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The Economic Structure of Higher Education:
Subsidies, Customer-Inputs, and Hierarchy

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ABSTRACT

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SUBSIDIES, CUSTOMER-INPUTS, AND HIERARCHY

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Misunderstanding its economic structure will make it difficult to predict the effects of changes that are sweeping higher education: increasing price competition, the weakening of tenure, taxpayer revolts, new technologies, the reduction in research support, etc. And while there is considerable utility in the parallels that see colleges as firms selling educational services in a market to student-customers, colleges and universities remain different in some very fundamental economic ways from the for-profit firms that inform our intuitions and economic theories. This paper follows Hansmann, James, Rothschild-White, Baku, and Clotfelter, *inter alia,* to describe the economic structure of higher education and identify its unique characteristics and circumstances. Chief among these: only its customers can provide key inputs to production so the firm cares about who it sells to; firms always sell their product for much less than the average or the marginal cost of its production, subsidizing their customers from donated resources; and the ability to support such subsidies differs dramatically among firms, creating a strongly hierarchical market. Rather than push a rigorous formal economic model as far toward this reality as possible, in this paper the stick is picked up from the other end to push the realities of higher education as far toward the economist's framing as possible. The result appears to be both preliminary and highly promising.

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THE ECONOMIC STRUCTURE OF HIGHER EDUCATION:

SUBSIDIES, CUSTOMER-INPUTS, AND HIERARCHY

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This paper asks how well our extensive experience with commercial businesses --
and the microeconomic theory of firms and markets that has evolved to describe them --
helps in understanding the economics of higher education. That experience and those
insights *will* be used -- by trustees and politicians and administrators and reporters and the
public with even a modicum of economic training, and by economists -- to understand
and evaluate the behavior of colleges and universities. So it is useful to ask how well it
will serve.

This is, then, a paper about "the economic analogy" -- how safe it is to draw on
parallels between universities and f'ums, students and customers, faculty and labor
markets, and so on. Higher education ha business -- it produces and sells educational
services to customers for a price and it buys inputs with which to make that product.
Production is subject to technological constraints. Costs and revenues discipline

decisions and determine the long run viability of colleges and universities. "But higher education is not just a business." And while that statement is often meant to imply that higher education is somehow finer than business -- more decent and humane and subtle in the purposes it serves -- it can also mean that even economically higher education is more than a business -- more complex and, in potentially important ways, simply different. That is the subject examined here in an effort to identify the key economic features of higher education that make it different from familiar for-profit industries and to ask what difference those differences make.

This is a stick that can be picked up from either end. One starts with meticulous economic theory to see how far it can be made to encompass the economic realities of higher education. An excellent recent paper by Rothschild and White [1995] does that. In their matching model, students and colleges meet in competitive markets where they simultaneously exchange human capital and student quality -- because of the "customer-input technology" that produces higher education (my phrase, expanded on below) -- to determine both gross tuition (the sticker price) and individual financial aid awards. All markets clear and all actors are perfectly informed.

This paper picks up that stick from the other end to start with the economic realities of higher education and see how far toward useful theoretical precision they can be pushed. It is inherently the less rigorous end of the stick, of course but, I would argue, equally important when the task is to make economic sense of a complicated industry -- only this end can identify the most seriously inappropriate of our familiar economic formalisms and assumptions.

I. THE ECONOMIC CIRCUMSTANCES OF HIGHER EDUCATION

In identifying what appear to be the central economic characteristics of higher education, I want first to draw on the literature -- a surprisingly small one -- and then add a couple of key elements. The influence of James, Cook and Frank, Rothschild and White, and especially Hansmann will be apparent. So will the influence of the data for 2,700 colleges and universities reported in Winston & Yen [19951 and summarized here.

A. Hansmann's Analysis of Nonprofit Enterprise

1. The non-distribution constraint

In a seminal article first published in the early 1980s Henry Hansmann, a Yale Law School economist, identified the key legal and economic characteristic of nonprofit enterprises as a "non-distribution constraint" [1981] Such firms are allowed to make profits, and usually do[2] but there is no one to whom they can legally distribute those profits as the normal firm distributes profits to its owners. Indeed, there are no owners of a nonprofit -- it owns itself. The non-distribution constraint can be fudged, Hansmann noted, by transfer pricing that inflates rewards to suppliers of purchased inputs -- as when managers like United Way's William Aramony or PTL's Jim and Tammy Bakker compensate themselves or their relatives too generously --'and Estelle James [19781 and Burton Weisbrod [19911 added that managers can and do shift profits around within a multiproduct firm, using those from activities they don't much like to cross-subsidize those they do -- so profits from undergraduate education may support faculty research and

graduate teaching or Rose Bowl teams. But the non-distribution constraint serves, at the very least, to eliminate any takeover market in nonprofit firms -- so no indirect competitive forces can operate in the guise of a take-over market.3

    2. Managerial motivations

    Because of the non-distribution constraint and the firms' charitable objectives, the managers of nonprofit firms are seen to be motivated by a less tidy incentive structure than we attribute to those running for-profit firms, (It is a commonplace, of course, that even for for-profit firms, 'profit maximization' is an oversimplification. But it is an oversimplification that usually works.) In nonprofits, the non-distribution constraint makes the purpose of profit maximization unclear and no equally simple alternative presents itself. Part of the problem is that managers often share the charitable motives of their donors -- they work for nonprofit firms because they care about their objectives, about equal opportunity through educational access or delivering food to children in Somalia or medical care for the homeless. Rose-Ackerman [1996 labels these incentives "ideological" and (a bit harshly, I think) the nonprofit entrepreneur motivated by them an "ideologue." In higher education, managers appear motivated by a desire to provide "academic excellence," improving the quality of the educational services they supply[4] and the equity with which they are provided [Bowen and Breneman, 1993] An implication of many of these ideological incentives is their shift from absolute measures, like dollar profits, to the relative measure like academic excellence with its strong positional aspect, one that can border on a striving for status and relative rankings. James suggests, indeed, that if there is a single-valued objective function guiding colleges and universities, it is

something like 'prestige maximization.' But, finally, because the behavior of a nonprofit firm must respect the fact that its total costs cannot long exceed its total revenues, the firm may appear to be profit *motivated* when in fact it is only *budget constrained.*

3. Donative-commercial revenues

Hansmann also distinguished two quite different sources of revenue for nonprofit firms. Some, like churches, are supported by charitable donations from people who endorse the firm's ideological purposes *(donative nonprofits,* in his term) while some, like day-care centers, are supported more conventionally by the sale of goods or services *(commercial nonprofits).* Others -- including colleges and universities -- are supported by *both* charitable contributions and sales revenues: *donative-commercial nonprofits.* In higher education, of course, sales proceeds in the form of net tuition receipts are the commercial revenues that combine with charitable donations, broadly defined, in the form of legislative appropriations, current gifts, and asset earning from the accumulated past donations embedded in endowment and physical plant[5]. Long run survival for the college, like the business firm, requires that current costs not exceed current revenues, but total revenues for the college have those two components, only one of which is related to the sale of product[6]. So donative-commercial nonprofits can *subsidize* their customers by selling them a product at a price that is far below the costs of its production. This *sustainable* separation of cost and price -- the continuing ability of a college to subsidize all of its customers -- is surely a defining economic characteristic of higher education, both public and private.

Donative revenues are supported by the various charitable motives of their donors — a dedication to equal opportunity under the belief that education is a human capital investment, an appreciation of the externalities of an educated citizenry, a sense of obligation to repay past subsidies,[7]etc. Commercial revenues are supported by more conventional personal consumption and investment incentives.

4. Information asymmetries and animal spirits

Hansmann added, finally, that nonprofits firms are most successful in those markets with serious information asymmetries where, *inter alia* customers are least informed about what they are buying, or indeed whether they've bought it at all. Did the CARE package get delivered in Somalia? Was the contribution to WAMC actually used to support radio programming? The non-distribution constraint and the managerial motivations it supports increase the probability -- and the donors' or buyers' confidence -- that they're getting what they are paying for. So commercial nonprofits are most frequently found in the markets for things like nursing homes and day care and education. These have been called 'trust markets' because of the vulnerability of their customers to deceptive supply practices from which they can be protected by honest if profit-sacrificing behavior that justifies trust.[8]

To this from **Hansmann** can be added the fact emphasized by Keynes, and by Shackle after him, that any investment decision (including an investment in human capital) proceeds in the face of an existential ignorance of how it will turn out and whether the hoped-for future gains will indeed materialize. This is the context in which Keynes said that we rely on the 'animal spirits' of near-blind optimism or pessimism

[1936] (Shackle, in his turn, took the darker view that we can know nothing and proceed in ignorance [1983]1). The relevance of this for higher education is clear -- as people investing in human capital, our customers don't know what they're buying and won't and can't know what they've bought until it is far too late to do anything about it. Education is a one-shot investment expenditure -- a unique rather than a repetitive purchase.' This appears to combine with the importance of the parental role in buying higher education to produce a market that largely fails to induce rational choice.

B. Other Kev Characteristics of Higher Education

From Hansmann, then, I want to take the central role of the non-distribution constraint, his recognition that the costs of production in colleges and universities are covered by a combination of charitable donations (past and present) and sales revenues creating subsidies for the paying customers, the more complex managerial motivation that values academic quality and the relative position of the institution, and both his emphasis on information asymmetries and a high level of ignorance and faith in the college purchase decision. To these, I want to add two more elements that I have come to believe are defining economic characteristics of higher education.

1. Customer-input technologies

The technology of producing much of what is sold in higher education is unusual in that colleges can buy important inputs to their production only from the customers who buy their products -- what is usefully called *customer-input technologies.* While this relationship may be clearest in a college's production of something like intercollegiate

sports entertainment -- where only its own students can play on its teams -- it is of more importance in the production process for high quality academic education where, to a significant degree, students educate students and the quality of the education that any one receives from his college depends in good measure on the quality of his or her fellow students. Inputs of faculty and facilities matter, too, of course, but fellow student quality counts for a very great deal in the quality of educational services the institution delivers.

In a variety of ways, this idea has long been reflected in the literature, most frequently as average SATs or other measure of student quality are used as a measure of institutional quality [Turner or Kletzer, et. al.]. Of course both Admissions Offices and the rating organizations like USNews put great stake in the fact that that student and institutional quality go hand in hand."

I want to suggest something a good deal deeper: that as an argument of the educational production function, student quality is, technically, an input that cannot be bought from anyone other than a school's customers; an input that costs, and an input that may or may not have substitutes, and an input whose use will be adjusted to reflect costs, available substitutes, and resources. Rothschild-White [1995] built their analysis on the simultaneity of transactions implicit in this technical relationship: the student-as-customer pays a price for her education while the same student-as-supplier-of-input is paid a wage rate, leaving a net payment as their difference. And later on I want to suggest that an important feedback operates through this technical relationship.

So a school's student-customer population defines and restricts the sources of important inputs to its product. And because different customers bring different amounts

of those inputs -- quite apart from their demand for the product, some students will supply high quality inputs while others will not -- institutions have strong incentives to care about -- to control or influence -- who they sell to. The familiar indifferent/anonymous market models of microeconomic theory aren't appropriate.

2 - The hierarchy of college and universities

A hierarchy of institutions results from their 'donative-commercial' revenue sources and from the radical differences among them in their successes -- past and present — in raising and accumulating donative resources. These differences in donative wealth, in turn, strongly influence their current commercial circumstances. Schools that get a lot of donated money from endowments and legislatures and gifts can and do sell, *in their commercial role,* at a lower price or higher quality. So Williams sells its $65,000 education for a net price of about $20,000. "The market" for higher education is very different, then, from commercial markets and competitive market forces play out in a much different environment. They may still work, perhaps, but they do so on a strikingly tilted playing field.

Table 1 is taken from a recent study of student subsidies at colleges and universities in the US in 1991 [Winston-Yen, 1995] The subsidies shown in column 2 are expressed in dollars per student; they are simply the difference between what it costs (Col. 3) to produce a year of education for the average student and what he or she actually pays for it (Col. 4). So the net price is the *commercial* component of the school's per student

Table 1
Subsidies, Costs, Prices, and Aid
1991

Subsidy Decile	Enrollments	Subsidy	costs: Instructional E&G&K	Price: Net Tuition & Fees	General Subsidy	Individual Student Aid	Price/ cost
	$	$	$	$	$	$	%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All Institutions	3,462	7,551	10,653	3,101	6,063	1,488	29.1
Public Institutions	5,128	7,839	8,760	921	7,099	740	10.5
Private Institutions	1,688	7,244	12,669	5,424	4,960	2,285	42.8
Decile 1	3,224	20,801	25,461	4,660	18,195	2,606	18.3
Decile 2	3,166	10,594	13,879	3,285	8,552	2,042	23.7
Decile 3	4,28 1	8,680	10,940	2,260	7,106	1,574	20.7
Decile 4	4,126	7,627	9,882	2,256	6,228	1,399	22.8
Decile 5	4,333	6,760	9,119	2,359	5,462	1,298	25.9
Decile 6	3,637	6,010	8,270	2,261	4,736	1,274	27.3
Decile 7	3,821	5,300	7,899	2,599	4,049	1,251	32.9
Decile 8	3,165	4,591	7,381	2,791	3,412	1,179	37.8
Decile 9	3,094	3,646	7,145	3,499	2,445	1,201	49.0
Decile 10	1,767	1,457	6,508	5,052	403	1,054	77.G

Notes: Includes 2687 institutions, of which 1386 are public and 1301 are private.

All dollar amounts are expressedper FTE student and are averages for the institutional grouping.

Source: Winston-Yen [1995]

revenue while the subsidy is the donative or charitable component. Together they must cover the costs of a year's education. Costs, then, can exceed net price by as much as a school's available donative resources will allow. So despite the fact that all firms must meet the same positive profit constraint, that constraint will mean very different things to the different firms in this industry because of their very different levels of donative resources. [11]

It's useful to make this concrete. At more than $7,500 a year, the average subsidy in US higher education in 1991 is impressive -- the student pays $3,100 for a $10,600 education. But the more relevant fact in Table 1 is the strikingly different subsidies that are supported by differences in the donative resources available to different colleges and universities -- the uneven distribution of that average. Even across the crude decile groupings of the table that lump very different schools together -- especially in the top and bottom deciles -- wealthy institutions have far more donative resources with which to subsidize their students than do poor ones. The average school in the top decile gives each student nearly $21,000 a year from donative resources -- to support a $25,500 education -- while the average school at the bottom gives each student a $1,500 subsidy to help pay for a $6,500 education (so the student at the bottom actually pays a higher net dollar price than the student at the top). If we were to separate the data from public and private sectors, these differences would be even more striking.

So a fact of fundamental importance to the economics of higher education is that any differences in managerial skill or luck or location or imagination among schools will

often be overwhelmed by differences in sheer donative wealth that become differences in price and cost and quality.

II. IMPLICATIONS FOR ANALYSIS OF THE FIRM

A central question is how these characteristics modify the way firms and markets work and what such modifications imply about competitive forces. So I want to suggest the economic dimensions of these characteristics of higher education, looking first at firm behavior, then at markets and competition.

A. Colleges as Firms That Rely on Customer-Inputs

1. Customer-input technologies

It is useful to return to the Rothschild and White paper (R-W) because it made a very helpful contribution to these issues by analyzing an industry's behavior when firms operate with technologies that depend on customer-inputs. Their aim was to show that efficient allocation of customers and inputs among firms would emerge from a competitive market: they used higher education as their case in point.

In a matching model of perfectly competitive, profit maximizing firms, R-W derived the market clearing prices for the firm's product, P_S, and for customer i's input to its production, W_i. W_i was allowed to vary among customers to reflect the different quantities of the input that each might supply." Over all of its customers (students), total sales revenues for each firm (college) had to equal total costs of production for the zero profit equilibrium. In a college, of course, product price, P_S, is the gross tuition or sticker

price while W_i is the ith student's financial aid award, making $P_s - W_i$ the net price paid by that student. Note that inputs are differentiated by customer, but product is not.

The R-W model serves both to recognize the simultaneous purchase-sale/sale-purchase relationships between firm and customer under a customer-input technology and to demonstrate that a net price will emerge from such relationships that can vary by input quality while still clearing all markets. "...[A] customer who buys a unit of output pays its marginal cost minus the marginal contribution of his/her input to the firm's output." [R-W, p. 4 in mss]. Good students pay a lower net tuition than poor students because they contribute more on the margin to the educational activities of the university. This is true, too, of the good athlete though her factor contribution takes a different form and she supplies an input to a different one of the university's products. Or the effective graduate TA or research assistant.

But setting their analysis in a fully informed, perfectly competitive, profit maximizing, market clearing industry did much to limit the relevance of the R-W model to higher education -- and, indeed, they include a section, "Limitations," acknowledging just that. The list of the key economic characteristics of higher education with which this paper began is almost entirely at odds with a model of profit maximizing firms in which all markets are fully informed and competitive with zero profit equilibria and with no donative revenues. In their competitive market, students are indifferent to where they go since they know they will get the same educational product" at Harvard or University of Oregon or at the poorest of the nation's private two year colleges -- and they pay the same market clearing price for it. Colleges are indifferent among students since they'll pay

them the going competitive wage, W, for a unit of student quality, whoever it is attached to. Individual students and schools face infinitely elastic supply and demand and indifferent choices, all at prevailing prices that they can't affect.

Starting from the other end -- trying to understand higher education rather than trying to apply a rigorous model -- runs into the fact that very different educational quality is produced in very different schools at very different cost and sold at very different prices -- gross and net -- to students with very different input characteristics and very different preferences. And all this exists in a world of massive ignorance about what is being bought and sold. So R-W's appears to be more than innocent and necessary abstraction.

2. Controlling who they sell to

What the perfectly informed competitive analytical context most seriously denies is that a firm that depends on its own customers to supply an important input to production will care, maybe very much, about who those customers **are** -- how well equipped they are with the input that matters. And it will translate that care into control, if it can.

a. Excess Demand

Colleges exercise control over who they sell to by generating excess demand and then selecting the students with the most desirable characteristics from the resulting queue. Indeed, selectivity -- the ratio of applicants to admissions -- is one of the most significant, and sought-after[14] facts about a college's educational quality. High quality colleges are selective because that is the way they assure an ample input of student quality.

Excess demand needs robust student demand <u>relative to</u> supply. So selectivity requires, simultaneously, the generation of demand and the restriction of supply. This is much like an efficiency wage where a "too high" wage rate is paid in order to be able to select individual workers on the basis of their desirable characteristics.[15,16]

b. Demand

The determinants of the demand for higher education -- and more so for an individual school -- are not a simple matter but at base, demand must be heavily influenced by what the student gets and what he pays for it. At a minimum, that requires attention not to the sticker price, tuition, but to the net price, the sticker price adjusted for any student aid. But in a world of highly variable college quality, neither of these prices necessarily reflects what the student will *get* for his money. Part of that is described -- putting the same thing in both absolute and relative terms -- by the school's student subsidy (cost minus net price) or its price/cost ratio (what the student pays for a dollar's worth of educational quality). These are Columns 2 and 7, respectively, in Table 1.

But since colleges work with a customer-input technology, an important part of institutional quality is due to the quality of existing students. So student demand is sensitive, too, to the quality of a school's students. That means that not only do students teach students in the educational production process, but because that fact is well known to potential students, demand is affected by a school's existing student quality. Again, this is a fact well known to Admissions Offices and <u>USNew</u>s And increased demand, ***ceteris paribus,*** increases excess demand and the opportunity for selectivity, and therefore future student quality. A feedback is created, then, through which student quality tends to

be concentrated in those schools with significant donative resources which become more attractive, ceteris paribus, because of the quality of their students. We think of high student quality as the result of selectivity; this feedback suggests that selectivity is a result, too, of high student quality.[17]   Cook and Frank [1993] documented this concentration in higher education as illustrative of a Winner-Take-All market, an issue to which we will return below.

c. Supply

Supply restrictions play a larger role in this process than might at first appear. Restrictions on supply are needed, of course, to turn demand into excess demand and thereby allow selectivity. [18]   A college that accepted all applicants -- that couldn't enforce binding supply restrictions -- could not be selective and would not be able to increase student quality through demand expansion.

But enrollment or size restrictions work to protect excess demand and selectivity in another way, too. With the fixed donative revenues most typical of private colleges and universities, [19] enrollment'is the denominator that maps the institution's total donative resources into the potential[20] subsidy **per student** that generates demand. So a private college will have two good reasons not to satisfy excess demand -- to increase selectivity directly and to increase subsidy per student, hence demand, hence selectivity. A public college more frequently relies for donative revenues on legislative appropriations that are capitated, increasing with increasing enrollments. Their incentive for restricting supply, then, is more focused on the maintenance of excess demand for selectivity (a goal they are often denied by public policy in the large but that can often be met in the small by

creating internal supply restrictions that govern entry into high-subsidy honors college programs or by selective flagship campuses within the larger university system)." It is significant that since World War II, far more of the expansion of higher education has been in the public sector and what expansion there has been in the private sector has come largely from new entrants.[22]

So to summarize, a school controls the quality of its customers' input to the production process by using its donative resources to pay for the student subsidies that attract more students than its restricted supply can accommodate, then selecting from that excess demand queue those students with the most desirable input qualities.[23] And since the quality of existing students is attractive to potential applicants, present student quality feeds back to increase future student quality. Clearly, the greater the donative resources, the greater the school's control over student quality or, putting it the other way around, with meager donative resources, a school will have difficulty being selective with respect to student quality. And differences in both of these directions appear to be amplified by potentially strong feedback.

3. Producing education using different factor proportions

Schools differ markedly in their ability to command student quality inputs through the donative-wealth-excess-demand-selectivity mechanism. They adapt to those quite different circumstances primarily by producing education in different ways[24] -- using different factor proportions that economize on scarce student quality. Those that command most of the student quality input tend to use it in residential colleges whose living arrangements facilitate student interaction. They are often geographically isolated,

they have small classes so that students interact, too, in the classroom, they use a non-vocational, "impractical" curriculum, they concentrate on students of compatible "college age." All of these institutional characteristics describe educational production technologies that amplify the effects that those high quality students have on each other.[25]

With less of the student quality input, schools shift to a technology with less of student interaction -- increasing commuter populations, larger classes, wider age and cultural diffusion among students, more vocational curricula. At the extreme are schools producing distance learning ('correspondence courses') with no student interaction and no contribution to one student's education of other students' qualities.

4. The products sold by higher education

While the discussion has concentrated on the production and sale of a "pure" education like that sold to undergraduate and graduate students, colleges and universities produce other products, most of which are also based on customer-inputs and many of which involve more complicated market interactions. The graduate and professional education of MBA and law programs may be enough like that of undergraduates -- especially in its heavy reliance on student quality -- to have been implicit in the discussion thus far. And so has some PhD education. But universities also produce big-time entertainment services in their intercollegiate athletic production, medical and health services in university hospitals, research, and hotel and restaurant services. In all, I count six major products.[26]

The input and market relationships among those products are often untidy. For some the customer-input is used directly to make the product the customer buys, as

student quality helps to produce undergraduate and professional education. But a cross-supply is also common as when PhD candidates work as TA inputs to the production of undergraduate education and as research assistants in the production of faculty research. In truly big-time athletics, of course, by no means all "student-athletes" are much interested in buying undergraduate education in the usual academic sense -- so the issue of a negative net price for athletes is once again on the agenda [NCAA]. To complicate it further, some education, like training in medical services, cannot be produced effectively without a 'practicum' that produces, as a byproduct of the education, another potentially marketable output. And some of the university's products are sold internally to its own customers, like restaurant services, while others are sold mainly to outside customers, like research and health care. For purposes of the present broad description, it is useful to continue to ignore these other products.

5. Cross-subsidies and conflicting incentives

These intersecting markets in which the same people simultaneously play very different economic roles can produce conflicting incentives and fertile ground for the use of the university's resources to cross-subsidize activities that increase the utility of its managers. So, for instance, aside from their role as suppliers of graduate student quality, TAs are often both the customers of PhD programs and an inexpensive substitute for faculty inputs to undergraduate teaching that can give those faculty members "discretionary time," in the Massy-Zemsky phrase, to do the research and graduate teaching they value more. On the one hand, then, a graduate faculty has an incentive for its high quality students to move quickly through the program, attesting to its quality, on

the other hand, the faculty has a large stake in assuring that enough substitute man-power

stays within the graduate program to protect it from too much undergraduate teaching. So

faculty have incentives to establish new PhD programs in order to have ready substitutes

in teaching undergraduates, regardless of the market for PhDs. This has frequently been

noted [Clotfelter, 1996] -- it is the James-Weisbrod cross-subsidization in action and it is

not clear (to anticipate the conclusions below) what market or administrative or political

pressures currently discipline the excesses that will appear if faculty put low value on

undergraduate teaching and are not especially influenced, as Hansmann felt they would

be, by an ideological respect for the purposes of the institution. An even more direct

cross-subsidy appears to operate when university officials get to play the role of major

league team owners -- George Steinbrenner or Marge Schott -- with the resources of the

institution.

6. Summary - the firm

So the central economic characteristics of the firms in higher education appear to

be these: that they have donative as well as commercial revenues so that costs can and do

exceed sales revenues by a great deal, subsidizing their customers; that there are very

different levels of donative revenues among different institutions; that firms use a

production technology in which an important input, student quality, can be purchased

only from their customers; so they control who they sell to by using their donative

resources to generate an excess demand that allows them to select among potential

customers for student quality; and that higher student quality feeds back to increase

demand, hence student quality.   A school with meager donative revenues produces

higher education in ways that don't require as much of the student quality input.

III, THE MARKET AND ITS HIERARCHY

Turn, finally, to the market made up of such firms as these. The economic

characteristics that make individual firms in higher education unique seem to have,

almost without exception, significant implications for a collection of firms in a market.

If, for instance, firms rely only on commercial resources -- sales proceeds, as is assumed

by Rothschild and White -- they would compete in the market on an even playing field

under the same rules of success and survival. They would do that, too, if donative

resources per student were always equal at all schools so price-cost ratios, though less

than one, were the same across the market. Or if colleges were always price-takers in the

markets for education and for student quality, they would not restrict supply to generate

excess demand and thereby select their students on quality. But none of this appears to be

the case.

At base, two derived market characteristics seem most important. Because

different schools have very different access to donative resources -- different levels of

endowment and gifts and appropriations -- they fall into a sharply differentiated

hierarchy. And because they use a customer-input technology with a strong feedback

through demand to reinforce student quality, the hierarchy based on donative wealth

becomes highly skewed. An issue of considerable importance is whether these

characteristics significantly alter the pressures of market competition.

<u>1. The hierarchy</u>

The market is therefore hierarchical with firms differentiated initially by their donative resources -- the subsidy rankings of Table 1 -- and what those resources will buy. And they will buy a great deal. To the extent that any college can get such resources, it can set its net price below cost, either by cutting price for a given quality of education or by improving the quality of its education for a given price or by a little of both. The more donative resources a school has, the greater the student subsidy it can give. To the extent that the school can thereby offer the student more for his money, it can attract more students and to the extent that it can restrict supply, it can turn demand into the excess demand that allows selectivity. And to the extent that it can enroll high quality students, it further improves the quality of its education, increasing, in turn, student demand. So the hierarchy that starts with differential donative resources is amplified by the feedback from such resources to quality to student quality to demand to selectivity to greater student quality...

At the top of the hierarchy are schools well endowed with donative resources that offer expensive and high quality education at highly subsidized prices and disproportionately attract high quality students. And their educational technology reflects that. Movement down the hierarchy brings less of student quality and more use of methods of educational production that don't so much rely on that quality.[27] Movement down the hierarchy, too, means less and less of excess demand until schools encounter increasing problems of selling the product at all -- from an excess demand at the top that controls quality, to near-market clearing demand in the middle where quantity and quality

trade off, to excess supply and empty seats and beds at the bottom. 'Demand augmenting' strategies -- like increased reliance on distance learning or foreign or older students or vocational curricula -- become crucial for schools with smaller proportions of donative wealth. Some of these strategies serve both to economize on student quality and increase market demand.

It is in this highly differentiated ranking of institutions that the positional nature of much academic success and the role of emulation and status and relative prestige become especially important in motivating institutional behavior. Those at the top have been called the "Jones-schools" that set standards for emulation across the market.[28] Table 2 shows the distribution of some of the student quality characteristics that go with the donative wealth hierarchy of Table 1 while Table 3 shows some suggestive measures of the changing production technology used across the hierarchy and strategies to augment demand.

A different perspective on the data is provided by Table 4 which reports the results of a set of plain vanilla linear regressions that ran costs, prices, financial aid, student quality, and technological and demand variables on per-student subsidies. Given the tautology, $S = C - P$, including both cost and price in the first set of regressions is redundant, but it serves to establish that both are significant even if the positive effect of subsidy on net price is small. Coefficients of all variables are consistent with our description and t-statistics are reassuring.

Table 2
Subsidies and Student Quality
1991

Subsidy Decile	% of Applicants Accept.	Mean SAT Score	% in Top 10% of HS Class	% Nat. Merit Semifinalist	% w/Math SAT > 600	% w/Verbal SAT > 600	% with ACT > 27
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All Institutions	**83.2%**	**972**	**19.7%**	**0.7%**	**21.0%**	**11.5%**	**18.3%**
Public Institutions	**88.1%**	**939**	**14.7%**	**0.3%**	**17.0%**	**6.7%**	**12.2%**
Private Institutions	**78.0%**	**988**	**22.7%**	**1.0%**	**22.8%**	**13.7%**	**22.2%**
Decile 1	67.1%	1085	**37.5%**	**2.7%**	**41.5%**	**27.7%**	**35.5%**
Decile 2	78.6%	997	**22.5%**	**0.9%**	**25.1%**	**14.4%**	**22.6%**
Decile 3	81.6%	952	**19.2%**	**0.6%**	**19.6%**	**9.1%**	**16.4%**
Decile 4	85.1%	971	**18.8%**	**0.6%**	**21.5%**	**9.7%**	**16.9%**
Decile 5	84.9%	955	**18.2%**	**0.6%**	**18.6%**	**8.4%**	**18.1%**
Decile 6	87.1%	943	**16.5%**	**0.4%**	**15.2%**	**6.9%**	**13.4%**
Decile 7	86.9%	937	**16.6%**	**0.4%**	**13.4%**	**7.1%**	**17.6%**
Decile 8	88.6%	934	**14.7%**	**0.2%**	**13.3%**	**6.3%**	**12.9%**
Decile 9	87.1%	945	**16.5%**	**0.4%**	**14.9%**	**7.0%**	**14.0%**
Decile 10	84.7%	916	**12.3%**	**0.2%**	**9.9%**	**5.3%**	**15.6%**

Sources:
Winston-Yen [19951; Peterson's Incorporated, Survey of Undergraduate Institutions.

Table 3
Educational Technologies and Demand Augmentation
I991

Subsidy Decile	Fraction of Schools w/ Undergrad Housing	Fraction of Undergraduates in Dorms	Fraction of Undergraduate Over 25 Years Old	% International Students	Fraction of Undergraduates in Vocational Programs	Fraction of Schools WI Part-Time Degree Prog.	Fraction of Schools w/ Adult Ed.	Fraction of Schools w/ External Degree Prog.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AI1 Institutions	65.2%	46.5%	32.1%	3.3%	9.6%	88.5%	81.7%	13.1%
Public Institution	47.0%	29.2%	39.9%	1.9%	6.4%	95.1%	92.6%	14.9%
Private Institutions	84.3%	56.3%	23.6%	4.4%	13.0%	81.7%	70.2%	11.3%
Decile 1	84.4%	60.7%	23.7%	4.8%	5.4%	67.6%	66.9%	4.7%
Decile 2	80.7%	58.0%	26.1%	3.5%	7.7%	84.5%	73.5%	11.8%
Decile 3	78.0%	47.1%	29.7%	3.3%	9.4%	92.2%	80.5%	15.4%
Decile 4	65.0%	47.3%	31.2%	2.8%	9.2%	93.8%	82.0%	11.6%
Decile 5	64.8%	43.7%	34.0%	2.8%	9.7%	94.7%	86.9%	12.0%
Decile 6	63.6%	42.3%	33.5%	2.7%	10.3%	93.0%	85.8%	12.4%
Decile 7	55.9%	40.2%	35.5%	2.6%	10.2%	95.1%	90.8%	12.3%
Decile 8	55.3%	40.1%	36.4%	3.0%	9.0%	92.9%	92.0%	15.9%
Decile 9	56.4%	38.1%	35.0%	2.8%	12.2%	93.8%	87.4%	18.5%
Decile 10	47.6%	34.1%	35.6%	4.5%	12.6%	77.5%	70.5%	17.2%

Table 4
Regressions on Per Student Subsidy

Dependent Variable	Intercept	Coefficient on Subsidy	Standard Error	t-Statistic	R^2	Degrees of Freedom
Cost, Price, Aid:						
cost	$2,907	1.0257	0.0089	114.8	0.8308	2,685
Net Tuition	$2,907	0.0257	0.0089	2.9	0.003 l	2,685
Financial Aid	$1,194	0.0389	0.0033	11.6	0.0480	2,685
Student Quality:						
Mean SAT	913.5	0.0069	0.0006	11.8	0.1303	922
% Selectivity*	91.0	-0.0010	0.0000	-19.5	0.1314	2,523
% FRlO**	10.9	0.0012	0.000 1	17.0	0.1626	1,481
Technology and Demand:						
% In Dorms+	39.1	0.0009	0.0001	9.4	0.0517	1,635
% Over Age 25+	35.0	-0.0004	0.0001	-5.6	0.0134	2,28 1
% International+	3.0	0.0000	0.0000	2.7	0.0037	2,009
% in Vocational+	11.3	-0.0002	0.0000	-5.7	0.0124	2,565

*Applicants accepted

**Freshmen from top 10% of high school class

+undergraduates .

The market structure, of course, is not so tidy as concentration solely on the wealth hierarchy would imply. Cutting across that ranking are important regional and ideological dimensions that differentiate among schools on criteria other than donative resources. College students don't travel well [Litten] and ideological differences like religious denomination are often important to them [Rose-Ackerman]. Only at the top of

the hierarchy is the market truly national and even that is a quite recent development[29] --
it is no accident that the rating agencies like US News separate national and regional
rankings. Keeping these qualifications in mind, though, it is useful still to focus on the
wealth differences that will have their effects within national, regional, and ideological
markets.

2. Competition

How might competition between firms function in this kind of hierarchical
market? Two things, I think, can safely be said: that competition will take place largely
within segments or 'bands' or 'packs' of similar schools within the hierarchy and that it
will have a very different character within differently positioned bands. For those market
segments toward the bottom, competition takes rather conventional economic forms -- a
competition for customers of ordinary input quality that focuses therefore on numbers, on
quantity of sales, on filling seats. It emphasizes price, convenience, and quality for a
customer of modest aims and it is most regionally or ideologically limited. For market
segments at the top of the hierarchy, donative resources are great, student quality is
important and amplified, competition is national, and it focuses largely on position and
maintaining or improving student quality [Clotfelter, p 26].

Schools at the bottom with meager donative resources offer small subsidies to
their students and, most striking, have very high price/cost ratios -- the bottom decile of
private schools charge their students 92 cents for a dollar's worth of education and,
indeed, the total dollar price paid by students at the bottom is higher than the price paid
by students at the top schools ($5,052 average net price per year in the bottom decile;

$4,660 in the top).[30]   A few of these appeared literally to be 'for-profit' schools in 1991 in that their tuition revenues were greater than costs and they practiced a stiff form of price discrimination among their students, "Robinhooding," by transferring resources from the sticker price student who pays more than his own costs to the discounted student who pays less (ironically, the charge of "Robinhooding" is usually leveled at the need-based aid policies of the schools at the top -- at Harvard and Williams -- where in fact **all** students get very large subsidies.) These marginal schools are often the source of news articles about aggressive sales practices and exaggerated forms of cross subsidy and managerial compensation. And with their independence from student quality, they are most vulnerable to future competition from electronic technology.

A significant cut up from the bottom are schools that face persistent enrollment problems -- excess capacity -- and exercise only modest control over student quality on the basis of their modest subsidies, but they deliver an educational product that economizes on student quality and augments demand with a vocational curriculum, distance learning, commuters and older students, more convenient campus locations and timing of courses.

Just below the top are second-tier schools for whom emulation is a central fact of life and hard choices have to be made between student quality and quantity. These schools have enough donative wealth to attract some student quality but not enough to hope to induce the strong feedback of student quality on reputation on demand on quality …that characterizes those they would emulate at the top.[31] These are the schools that must decide how much student quality they are willing to give up for a full class and

whether to incur a period of excess capacity and empty beds in order to improve student quality in the hope that that will draw a higher quality applicant pool in the future. This tension is often reflected, too, in a curriculum in which demand-augmenting programs in Management and Health Care are pitted against high prestige programs in Liberal Arts and it is reflected in aid and pricing policies that make aggressive use of merit aid to improve student quality pitted against the prestige of need-blind admissions with full-need aid. Competition at this level is with the richer schools for student quality, primarily through merit pricing, and with peers for student quantity, primarily through curriculum. In this market segment, competitive pressures have been manifested in increasing disparity between gross and net tuition revenues as institutional discounting increases,[32] in decreasing student numbers that force the choice between protecting revenues or quality, and in a vocationalization of the curriculum. Breneman's study of liberal arts colleges amply illustrates these pressures [1994]; as does McPherson and Schapiro's analysis of the tradeoffs in merit pricing and student quality inherent in enrollment management   [1996].

In the top band of schools, well endowed with donative resources, it is hard to see how competitive market pressures are to work at all. These schools give very large subsidies to their students in providing educational services that are produced with a lot of high quality purchased inputs, including physical and institutional capital,[33] complemented by very high average student quality, all amplified by a residential and classroom technology (and culture) designed to take advantage of them. The curriculum is non-vocational and challenging. The institutional wealth and queue of applicants let

these schools admit students on the basis of their qualities and without regard to financial

need, thus both expanding their pool of student quality and satisfying their charitable

motivations.[34]

      3. A winner-take-all market?

      Higher education has the characteristics of a Winner-Take-All (W-T-A) market

recently described by Frank and Cook -- heavily skewed rewards go disproportionately to

those at the top of a hierarchical market. Those disproportionate rewards induce the

expenditure of a lot of effort and resources to try to get them even though trying and

failing is a wasteful use of the resources.[35]   Amartya Sen saw much the same thing in the

wasteful overproduction of university graduates in India where, again, any individual's

chance of success was much enhanced by a university degree even though that success

took the form of a very low probability of a relatively very high-paying job [Shastri

Lecture]. Primary education in India was neglected in consequence. And Nate Sleeper,

using 1994 IRS income data from private colleges and universities, found the same sort of

skeweness in the reward structure of research faculties (though not of teaching faculties)

[1995].

      The hierarchy of donative resources reinforced by a student quality feedback

appears to create just such a highly skewed market for students in higher education.   But

it is not clear just where the more important potential for waste may lie. While some

resources may be wasted in students' efforts to get into the best schools -- Kaplan SAT-

enhancing courses and expensive counseling -- it is arguable that those efforts have the

socially beneficial effect of encouraging serious study when adolescent urges lead

elsewhere. The more serious threat of waste, it seems, might appear on the other side of the market where schools compete for the best of students.   Massive expenditures on recruiting and on 'competitive amenities' intended to lure high quality students to a particular school appear to yield no corresponding social advantage. But more serious may be the inflated promises of success that induce too many people into higher education in search of large payoffs that have, in fact, only modest probabilities. This, to be sure, must remain speculative until we have a better empirical sense of the distribution of returns to both the private individual (net price) and the public (total costs) investments in higher education.

IV. CONCLUSION

These characteristics appear to be basic to the economic structure of higher education, both public and private -- donative resources that break the necessary connection between costs and price; their very uneven distribution among colleges that creates a hierarchy of prices and costs instead of a level playing field; a technology that uses an input that can be bought only from the school's customers; hierarchically separated competition; and a feedback where success breeds success in a winner-take-all market. A good deal more needs to be done to sort out the implications of these characteristics. They appear to apply with equal force but in different forms in the public and private sectors. Not a lot has been said, yet, about the nature of the competition among the wealthy colleges with their excess demand and disproportionate share of student quality -- whether, indeed, effective competitive pressures exist in markets like

these and if so how they work. But the characteristics that have been identified here appear to be so central to the economic behavior of both firms and the industry -- colleges and universities and higher education -- that a confident understanding of higher education will have to incorporate them. In the meantime, a good deal of skepticism appears warranted that straightforward business intuition and conventional economic analysis will often give reliable insights.

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2 Thus confusing those of us who thought "nonprofit" should be defined by *not* making profits.

3One source of concern about the efficiency of nonprofit firms -- see Rose-Ackerman [1996], inter alia. Elsewhere I've argued that this fact, apart from damping competitive threats to management, also creates problems for the recognition of the economic costs of capital services in production. [NACUBO, 1993]

4"...the university lacks any corporate goal other than the pursuit of excellence" [Clotfelter, 1996a, p. 23]

5 Asset accumulation is due, too, to prudent management in the form of saving from current operations [Winston, *Planning, 1992*]

6 In Econ 101 notation, TR - TC 2 0, but the nonprofit firm's budget constraint is met even if with PQ < TC so long as donative revenues, DR, are enough to make up the difference since TR = PQ + DR.

7Donations are sometimes seen as the repayment of an implicit student loan from the college that recognizes the imperfection of human capital markets. See Hansmann's on endowments [19901. For an extensive discussion of donor motivation, see Susan Rose-Ackerman [1996].

8I have described higher education as operating in a 'trust market' [1992]. Rose-Ackerman has recently described nonprofits more generally in much the same way [1996].

9 Winston, 1988.

10This is not simply an 'endorsement effect' in marketing, whereby a college demonstrates its quality to potential customers by the characteristics of those who have already chosen to buy it -- "these smart people come here so we must be good." Nor is it a mostly a matter of numbers, as in much of the recent discussion of networks [Liebowitz and Margolis]. Nor does it describe the individual characteristics of students that make them better or worse at *utilizing* the educational services they buy from the college (a matter better modeled in a Becker-type household production function). Nor, finally, is it simply that the presence of others increases the utility a student derives from a given quantum of educational services. Among models I have found, Basu's analysis of "association markets" [1989] comes the closest, but it's not always clear there how much is due to positional effects and how much is substantial in its effect on the product made and sold.

11TR 2 TC in general, but TR = PQ + DR 2 TC and different schools have very different DR so TC - TR can be very different, too. In all that follows, institutional saving, TR > TC, will be ignored. It has been shown to be important for wealthy schools [Weber-Winston, 1994] but data are not available to assess its general importance.

12There's a bit of a fudge in the R-W model as the product of education is called 'human capital,' allowing them to have the price of human capital driven to equality across schools without, given differences in

productivity, requiring that tuitions are equal. I'm not sure what a more coherent pricing of the institution's <u>product,</u> as educational services, would have done to their model but I suspect it would have made a mess. Maybe, though, it's mostly semantics.

13 Human capital -- see note above.

14 See the *Change* piece [Webster] on the deceptions thatUSNews encounters in trying to get accurate data for its ratings -- the gimmicks used to inflate and distort selectivity numbers, especially. And Stecklow's Wall Street Journal article on misrepresentation of SATs

15 Indeed, what's going on here may be pure efficiency wage, as large subsidies represent large real wages paid for student quality -- the $45,000 a year subsidy paid to a Williams student in-kind. So the question "Why do we see this clumsy subsidize-and-select system instead of simply paying a market-clearing wage for student quality?' has an efficiency wage answer -- the existence of a "too high" wage rate for student quality that allows the institution to control what quality is and who they think has it. It's hard to see how a market for student quality, indeed, could work otherwise -- it's simply too hard to identify quality and agree on its amount between buyer and seller.

16 Interestingly, Rothschild and White, as White and Rothschild in an earlier article [1993], speculated on why the elite graduate professional schools charged such low prices of their customers -- why they fail to capture so much of the rent their students earn from their education. The answer, it would appear, has much to do with the price (wage) those schools are paying for the exceptional quality of their students. Schools of lower quality may capture a larger proportion of their students' rents because, this approach would suggest, they were buying lower quality students and hence paying less for them.

17 This is implied by two widely used enrollment management strategies: cutting class size to improve quality to increase the future applicant pool and spending resources to finance merit aid to improve quality to increase the future application pool. Both, of course, are intended as short term strategies whose justification will be ended by improved quality of the applicant pool.

18See Clotfelter, 1996a.

19 And, it seems, increasingly moving to the public sector. Breneman on UC System [1995].

20 It is useful to remember that donative resources can be saved, too. See Winston-Yen, 1995.

21 So Cook and Frank use Berkeley's disproportionate (and increasing) share of the high-SAT freshmen in the UC system as evidence of concentration of the best students within the public sector [p. 134].

22 The expansion of established and wealthy men's schools due to coeducation did reduce donative wealth per student, but it also doubled the potential applicant pool to augment excess demand. That can't happen again.

23 While it would not help to go too far into the definition of "student quality," the emphasis on *interaction*- - among students and with faculty -- implicit in peer effects suggests that it must involve the intelligence to

understand concepts and patterns, the discipline and ability to read with comprehension, the ability to understand and communicate with others, to listen, and to encourage them to cooperate in interaction.

24 These differences could be described as "different products," but since all come under the label of 'undergraduate and professional education' -- in contrast to the truly different products like athletic entertainment discussed in the next section -- it seems better to see them as different ways to make the same thing.

25 For better and for worse. These educational technologies work well when student quality is high but with an anti-academic student culture, what is amplified may be hostility to academic goals. No one who saw the positive academic effect on the Williams campus in the early 1960s of the removal of fraternities can doubt the powerful influence on the educational process of a reinforcing negative student culture, and its removal. See Moffat, *Coming of Age in New Jersey* [*1989*].

26 Undergraduate education, graduate and professional education, research, athletic entertainment, medical-health services, restaurant and hotel services.

27 is useful to note that some wealthy schools with high quality students appear to use that input as a underline substitute for other inputs -- so Harvard, for instance, offers large TA-taught classes, a technique that would produce an inferior undergraduate product were it not offset by an ample number of excellent fellow-students. (Clotfelter [1996b] reports that the average class size in Social Science at Harvard in 1991/92 was 242 and that 48% of the courses were taught by regular faculty.) If fellow-student-quality is as important as I suspect, such schools -- so long as they can attract and select superior students -- can get by with a lot of corner-cutting in the direct inputs used in their undergraduate education. It's doubtful that the a lesser university can get by with impunity in doing the same thing.

28 It is useful to note that some wealthy schools with high quality students appear to use that input as a substitute for other inputs -- so Harvard, for instance, offers large TA-taught classes, a technique that would produce an inferior undergraduate product were it not offset by an ample number of excellent fellow-students. (Clotfelter [1996b] reports that the average class size in Social Science at Harvard in 1991/92 was 242 and that 48% of the courses were taught by regular faculty.) If fellow-student-quality is as important as I suspect, such schools -- so long as they can attract and select superior students -- can get by with a lot of corner-cutting in the direct inputs used in their undergraduate education. It's doubtful that the a lesser university can get by with impunity in doing the same thing.

29 A development currently being studied by Caroline Hoxby.

30 Winston-Yen, Table 6.

31 An endowment of $100,000 per student -- $200 million for a liberal arts college of 2,000 students-- has been described by administrators as the threshold defining entry into the elite.

32 Between 1986-87 and 1992-93, the middle range of private institutions -- deciles 3 through 7 -- reduced their general subsidy by an average of $1,330 while increasing the subsidy in the form of student aid by

$1,106. Public institutions in the same range reduced the general subsidy by $7 18 but increased aid by only $282 [Lewis and Winston, 1996].

33 In the top decile of all schools -- a group of nearly 270 schools in our study of 1991 data, hence far more inclusive than "the top market band" of schools discussed here -- the average student subsidy is $20,801 per year, the school uses over $330 million worth of physical capital stock to provide each student with more than $100,000 worth of facilities. [Winston & Lewis, 1996]

34 It can rarely be least-cost for a school to depart from 'merit based' aid in paying for its student quality. So those schools that do use need-blind admission and full-need aid are serving egalitarian or other charitable motives. See Bowen & Breneman [1993].   A straight sales policy would select from those students who were both willing and able to pay the sticker price. Enrollment management using price discounts to further improve student quality would give price concessions to any student of higher quality who was either unwilling or unable to attend at the sticker price. Need-based aid puts a restriction on that policy by giving price concessions only to those who are willing but unable to attend at the sticker price. So to achieving a given increase in student quality by price discounting will always be more costly through need-based than through merit aid. Only if the willingness to pay of full-price students is affected by the *existence* of merit aid might need-based aid be cost-effective.

35 The clearest illustration of a W-T-A market in action is not Cook and Frank, I think, but in Harris and Todaro's explanation for overcrowded slums in the cities of poor countries [1970]. It is, they argued, the result of perfectly rational migration of low-paid rural farm workers into the city in the hope of getting much higher paying jobs. Those high-pay jobs exist in the city but the probability of any migrant's getting one is low -- unemployment is the far more likely outcome. But despite the poor odds on individual success, the exaggerated level of success -- the large difference between rural and urban wages -- is great enough to make it a good and sensible bet for the farmer to migrate. The expected value of post-migration income is sufficiently high. The result, of course, is slums crowded with unemployed and the waste of much socially valuable manpower -- individual rationality produces social waste.