function studies--the use of aggregative data. While no empirical analysis was performed in the thesis, the arguments presented outline the types of steps which would need to be taken in order to remedy the problems caused by aggregative data. In the model, learning performance is produced by the student and not by the school as is implicitly assumed by previous educational production function studies. A student's socio-economic background, innate ability, and prior knowledge are constant for any one individual. But, for a classroom or a school of students, it is possible to consider instructional attributes and other external factors constant in the educational production functions of each individual student. Therefore, we maintain that it is the student who plays the active role in producing learning achievement.

Second, our approach incorporates a behavioral theory which accounts for the motivation and effort a student puts forth to learn. Past educational production function studies have largely ignored the fact that some students put forth a greater effort to learn than others. Distinguishing between elapsed and effective learning-time accounts for differences in motivational factors. Also, the student, once again, is considered to be the key player during the learning process. Any teacher knows that a student cannot be forced to learn. It is the student's choice, and not the teacher's, to allocate his resources toward learning or non-learning. Therefore, the model's hypothesis that students maximize their own utility by allocating their time toward what they enjoy the most explains why students with higher innate abilities, more favorable socio-economic backgrounds, and larger stocks of prior knowledge do not necessarily perform as well as students from less advantageous backgrounds.

And finally, the descriptive model suggests a possible explanation on the failure of past educational production function studies to produce evidence to support, what many intuitively believe is true--a relationship between educational achievement and school expenditures. The model also reveals that failure of historic educational reforms to improve the level of learning outcomes and equality of education opportunity, perhaps, lies in the fact that the conventional instruction method remains intact following the implementation of these policies. For example, innovative programs, such as Head Start, which augments the time-

input variable from the front-end, and the Wheel, which rotates students from topic to topic in shortened time-period modules to increase the effective proportion of elapsed learning-time, have all been successful in improving their students' levels of learning achievement.

The historic failures to establish a link between school expenditures and student achievement, though, do not necessarily imply that significant changes in school expenditures will not improve learning achievement. The programs given as examples above obviously require additional funds to implement. However, one must certainly believe that, once the reforms are implemented, it will be the more effective time-intensive instruction methods instituted by these programs which produce the improvements in learning performance and not simply the increase in school expenditures.

Nearly everyone now criticizes and bewails the downward trend of achievement levels in our primary and secondary school systems. Yet very few policymakers appear to be enthusiastic enough to enact tougher measures which could improve the system. Simply spending more money on schools is always a popular answer for politicians who at least want to appear concerned about education. Unfortunately, merely throwing money at schools has not and will not solve our educational problems. Few policymakers would champion an extension of either the school day or the school year or the creation of a system of performance levels which make grade advancement contingent upon the student demonstrating proficiency at those levels. School systems around the world operate through

a longer portion of the year, assign more homework and individual study, and mandate strict testing standards at numerous stages in a student's academic development. We, on the other hand, sit idly by watching enviously as other countries' children surpass our own.

Our body of laws, from the Bill of Rights to the Brown decision to Education Consolidation and Improvement Act, were all designed to insure that individuals enjoy, as President Lyndon Johnson once stated, "opportunity--not just legal equity but ability--not just equality as a right and a theory but **equality as a fact and as a result.**" Our working definition of equal education opportunity espoused the idea that society's goal should be to allow each individual free pursuit in attaining an optimal level of learning performance. The historical policies we examined addressed only part of this ideal--they encouraged free pursuit of opportunity but left the question of attaining full performance unanswered. The policy recommendations we have made attempt to respond to this unanswered portion of our goal. Former U.S. Commissioner of Education Francis Keppel may have stated the goal of equal education opportunity best when he said that, "The school must inspire hope, instill desire, and show all our children that they are free to develop their capabilities as far as their ability and ambition will take them." Unless future educational reforms allow individuals the free pursuit of their fullest possible achievement, we may never move closer to the goal of equal education opportunity.

APPENDIX A

Summary of the Equations of the Economic Model

•In general, we express an individual's educational function in the following form:

$$P_t = f(X_1, X_2, \ldots, X_M, X_N, \ldots, X_V, X_W, \ldots, X_Z) \quad (4.6)$$

where P_t is some measure of learning performance at the end of the time period t; $X_1, X_2, \ldots, X_M$ are "internal" variables measuring individual student attributes such as innate ability, prior learning, and motivation at the beginning of the time period; $X_N, \ldots, X_V$ are variables measuring instructional attributes and relevant resources "external" to the student such as the teacher's experience, style, and method; and $X_W, \ldots, X_Z$ are variables measuring the time that a student spends to learn a given task.

•Equation (4.6) is modified under Bloom's assumption concerning the learning process. Bloom assumes that students in a typical classroom are all learning under the same instructional conditions and come fairly homogeneous socio-economic backgrounds. Therefore, we can rewrite our individual educational production function as:

$$P_t = f(X_i, Y_j, Z_k, T) \quad (4.7)$$

where P_t is a measure of learning performance at the end of the time period t; X_i is the vector of individual student attributes; Y_j is the vector of instructional attributes; Z_k is the vector of relevant "external" resources; and T is the total elapsed learning time.

•Equation (4.8) distinguishes between the time which is allocated toward the learning task, T+, and time devoted to other activities, T-. So for a given learning task:

$$P_t = f(X_i, Y_j, Z_k, T+) \quad (4.8)$$

•Under Bloom's assumptions, we assume Y_j and Z_k are fixed and, for a given student, our individual educational production function is given by:

$$P_t = g(X_i, T+) \quad (4.9)$$

•We now distinguish between that portion of time which actually produces the achievement gain. Elapsed learning time is the amount of clock time spent attempting to learn and produce an achievement gain. Effective learning time is the fraction of elapsed learning time which actually yields the achievement gain.

(4.10) $$t+ = c\ (T+)$$

Equation (4.10) represents this distinction where t+ is effective learning time, T+ is elapsed learning time, and c is a fraction between 0 and 1.

•In developing Equation (4.9), we made the assumption that a student does only two things with his time: learning and non-learning. However, learning requires a certain response mechanism since we assume that the student maximizes his utility function as part of the learning process. Therefore, a student's learning performance may not be a function of his learning time but rather his learning time may be a function of some desired level of performance. So we rewrite our individual educational production function as:

(4.11) $$T+ = \text{Time to Criterion} = f(X_i, Y_j, Z_k, P_t)$$

and now pursue an outcomes-based approach towards the learning process.

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