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An Economic Analysis of Residential Abandonment and Rehabilitation

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Building Economics Section
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U.S. DEPARTMENT OF COMMERCE, Elliot L. Richardson, *Secretary*
Dr. Betsy Ancker-Johnson, *Assistant Secretary for Science and Technology*
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Acting Director*

PREFACE

This paper is an analysis of market and governmental factors which lead to socially inefficient rehabilitation and abandonment decisions. Our purpose has been to abstract from complex problems related to the rehabilitation and abandonment of residential buildings by identifying the essential characteristics of the problems and the role some past and existing social programs have had in aggravating or mitigating these problems. Alternative programs are analyzed for their potential effects on these problems; however, policy recommendations are not made. Hopefully, the analysis will give public decision makers greater latitude and direction in their choices so that social programs might be both politically palatable and efficient in the sense of improving the allocation of resources.

Dr. Harold E. Marshall, Chief of the Building Economics Section, provided valuable technical and editorial reviews of this project. Dr. Joseph G. Kowalski, the project leader, and Mr. Joel Levy, an economist with the Building Economics Section, corrected a number of analytical errors. Those errors which remain are, of course, the author's responsibility.

ABSTRACT

This paper is an analysis of market and governmental factors which lead to socially inefficient rehabilitation and abandonment decisions. Its purpose is to abstract from complex problems related to the rehabilitation and abandonment of residential buildings by identifying the essential characteristics of the problems and the role some past and existing social programs have had on aggravating or mitigating these problems. Alternative programs are analyzed for their potential effects on these problems.

The paper begins by developing a model of individual owner or firm behavior regarding optimal investment (i.e., maintenance and rehabilitation) decisions. These decisions are shown to be affected by factors such as the price of housing services, the rate of interest, the cost of investment, and the parameters of the technical relationship between output, housing services, and the inputs, housing stock and operation. The conditions under which abandonment will take place are discovered in the course of analyzing the model of firm behavior. This model is then linked to a model of the aggregate housing market in which the housing stock changes through net depreciation or net investment and new construction. The comparative statics and dynamics of these models are explored by showing the impact of changes in factors such as income, the rate of interest, the rate of depreciation, and the cost of new construction. These models are used to analyze a number of issues (e.g., the impact on rehabilitation and abandonment of rent control, accelerating the rate of filtering-down, and the property tax).

The interdependence among firms as the result of neighborhood effects or externalities is analyzed next. Models of bilateral and multilateral neighborhood effects are outlined. Conditions which

encourage, and those which discourage, the private production of neighborhood quality are discovered by analyzing these models. Stable neighborhood clubs are shown to be necessary for the private production of neighborhood quality. Enlightened self-interest, cost sharing, compliments and ostracism are discussed as factors which can generate club stability in the face of the free-rider threat. Besides exploring the general factors which determine the private production of neighborhood quality, the paper takes an in depth look at two types of specific factors: neighborhood size and the ownership characteristics of the neighborhood.

It is hoped that the analysis in this paper will give public decision makers, and their economist-advisors, greater latitude and direction in their choices so that certain housing programs might be both politically palatable and efficient.

EXECUTIVE SUMMARY

This paper develops a model of individual owner or firm behavior regarding maintenance and rehabilitation decisions. In the model the owners' investment decisions are based on factors such as the price of housing services, the cost of operation, the cost of maintenance and rehabilitation (i.e., the cost of investment), and the technical relationship between output, housing services, and the inputs, housing stock and operation. Certain conditions under which abandonment will take place are outlined using the model. This model is linked to a model of the aggregate housing market in which the stock of housing changes through net depreciation, rehabilitation (i.e., net investment in existing housing), and new construction. The workings of these models are illustrated by showing the impact of changes in factors such as demand for the stock of housing, the rate of interest, the rate of depreciation, and the cost of new construction.

These models are used to analyze a number of issues. It is shown that accelerating the rate of technological change in new housing and thereby accelerating the rate of filtering-down may have some positive effects, but blight will be exacerbated as a result. Technological improvements which reduce the cost of maintenance and rehabilitation would increase maintenance and rehabilitation activities. However, such improvements might not reduce problems of too little resources being allocated to these activities as a result of externalities. Rent control is shown to result in a decline in housing stock. An extension of the firm model is developed in order to show the impact of the property tax. The property tax is shown to be a disincentive to invest in housing and to accelerate the physical decline of buildings which are declining in value as a result of tax rates being inflexible downward.

The factors which are important to the creation and the disruption of the delicate social contracts essential for neighborhood conservation are generally informal and even unspoken. These social contracts consist of agreements to paint at regular and frequent intervals, to repair when needed, to contain garbage, to testify against criminals, and do a myriad of other things which produce neighborhood quality. In the context of strategic choice as illustrated by the well-known, bilateral game situation called the prisoners' dilemma, cooperative behavior is highly unlikely without each of the owners having long experience in interacting with the other in order for them to be assured that the other is likely to cooperate. Where there is interdependence among many decision makers, stable neighborhood clubs are shown to be necessary for neighborhood conservation. Enlightened self-interest along with cost sharing, compliments, and ostracism are tools of enforcing club stability against the threat of free-riders.

In addition, this paper takes an in depth look at two types of specific factors, neighborhood size and ownership characteristics, determining club success. Neighborhood size is shown to be related to the cost of preventing spill-ins and to the chances of club success so that there may be an optimal size or range of sizes. The public sector can influence neighborhood size through the spatial distribution of public capital. The analysis of ownership characteristics indicates that the conditions for conventional, individual homeownership promoting neighborhood conservation are more restrictive than conventional wisdom would have it. The 235 program and urban homesteading programs are analyzed. In addition, a number of alternatives to conventional homeownership programs are analyzed. These include a single neighborhood owner and a neighborhood-wide condominium.

The purpose of developing these models and extracting their implications regarding a number of issues is to provide greater latitude within which public decision makers can find efficient program directions and to reduce the possibilities of selecting inefficient directions. For example, the rather unique, if not yet fully developed, treatment of rent control in this paper could demonstrate that the goals sought by the proponents of rent control are unobtainable through rent control. On the other hand, those who seek to encourage homeownership for moderate income households are provided with a rationale and some criteria for developing new programs to accomplish this. It is hoped that economist-advisors of public decision makers will be able to utilize the analysis in this paper directly as well as extend the analysis to issues which are neglected herein.

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SYMBOLS AND THEIR DEFINITIONS

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A	a parameter of the cost of investment function
α	the ratio of labor services to housing stock
C	the cost of gross investment
$C=A(e^{\delta I}-1)$	the cost of investment as an exponential function of the rate of investment
CCND	the central city net depreciation curve
CCNS	the central city new supply curve
d	the depreciation rate (i.e., the periodic rate of depreciation)
d-I*	the optimal rate of net depreciation or negative net investment
δ	a parameter of the cost of investment function
$\dot{EB}$	the periodic rate of change of external benefits of investment
γ	the ratio of housing services to housing stock
h	the quantity of housing stock
$\dot{h}$	the rate of change in the housing stock
H	the quantity of housing services per unit of time
H=F(h,l)	the production function (i.e., the technical relationship between inputs and output) which is assumed to be linear homogeneous
I	the rate of gross investment
I*	the privately optimal rate of gross investment
$\hat{I}$	the socially optimal rate of gross investment
K	the (rent control) ceiling curve
L	the quantity of labor services per unit of time
ND	the net depreciation curve

NS the new supply curve

p the real price of a unit of housing services

ϕ the constant of proportionality which describes the relationship between the depreciation rate and the housing stock

Ψ a constant having no economic meaning

r the real discount rate

SND the suburban net depreciation curve

SNS the suburban new supply curve

$\dot{TB}$ the periodic of change in total (i.e., external plus internal) benefits of investment

Θ the property tax rate

TSD the total stock demand curve

TND the total net depreciation curve

$\dot{V}$ the rate of change in the present value of the residual cash flow which accrues to the housing stock

$\dot{V}=\frac{p\delta-w\alpha}{r+\phi} I$ the rate of change in present value described directly above as a function of the rate of gross investment

w the wage rate

CHAPTER 4

d,h,m,n, the sizes of neighborhood quality producing clubs

I an indifference curve where higher subscripts refer to higher levels of satisfaction

n the size of the neighborhood quality consuming group

P an initial endowment of the private good

P* initial levels of neighborhood quality and the private good

P_x^1P	points or combinations of points in neighborhood quality-
P_x^1	private good space which are used to indicate transformation (or production possiblities) curves and where subscripts refer to club size (i.e., x = d,h,m,n etc.)
R*	neighborhood quality and private good consumed in the absence of a club
R,R**	unattainable points sought by free riders

1. INTRODUCTION

Nearly all the major metropolitan areas have experienced widespread abandonment of residential property.[1] Both individual owners and society generally would benefit from higher levels of maintenance and rehabilitation and thus less rapid abandonment of urban residential property. Unfortunately, the processes of residential decay and conservation are not sufficiently well understood for the federal government as well as state and local governments to create a climate (i.e., a system of incentives) which will generate more efficient private sector behavior.[2] This lack of understanding is due to a dearth of solid theoretical work on these issues.[3]

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[1] Although several years have passed since they were written, two studies are especially useful for providing a sense of the magnitude of the current abandonment wave: Linton, Mields, and Coston, Inc., A Study of Abandoned Housing, NTIS PB No. 212198, February 1971; National Urban League and the Center for Community Change, National Survey of Housing Abandonment, New York, April 1971. For a more recent empirical study see: George Sternlieb and Robert W. Burchell, Residential Abandonment: The Tenement Landlord Revisited, Center for Urban Policy Research - Rutgers University - The State University of New Jersey, New Brunswick, N.J., 1973.

[2] For recommendations of programs to deal with abandonment and to encourage rehabilitation see Real Estate Research, Possible Program for Counteracting Housing Abandonment, HUD, 1971. One of the most interesting parts of this paper is a recommendation that Neighborhood Management Corporations be formed. Such a corporation would manage a project area like a condominium management organization would. Also see George Sternlieb, "Abandonment and Rehabilitation: What Is to Be Done?" Papers submitted to the Subcommittee on Housing Panels on Housing Production, Housing Demand and Developing a Suitable Living Environment, Part 1, Committee on Banking and Currency, House of Representatives, June 1971.

[3] Of course, there has been some interesting theoretical work. For two recent theoretical contributions, see: Larry L. Dildine and Fred A. Massey, "Dynamic Model of Private Incentives to Housing Maintenance," Southern Economic Journal, April 1974; Gregory K. Ingram and John F. Kain, "A Simple Model of Housing Production and the Abandonment ProVol. 1, No. 1, June 1973. However, most of the work has been more Vol. 1, No. 1, June 1973. However, most of the work has been more descriptive than theoretical. For one of the best characterizations of the socio-economic conditions in a neighborhood experiencing abandonment and outlines of the stages in the abandonment process see Real Estate Research Corp, Possible Program for Counteracting Housing Abandonment, HUD, 1971.

> "The reality of abandonment is challenging the theoretician's capacity to explain the phenomenon or predict its growth. Analysts of the reasons for the decline of blighted areas and of their prospects for renewal have brought their entire theoretical arsenal to bear on the subject but the dynamics have evaded the state of the art."[1]

It is the purpose of this paper to meet this challenge by developing models of individual, group, and market behavior which explain maintenance, rehabilitation, and abandonment activity. This analysis can be of use to public decision makers by providing a greater understanding of the market and extra-market processes, by identifying related resource allocation problems and programs which have a chance of being efficient, and by providing a systematic approach to judging the probable impact of various policy instruments on these problems. In addition, it is the purpose of this paper to build a theoretical base for future econometric work on residential maintenance, rehabilitation, and abandonment.

1.1 Abandonment and Efficiency Problems

While the abandonment of housing in our central cities involves efficiency problems, it is incorrect to suggest that abandonment, per se, is an indication that resources are being wasted. Under certain circumstances, abandonment may be seen as the last stage of the filtering-down process.[2] Thus abandonment may be desirable from the standpoint of allocating resources most efficiently. However, there may also be factors associated with abandonment which indicate that the pace

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[1] Sternlieb and Burchell, Residential Abandonment: The Tenement Landlord Revisited, p. xii.

[2] The filtering-down process is the market process by which a dwelling unit experiences a decline in real value (i.e., not necessarily nominal value). Some economists would say that a dwelling unit had filtered down if it had experienced a decline in relative value regardless of what happened to real value.

of abandonment is too rapid (i.e., resources are being allocated inefficiently).[1]

The current wave of residential abandonment is not the first this country has seen. As the country was becoming urbanized, housing in rural areas was abandoned while there was a great deal of demand pressure in urban housing markets.[2] In order to understand the extent to which the current experience with abandonment embodies resource allocation or efficiency problems, it is useful to identify some of its similarities to and differences from this earlier experience.

To some extent the urbanization process and the concomitant abandonment of housing was a response to the signals of well-functioning markets (i.e., the rise in urban income along with low income elasticities of demand for agricultural products and increases in labor productivity on farms).[3] However, some of the urbanization and the abandonment it produced was due to distortions in the marketplace. Increases in the productivity of farmers were to some extent an illusion. The green revolution's dependence on pesticides, large quantities of fertilizers, and single crops over large areas was encouraged by a price system which did not require payments from farmers for all the costs, especially the environmental costs, generated by their activities.

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[1]While there are some analytical differences with this paper, it is useful to see the discussion of "good" and "bad" abandonment in Philip H. Friedly, Experimental Approaches to the Amelioration of Housing Abandonment and Neighborhood Decline, Paper presented at the meetings of the AREUEA in New Orleans, December 1971.

[2]Other examples of large scale abandonments include entire cities being abandoned after their mines gave out, after a disaster struck, or after being by-passed by a new transport route.

[3]Thus we see that evidence of structurally sound hosuing being abandoned is not evidence of a resource allocation problem (i.e., it does not necessarily mean resources are being wasted).

Furthermore, these environmental costs were diffuse so that farmers could not be paid to change methods by those who were injured by these costs. Similarly, the productive advantages of agglomeration in cities were overstated by markets which were unable to process many of the costs associated with dense clusters of people and with by-products of the growing industrial activity in cities.

Like the earlier rural abandonments, the current urban abandonments are, in part, the result of well-functioning market processes. The decentralization of activity within urban regions is largely a result of correct market responses to factors such as transport innovations, increases in income, and the high income elasticity of demand for private recreation.[1] Thus, centrally located housing is becoming locationally obsolete and abandoned for some good reasons. But just as distortions in the marketplace accelerated the urbanization process and the associated abandonment of rural housing, they have also accelerated the decentralization process and the abandonment of centralized housing within urban regions. For example, peripheral users paying less than the full cost of the extension of facilities, such as highways and sewers, to the urban periphery is one kind of market distortion which has accelerated the peripheral growth and central decline of urban regions. Monopoly power disrupting land assembly and the conversion of previously developed land to other uses is another kind of market distortion which has contributed to the decay and abandonment of urban housing.

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[1]Examples of transport innovations are the street railway, the automobile, the truck, the limited-access freeway, and the inter-urban (i.e., inter-state) freeway system. Private recreation refers to such things as watching TV in a den rather than in a neighborhood bar, playing croquet or volleyball on the lawn and basketball on the driveway, growing roses, and barbecuing on the patio.

There are, on the other hand, a number of important differences between the rural and urban experiences with abandonment. In an urban setting, decay and abandonment of housing creates more of the same because of the interdependencies among neighboring properties. The value of a property (i.e., the present value of the flow of services which are imputed to it through time) has to do not only with the physical characteristics of the property itself but also with the characteristics of neighboring properties. The rehabilitation of housing units and high maintenance levels of housing units may provide direct benefits to society (i.e., increase the value of services imputed to neighboring properties). Similarly, low levels of maintenance and rehabilitation may result in direct and involuntary transfers of cost to society. These benefits and costs are called externalites because they are external to the marketplace. The impact of these externalities is a function of proximity. Thus, externalities of this kind are extremely important forces distorting resource allocation in urban areas.

Incentives within urban housing markets result in too little maintenance and rehabilitation and thus too rapid abandonment, because all costs or benefits created by the decision maker do not accrue to him (i.e. some costs and benefits are externalities). There is no legal liability for foisting these costs on others and there may be no opportunity for those who receive externalties to bribe or threaten the producer of external benefits or costs into more socially optimal (i.e., more allocatively efficient) decisions. Therefore, it is useful to examine the aspects of the housing market which distort decisions and lead to efficiency problems relating to maintenance, rehabilitation and abandonment.

Besides the role of externalities, the rural and urban abandonment experiences differ with respect to the extent to which public programs contribute to the problems. In the past, the unintentional but undeniable effect of many governmental programs has been to exacerbate problems related to the maintenance, rehabilitation, and abandonment of urban housing. Rent control, the property tax, the income tax, and housing codes are examples of programs which have contributed to urban residential decay and abandonment. In this section, urban abandonment has been shown to be only partly caused by distortions in market processes. Thus, the complete elimination of abandonment would not be an efficient objective of governmental programs. It would be just as inefficient to pursue too much rehabilitation as to allow too little.[1] In order to shape future governmental programs in a more efficient mold, it is necessary to carefully analyze various past, existing, and proposed governmental programs which impact on maintenance, rehabilitation, and abandonment decisions. Toward this end, relevant models of individual, group, and market behavior must be developed.

1.2 Terminology

The purpose of this section is to provide a kind of glossary of key terms used in this paper which have no common definition or a different common definition. It is also the purpose of this section to give the reader a feeling for the analytical directions of the paper through an explanation of key terms and without immediately thrusting rigorously analytical material on the reader.

Property is abandoned when it is the intent of the owner to never again claim rights in the property. When the owner no longer meets

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[1] For two studies of rehabilitation costs see D. Gordon Bagby, Housing Rehabilitation Costs, D.C. Heath and Company, 1973 and David Listokin and George Sternlieb, Rehabilitation Versus Redevelopment: Cost-Benefit Analysis, Center for Urban Policy Research, Rutgers University, New Brunswick, N.J., 1973.

property tax and mortgage obligations, and no longer pays utility bills, the stage is set for abandonment.[1] When the owner no longer collects rent or makes any other use of the property it is abandoned. It is a very profound error to confuse vacancy with abandonment. With some important exceptions, the distinction between abandoned and vacant property relates to the potential of the property to produce a stream of positive net income (i.e., money and/or inputed income).[2] Generally, property is abandoned because the owner estimates that it is no longer capable of producing a positive net income. Property is considered to be vacant if it is simply unoccupied. Thus, property may be vacant but not abandoned. The fact that property is vacant does not indicate that it cannot generate positive net income and that the owner does not intend to claim rights in the property. Vacancy without abandonment may be a very rational and efficient response to a thin market (i.e., infrequent sales or rentals of heterogeneous goods).[3] Rather than have price fluctuate wildly in order to minimize vacancies, there may be some optimal vacancy period and vacancy rate which would maximize the present value of the return to the owner. Just as vacancy does not imply abandonment, property may be abandoned but not vacant. Tenants may stay for some time in housing which has become abandoned depending on the weather, the speed with which utilities respond to non-payment of bills by

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[1]There may be significant lags between default on property taxes and abandonment.

[2]Real property may be abandoned when it has positive value as is demonstrated in chapter 5 of this paper.

[3]Vacant buildings may produce external costs, blight, and thus may indicate inefficient market response just as abandoned buildings.

discountinuing service, and the other opportunities the tenants have for obtaining housing services. In addition to tenants staying on in abandoned buildings, winos, junkies, runaways, and other individuals in difficult straits may move into abandoned buildings.

Rehabilitation includes expenditures on alterations and renovation which increase the capacity of a dwelling unit to produce housing services.[1] That is, rehabilitation results in increases in the potential flow of money or inputed income.[2] Maintenance refers to a range of expenditures which are associated with no change in the capacity or a decrease in the capacity of a dwelling unit to produce housing services. Thus, one may conceive of a continuum of possible rates of change in housing services produced by a dwelling unit. Expenditures which are associated with non-positive rates of change will be referred to as maintenance, and expenditures which result in positive rates of change will be referred to as rehabilitation. Thus, maintenance refers to gross investment which replaces housing stock as it is lost to depreciation, while rehabilitation refers to net investment.

In this paper, the term externality refers to what is more precisely called a technological externality. Externality is the general term for costs called external costs or external diseconomies and for benefits called external benefits or external economies. External costs and benefits (i.e., of the technological variety discussed in this paper) flow outside the marketplace and thus are excluded from the

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[1]A distinction is made between alterations and renovation. Renovation really means restoring previously held qualities while alterations may include remodeling to update style or technology.

[2]For other definitions of rehabilitation, see Bagby. p.1.

externality producer's cost-benefit analysis. As a result, the existence of externalities can cause efficiency or allocative efficiency problems in the sense of too many (too few) resources allocated to an activity with external costs (external benefits) as a by-product. A spill-over is an externality which flows across a border of some kind (e.g., a region, a municipality, a state, a nation, or a neighborhood border). A spill-over is called a spill-in if it is flowing into a reference area such as a neighborhood.

A neighborhood is a cluster of residences which is buffered from other neighborhoods and land uses so that the flow of externalities (i.e., spill-ins) is low. Distance, limited-access freeways, heavily traveled streets, large parking lots, and hospital or office building complexes are some of the more important buffers which serve to define neighborhoods. Neighborhood quality refers to the ambient quality of a neighborhood. The beauty, safety, quiet, cleanliness, healthfulness, etc. which permeate a neighborhood make up the quality of the neighborhood. The typical level of maintenance and rehabilitation (i.e., investment in the physical environment) is one important dimension of neighborhood quality. The term neighborhood conservation refers to actions which produce or are conducive to the production of neighborhood quality or which inhibit the destruction of neighborhood quality. A neighborhood effect, which is more precisely termed an intra-neighborhood effect if neighborhoods are perfectly buffered against spill-overs, is simply an externality. Neighborhood blight is a type of neighborhood effect. Blight is an external cost or diseconomy which is caused by the deterioration of a physical feature of a neighborhood.

The term public good refers to a good which cannot be consumed exclusively (e.g., national defense, street lighting, radio broadcasts, neighborhood quality). That is, it is impossible or at least very costly to exclude individuals from consuming a public good. As it is used in this paper, the term public good does not necessarily refer to a pure public good. This means that it is not necessarily impossible to exclude individuals from consuming a public good. There only needs to be a large amount of publicness or non-exclusivity associated with a good for it to be called a public good. A private good is a good which can be consumed exclusively. Food, paintings, and underwear are examples of private goods. However, an outer garment exhibits some publicness, because it is consumed by the wearer and by the individuals who happen to see the wearer. Public goods generate externalities.

A neighborhood club is a voluntary association in a neighborhood which has as its objective the production of public goods having to do with neighborhood quality. Such a club may be organized very formally, but it is more likely to rely on an informal channel of communication and set of social contracts which really amount to understandings of club approved behavior.

2. MICRO-ECONOMIC MODELS OF RESIDENTIAL ABANDONMENT AND REHABILITATION

It is the purpose of this chapter to develop a model which explains behavior regarding maintenance and rehabilitation at the dwelling unit level. The dwelling unit level behavior will then be connected to a model of the aggregate housing market. In this chapter, these models are used to trace out the effects of factors such as changes in income, population, the discount rate, maintenance and rehabilitation costs, and new construction costs on neighborhood conservation (i.e., investment and disinvestment).

2.1 The Dwelling Unit - Firm Model

We will refer to owners of housing as firms whether they are owner-occupiers or landlords. We will assume that these firms are rational and that they exist within a competitive industry (i.e., they are price takers).[1] The objective of the firm is to maximize wealth or the present value of net income which is associated with its investments in housing stock.[2] In the context of the firm model developed in this section, this objective may be restated as maximizing the difference between the periodic rate at which the present value of the residual cash flow is changing and the periodic rate at which investment costs are incurred.[3] Figure 2.1 shows the rate of change in this residual cash flow ($\dot{V}$ hereafter referred to as the value function) and the cost of investment (C) as functions of the firm's rate of gross investment

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[1]For a much more restrictive assumption of competitiveness in the context of a housing market, see E. Olsen, Competitive Theory of the Housing Market, American Economic Review, September 1969, pp. 218-224.

[2]Net income refers to gross income minus all associated costs including operating and investment costs.

[3]Residual cash flow refers to gross income minus operating costs.

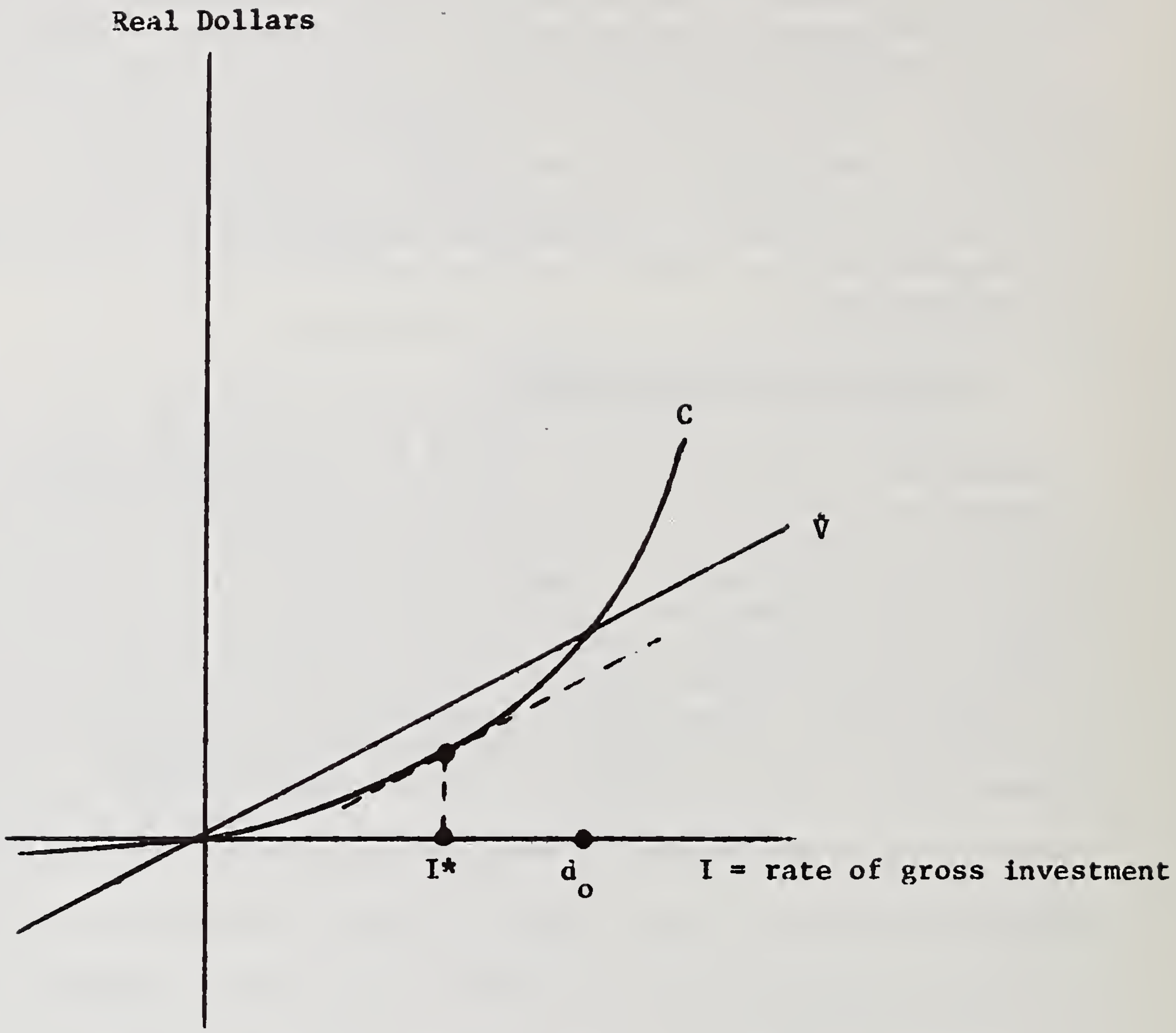

Figure 2.1 The determination of the optimal investment rate.

(I). The optimal rate of investment (I*) maximizes the difference between these two functions.

In order to make the firm's objective consistent with the owner's individual objective of maximizing satisfaction or utility, we assume the existence of a perfect credit market.[1] In a perfect credit market, all lending and borrowing rates are equal. Furthermore, in a perfect credit market, a firm may borrow or lend as little or as much as it desires constrained only by its ability to pay. The assumption of a perfect credit market assures us that we know the discount rate which has the potential to maximize satisfaction (i.e., the discount rate equals the single interest rate assuming that there is no income tax).

2.1.1 A Derivation of the Value Function

In order to derive the value function, it is necessary to reveal the character of the production function, develop an expression for the residual cash flow accruing every period to a constant unit of housing stock, and explore the time path of productive capacity which remains from an initial unit of depreciating housing stock. The firm produces housing services[2] (H) by combining housing stock (h) with other inputs. For simplicity, we will assume that only one other input is used, labor (L). The labor input can be thought of as what is commonly referred to as operation (e.g., as in operation and maintenance). We will assume that the production function which relates housing services to housing stock and labor (i.e., H = F(h,L)) is linearly homogeneous.[3]

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[1]Jack Hirshleifer, "On the Theory of Optimal Investment Decision," Journal of Political Economy, 1958.

[2]Housing is defined as a composite good. For a discussion of the index number problem created by this definition, see Richard F. Muth, Cities and Housing: The Spatial Pattern of Urban Residential Land Use, The University of Chicago Press, Chicago, pp. 18 - 19.

[3]A linearly homogeneous production function has the following property: F(h,L) = F(h,L).

The marginal products of a linearly homogeneous production function are constant along a ray out of the origin. Assuming that the value of the marginal product of labor will be held equal to the wage rate, the firm will desire to stay on a single ray as long as the price of housing services and the wage rate are constant.[1] Under these conditions, housing services and labor are constant proportions of the housing stock.

$$H = \gamma h \text{ and}$$

$$L = \alpha h.$$

The residual cash flow is

$$pH - wL$$

where p and w are the real prices of housing services and labor, respectively. Using the housing services to housing stock and labor to housing stock ratios, γ and α, the periodic residual cash flow per unit of housing stock may be written as

$$p\gamma - w\alpha.$$

In order to determine the value of investment in housing stock, it is necessary to know the quantity of stock which will remain after depreciation has taken its toll. By conventional definition, the gross investment rate (I) equals the rate of depreciation (d) plus the rate of change in the housing stock ($\dot{h}$). That is,

$$I = d + \dot{h}.$$

The depreciation rate is assumed to be a constant percentage of the housing stock. That is,

$$d = \phi h.$$

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[1]The value of the marginal product of labor (VMP_1) equals the price of housing services (p) times the marginal product of labor (MP_1). The marginal product of labor is the first partial derivitive of housing services with respect to labor.

This implies that the housing stock depreciates negative exponentially through time at the rate ϕ. If h_o is a firm's present stock of housing and h_x was its housing stock x periods in the past, we know that

$$h_o = h_x e^{-\phi x}$$

if no maintenance has occured in the intervening periods.

$$d_o = -\frac{dh_o}{dt} = \phi h_x e^{-\phi x}, \text{ therefore}$$

$$d_o = \phi h_o.$$

Thus, we can see that the assumption that the rate of depreciation is unrelated to the time at which the firm acquires the stock and is a constant percentage of the housing stock derives from the assumption that housing stock depreciates negative exponentially.

Depreciation should not be confused with the observed decay and obsolescence of a dwelling unit. This is because maintenance and rehabilitation may counter the effects of depreciation. Maintenance is viewed as adding to the housing stock no more than and possibly less than the amount which is lost due to depreciation. Thus, it is helpful to think of the depreciation rate as being a periodic gross loss of housing stock which can be overcome by positive expenditures on maintenance and rehabilitation.

After t periods, the periodic residual cash flow which accrues to a unit of housing stock added in the present will be

$$[p\gamma - w\alpha]e^{-\phi t}e^{-rt} \text{ or } [p\gamma - w\alpha]e^{-(r+\phi)t}$$

where r is the real discount rate. The present value of the residual cash flow from the present to infinity which accrues to a unit of housing stock added in the present is

$$\int_0^\infty [p\gamma - w\alpha]e^{-(r+\phi)t}dt$$

By multiplying the expression for present value shown directly above[1] by the investment rate, we obtain the rate at which the present value of housing stock is growing due to gross investment. This product is what we have called the value function,

$$\dot{V} = I \int_0^{\infty} [p\gamma - w\alpha]e^{-(r+\phi)t}dt.$$

By solving the integral, the value function may be simplified as follows:

$$\dot{V} = \frac{p\gamma - w\alpha}{r + \phi} I.$$

The value function above assumes an infinite time horizon and expectations of constant real prices (i.e., p and w are expected to remain constant). The expectation of constant prices does not require that the firm expects that its gross receipts per dwelling unit are to be constant but only that the price per unit of housing service and the price per unit of labor are to be constant. Furthermore, the expectation of constant real prices and wages does not mean that real prices and wages do not change . . . . only that such changes are unanticipated. This assumption is often used by appraisers and investment counselors dealing with real property. Finally, the expectation of constant real prices is rational. To expect a path much different (e.g., the chartist view that the future path will be an extension of the past path) would lead to a self-defeating prophesy. This is because speculators with expectations

[1]This expression, the slope of the value function, is the stock price (i.e., the market value of a unit of housing stock). This implicitly assumes that no owner can extract more value from a unit of stock than any other owner. Thus there is no entrepreneurial factor which has been excluded from the production function, and there is no income tax law which decreases this present value with the length of ownership.

of a non-constant price path would enter the market and thereby disrupt the very path they expect.

An alternative version of the firm model which dispenses with the assumption of an infinite time horizon is discussed in an appendix.[1] However, an infinite time horizon is the most natural assumption to make where negative exponential depreciation is assumed. This is because housing stock does not have a finite life under the negative exponential assumption. Finally, negative exponential depreciation and an infinite time horizon are useful in that they result in a very tidy model.

2.1.2 The Cost Function

It is assumed that the cost of investment in housing stock is an increasing, strictly convex function of the rate of investment, and the cost equals zero at zero gross investment. This kind of function characterizes investment models which are called cost-of-adjustment models.[2] The following exponential function satisfies this assumption:[3]

$$C = A(e^{\delta I}-1).$$

This cost function is illustrated in Figure 2.1. To the left of the origin, the cost function falls below the horizontal axis, indicating that there are benefits (i.e., negative costs) associated with negative gross investment.[4] For example, old stained glass windows, lobby furniture,

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[1] See Appendix I.

[2] J. P. Gould, "Adjustment Costs in the Theory of Investment of the Firm," Review of Economic Studies, January 1968. For another approach but one which is incompatible with the value function in our model, see Richard S. Higgins, "Microeconomic Foundations of Investment and Stock-Flow Analysis," Western Economic Journal, March 1972.

[3] See Gould, "Adjustment Costs...," p. 48, for a quadratic cost of investment function.

[4] An alternative assumption would be that any gross investment (i.e., positive or negative) is associated with positive adjustment costs. That is, demolition or dismantling costs exceed gross salvage value.

or even copper pipe and wiring may be sold by the owner. To the right of the origin, the cost function becomes positive and continues to rise at an increasing rate to show the levels of cost associated with maintenance (i.e., replacement) and rehabilitation (i.e., increasing the firm's housing stock).

2.1.3 Firm Behavior

In Figure 2.1, both the value function and the cost function are shown. The optimal investment rate (I*) is where the vertical distance between these two functions is maximized (i.e., where the slope of the cost function equals the slope of the value function). If I* is to the right of d_o, there will be net additions made to the housing stock. This will cause d_o to increase until $d_o = I^*$. If, however, I* is to the left of d_o (i.e., as shown in Figure 2.1), there will be net reductions in the housing stock, and d_o will decline.

The model generates conditions under which the property will be abandoned. If $p\gamma - w\alpha \leq 0$, the value function coincides with the horizontal axis or falls below it sloping negatively so that abandonment (i.e. negative investment equal to the firm's stock) would maximize the difference between the value and cost functions. Otherwise, the property will ultimately be abandoned if the slope of the value function is less than the slope of the cost function at $I = 0$.

2.2 <u>The Aggregate Housing Market Model</u>

In this section, we will separately derive the elements of the model: the total net depreciation curve, the new supply curve, and the total stock demand curve. These elements will then be brought together in a kind of stock-flow analysis. The price of housing services and the quantity of housing stock are explicitly determined in this stock-flow analysis. The stock price of housing and the quantity of housing services are determined implicitly.

The total net depreciation curve is derived from firm behavior . . . each firm having a net depreciation curve. Thus, the total net depreciation curve is what connects the market model to the firm model. Our new supply curve (i.e., new supply as a function of service price) is derived from what might be considered a true new supply curve (i.e., new supply as a function of stock price). The total stock demand curve is derived from the demand of consumers for housing services, from the production function, and from firm behavior.

The short-run service price is shown to be determined by the total stock demand curve and the existing stock. In the long-run, equilibrium service price is found where there is a zero rate of new supply and a zero rate of net depreciation.

2.2.1 The Net Depreciation Curve

By noting the effects of various service prices on net investment behavior, it is possible to provide a link between the firm and the aggregate housing market (i.e., the industry). As the price of housing services rises, the value function becomes steeper.[1] Because of the increased steepness, the optimal gross investment rate increases (i.e., more is spent on maintenance or rehabilitation). The optimal rate of net depreciation (i.e., $d - I^*$ or negative net investment) of a firm's housing stock can also be shown as a function of the service price by allowing service price to change and noting the optimal rate of net depreciation at each service price. At high prices, there will be a desire to increase the stock while at lower prices there will be a desire to allow the stock to decline.

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[1]As p increases, $(p\gamma - w\alpha)$ increases. Note that both γ and α increase as p increases assuming that equality will be maintained between the value of the marginal product of labor and the wage rate.

A schedule showing a firm's net depreciation at each and every price (i.e., a net depreciation curve) is derived in Figure 2.2. Holding the stock constant at h_o and allowing price to vary causes the desired rate of investment to vary. Because the housing stock is held at h_o, the rate of depreciation is constant and equal to d_o. At p_1, I_1^* exceeds d_o, thus the firm will have a negative rate of net depreciation equal to $d_o - I_1^*$. At p_2, the firm is in equilibrium with $d_o = I_2^*$. At p_3, the firm will have a positive rate of net depreciation equal to $d_o - I_3^*$.

A different housing stock will result in a different net depreciation curve. A shift in a firm's net depreciation curve from ND_1 to ND_2 is shown in Figure 2.3. This shift is the result of an increase in the firm's housing stock from h_1 to h_2. The increase in the stock causes the depreciation rate to increase from d_1 to d_2, and this, in turn, results in a rightward shift in the net depreciation curve. A rightward shift in the net depreciation curve means that at each and every price the firm will experience a more rapid rate of net depreciation. It is also possible to show that a decrease in a firm's housing stock will cause the net depreciation curve to shift to the left meaning that there will be a less rapid rate of net depreciation at each and every price.

If the market determined price remains constant, a firm which is out of equilibrium (i.e., which is experiencing positive or negative net depreciation) will move toward equilibrium. Figure 2.4 illustrates this characteristic of the model. Let us begin by assuming that the market price is and remains at p_1. If the firm has housing stock h_1 which is depreciating at the rate d_1 while gross investment is I_o^*, the firm is adding to its housing stock causing its net depreciation curve to shift to the right. Similarly, a firm with h_2 will be decreasing its housing stock causing its net depreciation curve to shift to the left. There is

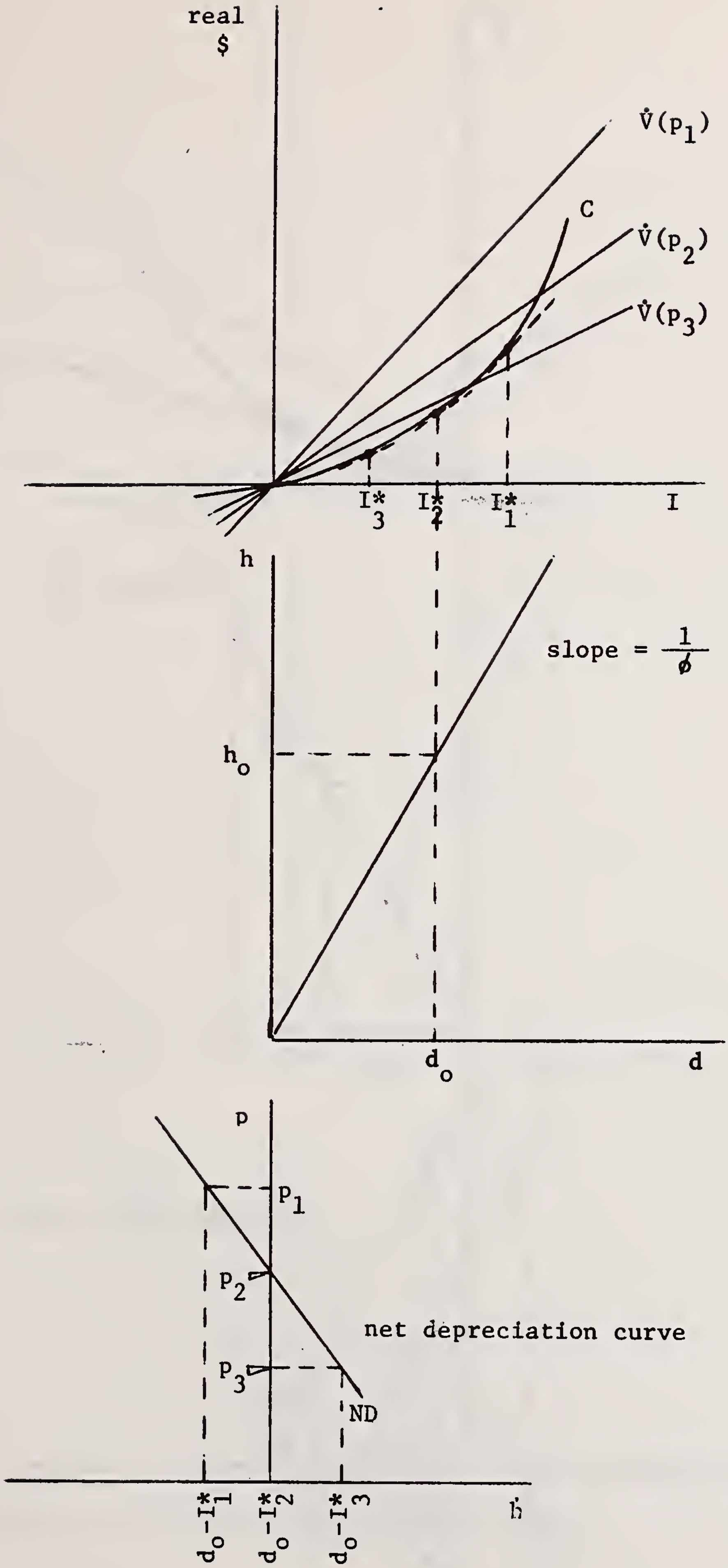

Figure 2.2 The derivation of the net depreciation curve.

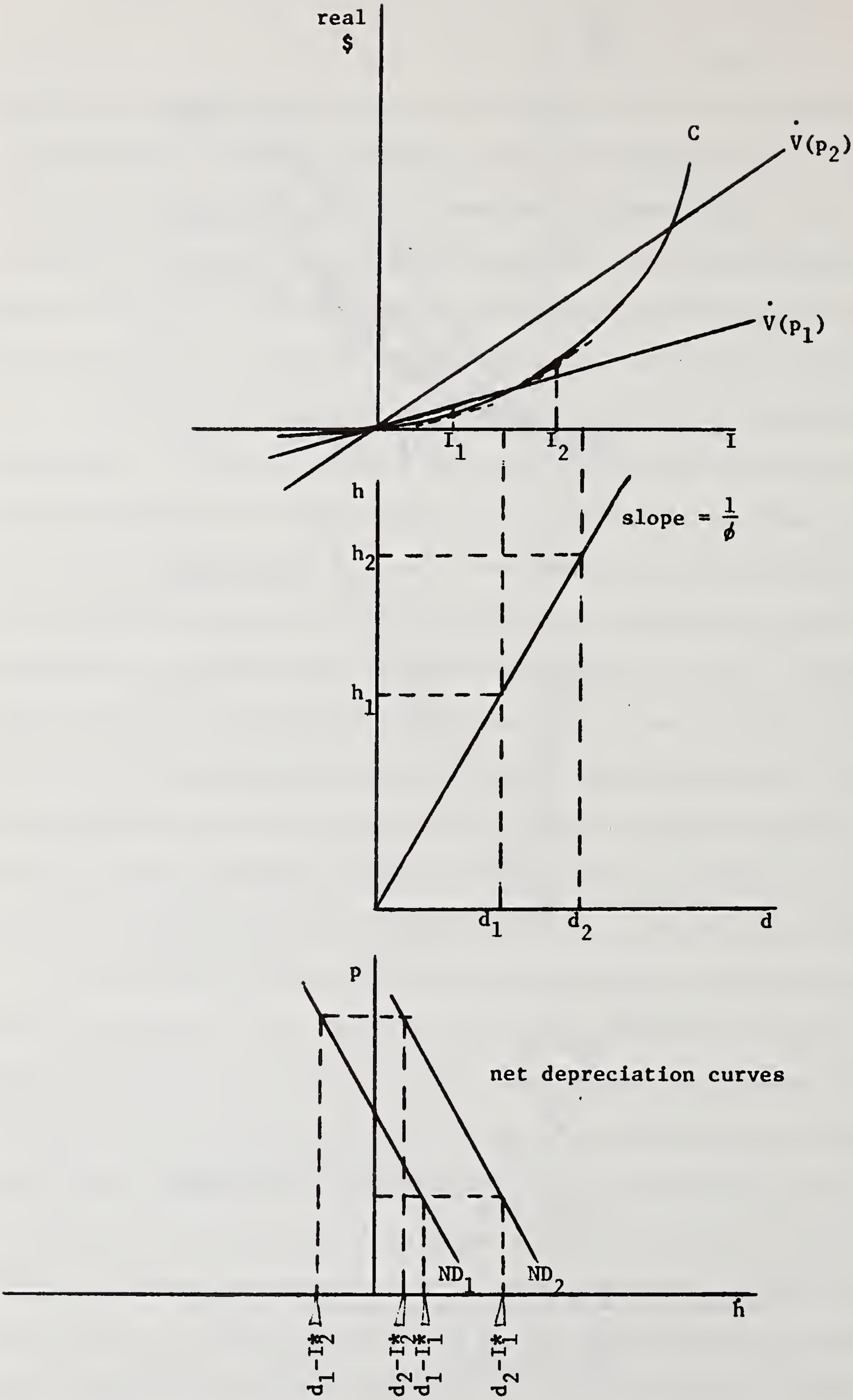

Figure 2.3 The effect of size of the housing stock on net depreciation.

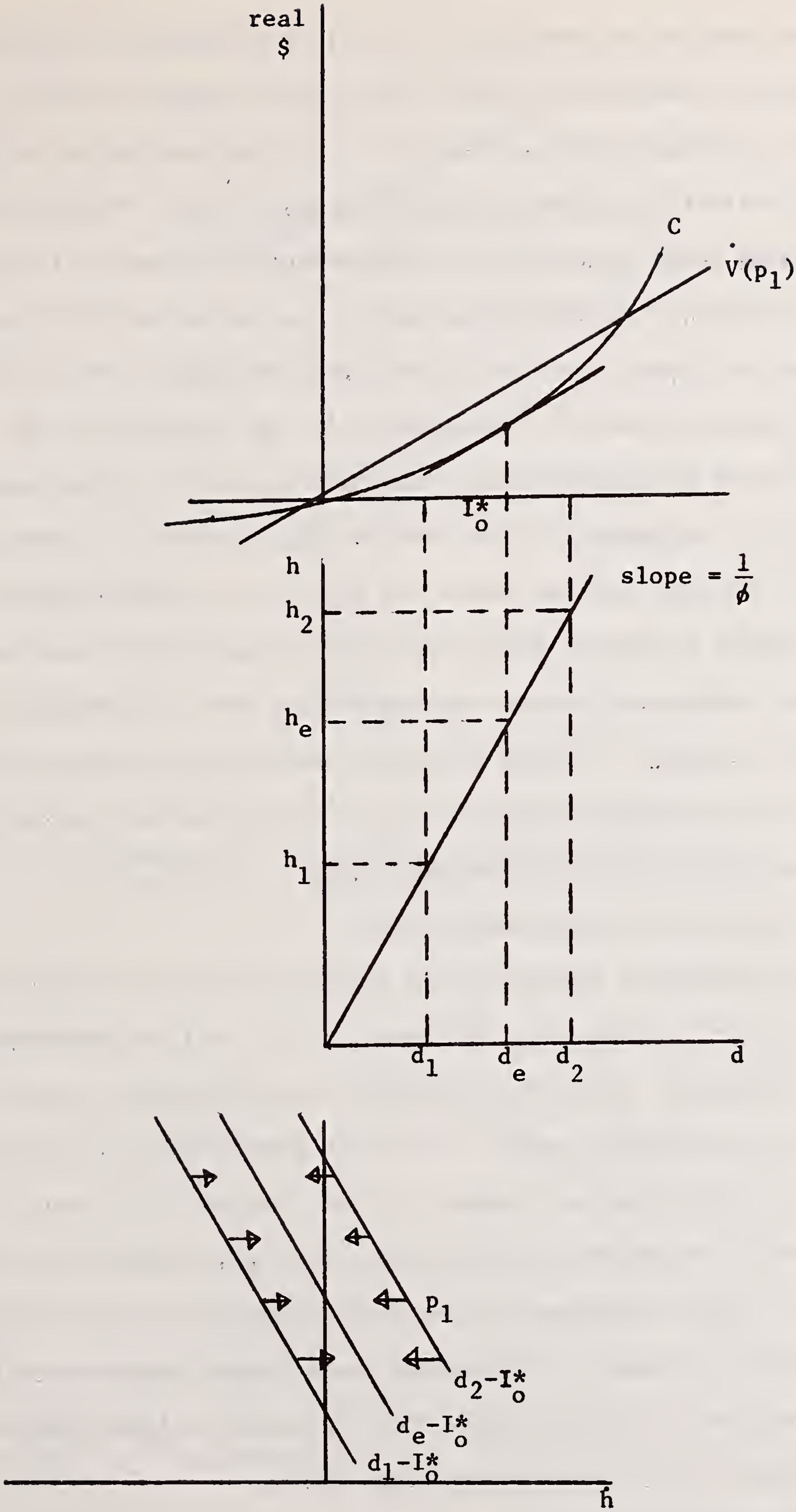

Figure 2.4 Firm movement to equilibrium.

only one equilibrium stock, h_e, for the firm illustrated in Figure 2.4 if the price remains at p_1 and all other things remain constant.

It is assumed that new firms (i.e., new dwelling units) are built so that initially, at least, they are in equilibrium. This means that the housing stock is such that the depreciation rate equals the rate of gross investment. In still other words, the housing stock of a new dwelling unit equals the ratio of the gross investment rate to the unit rate of deterioration and obsolescence, ϕ. The selection of the correct housing stock to be embodied in a new dwelling unit is illustrated in Figure 2.5. Beginning with the point on the cost function where the slope of the cost function equals the slope of the value function, the rate of gross investment and the equilibrium depreciation rate is found. The stock which would produce the equilibrium rate of depreciation can then be determined. In terms of the net depreciation curve, the assumption in this paragraph results in a net depreciation curve which intersects the price axis at the current price.

2.2.2 The Total Net Depreciation Curve

By horizontally summing the net depreciation curves for all firms (e.g., $(d_o-I^*)_1$ and $(d_o-I^*)_2$ in Figure 2.6), a total net depreciation curve is obtained. Thus, the individual firm behavior is finally connected to the aggregate market. Total net depreciation is inversely related to service price. Figure 2.6 shows the total net depreciation curve (TND) crossing the vertical axis. This means that, in the short run (i.e., before adjustment in the stock), high service prices will generate net increases in the housing stock through improvements (i.e., rehabilitation) in existing units. At low service prices, positive net depreciation (i.e., disinvestment) will occur.

2.2.3 The New Supply Curve

The rate at which new housing units are supplied is a function of the stock price of housing. However, we want a new supply curve to show

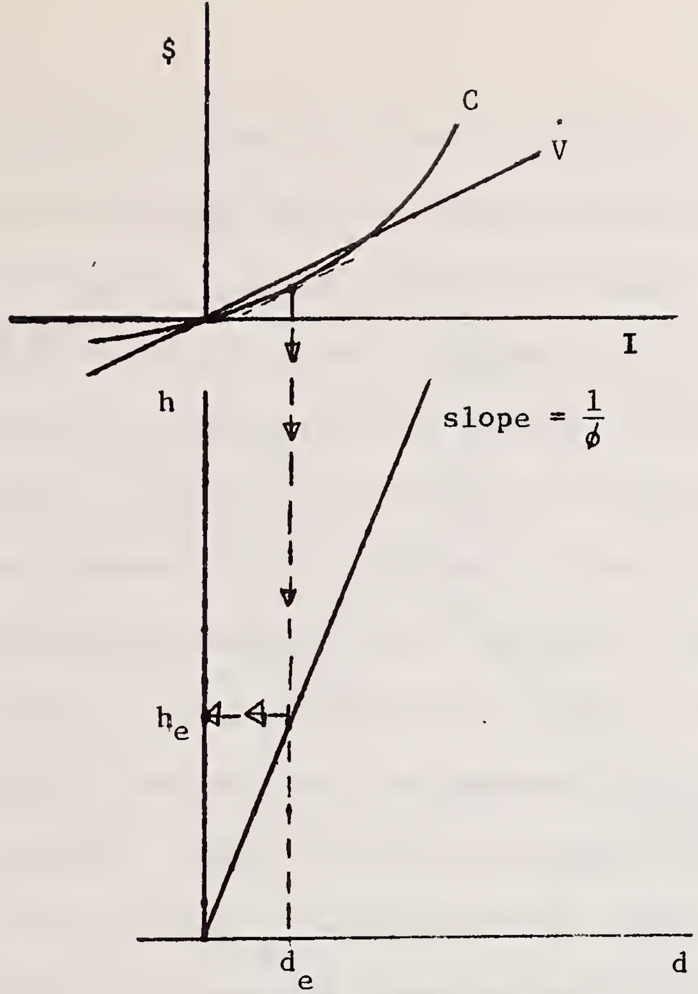

Figure 2.5 Determination of the optimal size housing stock to be embodied in a new dwelling unit.

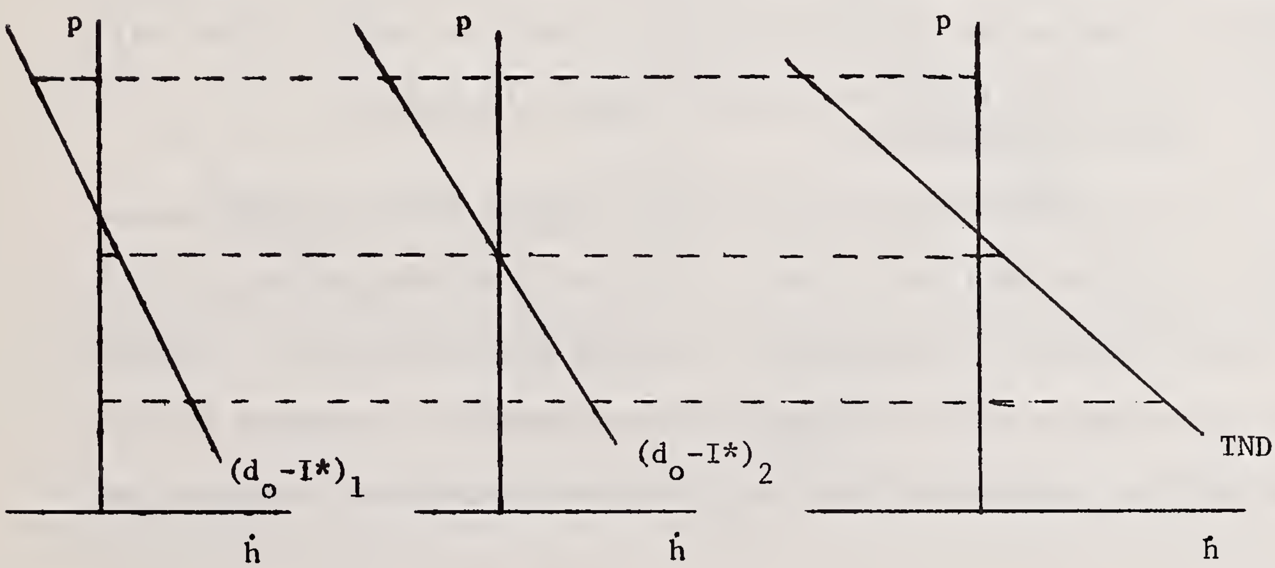

Figure 2.6 Horizontal summation of individual net depreciation curves to determine the total net depreciation curve.

the rate of new supply at each and every service price. The derivation of the new supply curve from the true new supply function is shown in Figure 2.7. Figure 2.7 has four parts. In Part III, new supply is shown as a partial function of the stock price, $\frac{p\gamma - w\alpha}{r + \phi}$. In Part IV, the stock price is related to the residual cash flow ($p\gamma - w\alpha$) which accrues to an owner of a unit of housing stock. The constant of proportionality relating stock price to the residual cash flow per unit is the reciprocal of the sum of the discount rate and the unit rate of depreciation. In Part II, the service price is shown as being positively related to residual cash flow per unit. This relationship assumes that the wage rate (w) is constant. Finally, Part I shows a new supply curve (NS). One may follow the dashed lines to see how a point on NS is derived from the supply function in Part III. If either the discount rate or the unit depreciation rate increases, the constant of proportionality in Part IV decreases and the new supply curve shifts to the left. The new supply curve may also shift as a result of a change in the wage rate. If w were to increase, the relationship between service price and residual cash flow per unit in Part II would shift to the left causing the new supply curve in Part I to shift to the left.

2.2.4 The Derivation of Total Stock Demand and Service Price Determination

The curve which we call total stock demand is not a stock demand curve in the conventional sense. It is not a schedule of the quantity of stock demanded by producers at each and every stock price. Rather, it is a schedule derived in part from the demand of consumers for housing services and in part from what we know of producers' behavior and

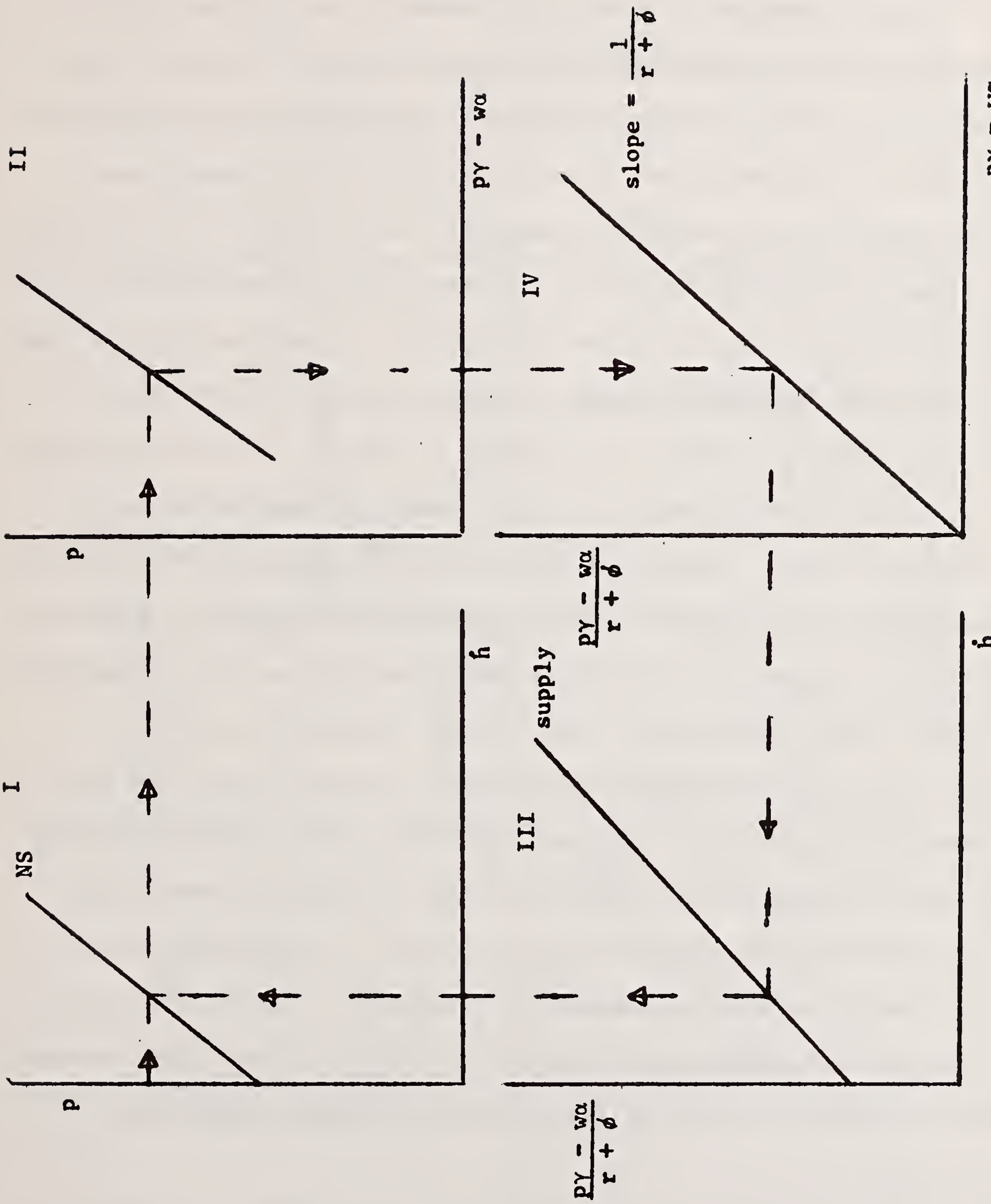

Figure 2.7 The derivation of the new supply curve.

the production function.[1] Our total stock demand curve shows the quantity of housing stock necessary to meet the quantity of services demanded by consumers at each and every service price.

Service demand is a function of service price, and the ratio of housing services to housing stock (γ) is a function of service price. Dividing the first of these functions by the second results in housing stock as a function of service price, the total stock demand curve. This curve may also be derived graphically as in Figure 2.8. Two parts of Figure 2.8, Parts III and IV, are simply used to turn corners (i.e., the rays out of the origins have slopes equal to unity so that the same variable may be measured along both axes). In Part II, the demand for housing services is shown. The purpose of Part VI is to set the slope of the ray out of the origin in Part V which relates housing stock to housing services. The relationship in Part VI arises because the housing service to housing stock ratio increases with increases in service price if the wage rate is held constant. The constant, Ψ, is needed to produce scale large enough in Part V to be graphically clear.

The total stock demand curve in Part I is derived from the service demand curve in Part II. The derivation of a point on the total stock demand curve proceeds by first arbitrarily selecting a service price (p_1); secondly, the slope of the ray in Part V is determined; thirdly, the quantity of services demanded is determined; finally, the housing stock needed to produce this quantity of housing service is determined. This derivation is shown on Figure 2.8 by the light dashed lines.

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[1] Throughout this section, we very conveniently assume that all firms have the same production function and face the same wage rate. It should be remembered that the production function is linear homogeneous and that firms will equate the value of the marginal product of labor to the wage rate. If the wage rate is constant and the price of housing services increases, the ratio of housing services to housing stock will be increased.

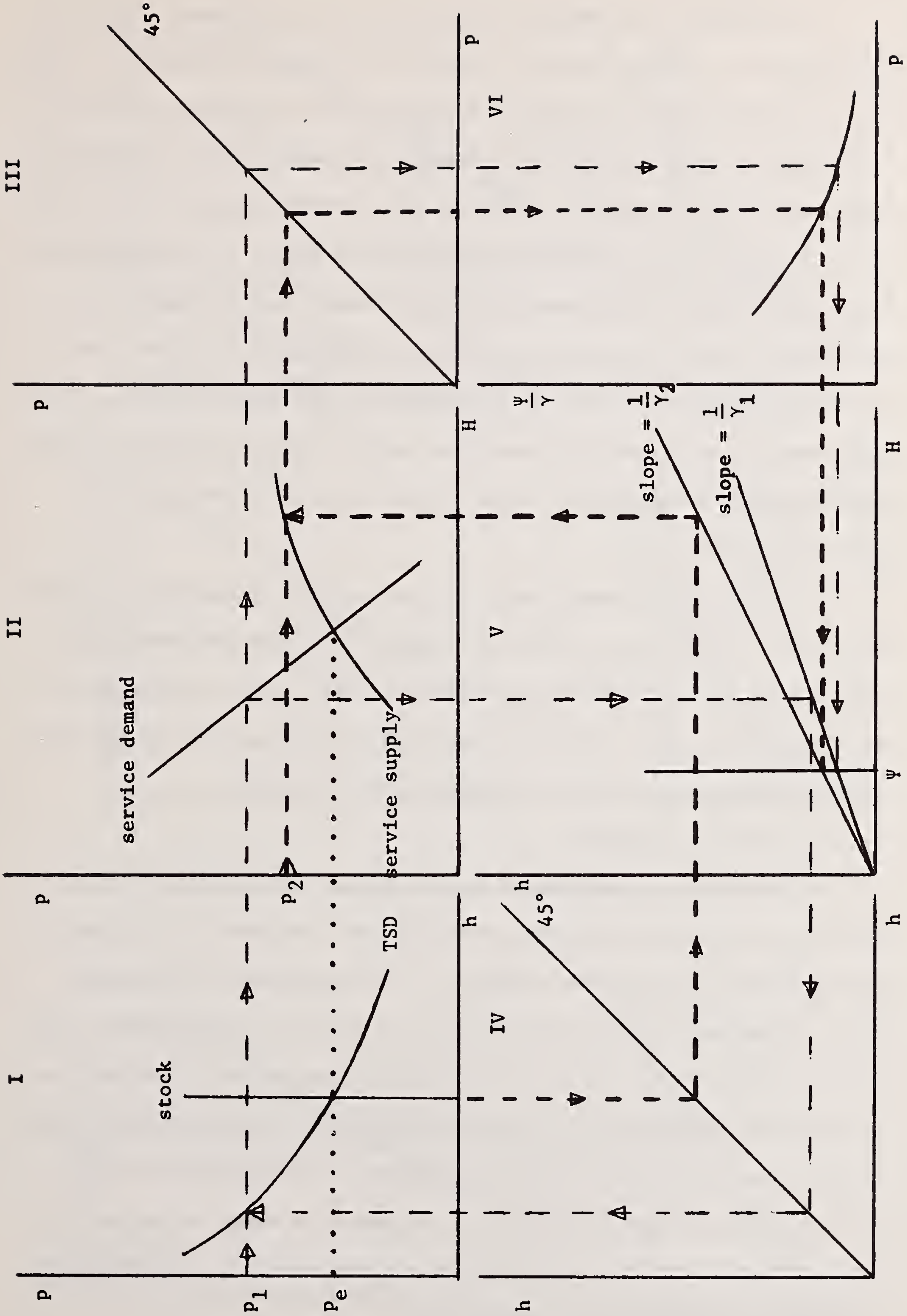

Figure 2.8 The derivation of the total stock demand curve.

In addition to the derivation of the total stock demand curve, the derivation of a service supply curve is illustrated in Figure 2.8. Otherwise, we could obtain the service supply curve by multiplying the ratio of housing services to stock as a function of service price by the housing stock. But graphically, a point on the service supply curve in Part II is derived from the existing stock shown in Part I. This derivation can be understood by following the dark, dashed lines in Figure 2.8. The service price can now be seen as being determined in either Part I by the intersection of total stock demand and the stock or in Part II by the intersection of service demand and service supply. Note the dotted line extending between Parts I and II indicating the same short-run equilibrium price, p_e.

The total stock demand curve, like the service demand curve, would be expected to shift as a result of changes in income and demographic characteristics. In addition, if the wage rate changes, the relationship between Ψ/γ and p in Part VI would shift causing both the service supply curve and the total stock demand curve to shift.

2.2.5 Stock-Flow Analysis

By bringing the total stock demand curve, the total net depreciation curve, and the new supply curve together, the model of the aggregate housing market is made complete. In the short-run, the service price is determined by the intersection of the total stock demand curve and the current stock. The rate of change in the stock is the horizontal distance between the new supply curve and the total net depreciation curve. Figure 2.9 shows the housing market in equilibrium with the service price, p_e, and the stock, h_e, Figure 2.10 shows the market out of equilibrium with the service price, p_1, the stock, h_1, and the positive rate of increase in the stock, ab.

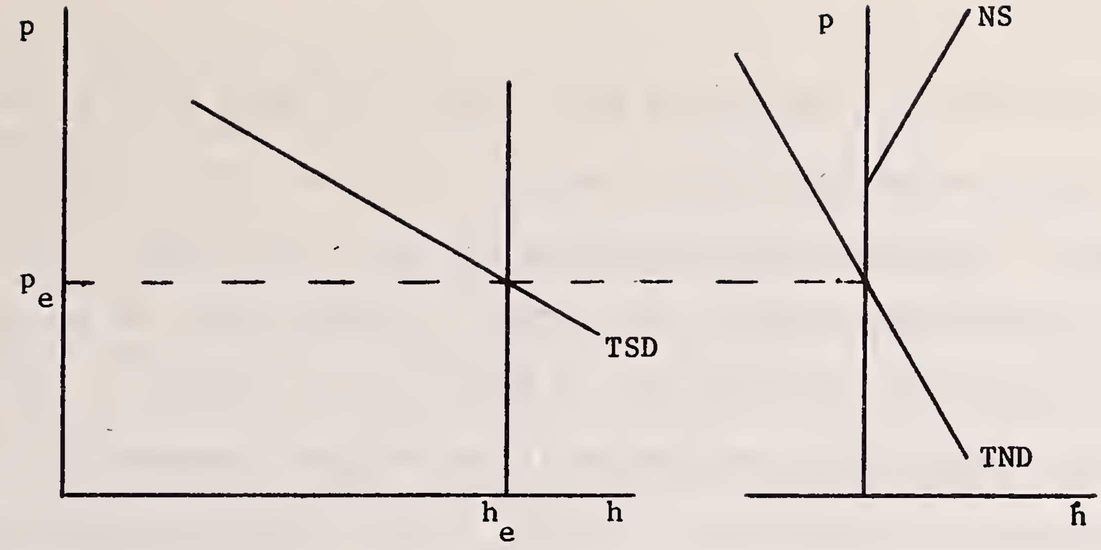

Figure 2.9 Stock-flow equilibrium in the housing market.

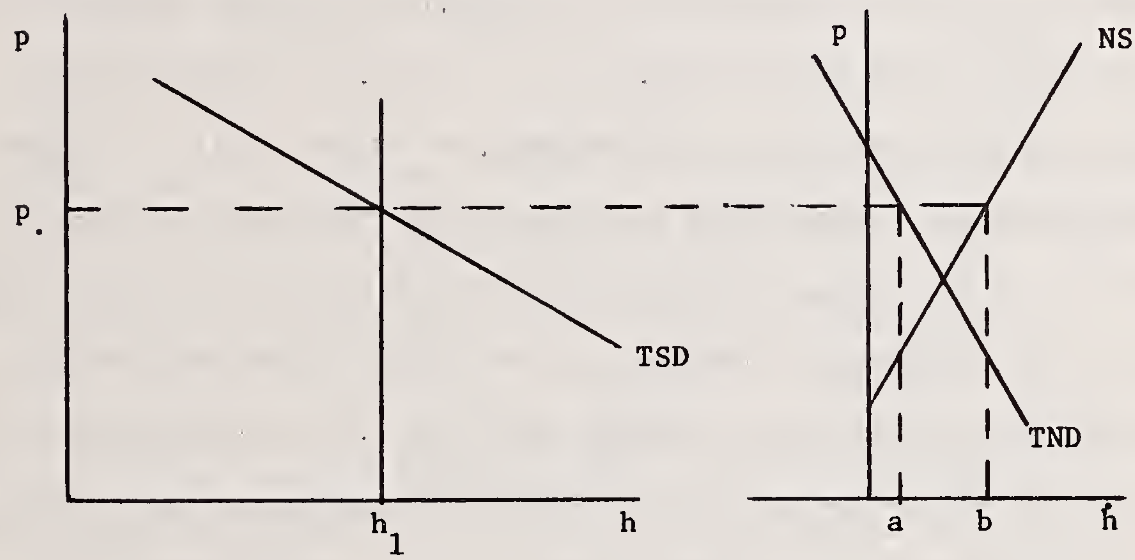

Figure 2.10 Disequilibrium in the housing market.

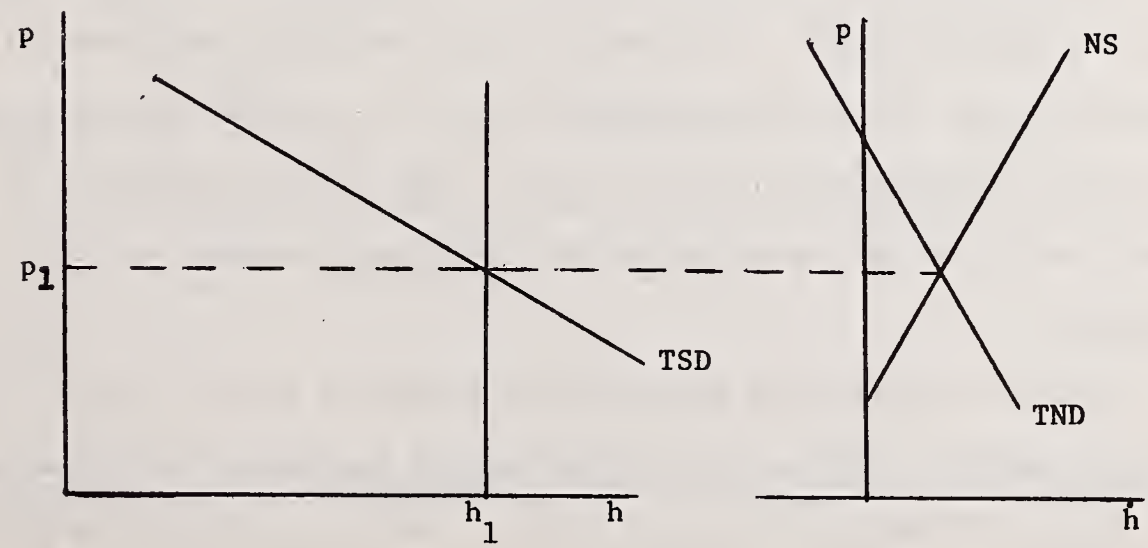

Figure 2.11 Shifts in the TND curve when the rate of total net depreciation equals the rate of new supply.

Equilibrium in the housing market means that there is no tendency for either the service price or the stock to change. This requires both the rate of total net depreciation and the rate of new supply to equal zero at the current service price. Thus, in equilibrium, TND and NS may have the same vertical intercept, or NS may have a higher one. However, the market cannot be in equilibrium if the vertical intercept of NS is lower than that of TND even if the rate of total net depreciation equals the rate of new supply at the current service price.

A question may arise in the mind of the reader as to why, if price happens to be at the intersection of TND and NS and that intersection is to the right of the vertical axis (i.e., it is not on the vertical axis), the market is not in equilibrium (see Figure 2.11). At first blush, there may appear to be no tendency for the stock and thus the price to change, because the rate of total net depreciation just equals the rate of new supply. However, this will not be the case for long. TND will shift to the left, because new firms are in equilibrium (i.e., they do not add to the rate of total net depreciation at the current price) while old firms are equilibrating (i.e., their rates of net depreciation are decreasing). This means that the stock of housing which is embodied in existing dwelling units declines causing the TND curve to shift leftward. This shift causes the rate of new supply to exceed the rate of total net depreciation at the current service price. The stock increases and the price falls. This process continues, at least, until the TND curve and the NS curve have the same vertical intercept.

Prior to applying and extending the models to several issues, it would be useful to illustrate the workings of the models by following the impacts of changes of certain factors. For this purpose, we will examine the impacts of changing population or income, the discount rate, maintenance and rehabilitation costs, and construction costs.

Suppose that there is a net imigration or an increase in income which causes the total stock demand curve to shift to the right. This is shown in Figure 2.12 as a shift from TSD_1 to TSD_2. At the new short-run price, p_2, there is a substantial horizontal distance between NS and TND which indicates that the stock would be increasing. Increases in the stock would cause the price to decline. At the same time, the total net depreciation curve would be moving to the right (see Figure 2.4). The shifting TND curve and falling price will trace out a path of actual rates of total net depreciation shown by the dotted line in Figure 2.12.[1] After the price reaches a point where it intersects the TND curve (TND_2) on the vertical axis, further reductions in price result in leftward shifts in the TND curve (again see Figure 2.4). Finally, the TND curve returns to its initial vertical intercept (TND_3), and the price reaches its initial level, p_1. However, the stock would have increased from h_1 to h_2 as a result of the shift in total stock demand. If the intercept of the new supply curve had been higher, the final price would be higher than p_1, and the final stock would be less than h_2.

The effects of a decrease in total stock demand are followed in Figure 2.13. The price is initially lowered to p_2. The stock then begins to decline and the price rise as TND begins to shift to the left. A new equilibrium is reached where price, p_3, is below p_1 but above p_2, stock, h_2, is below h_1, and the rate of total net depreciation is zero (see TND_2).

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[1]This is a graphical convention we shall use throughout the remainder of this chapter.

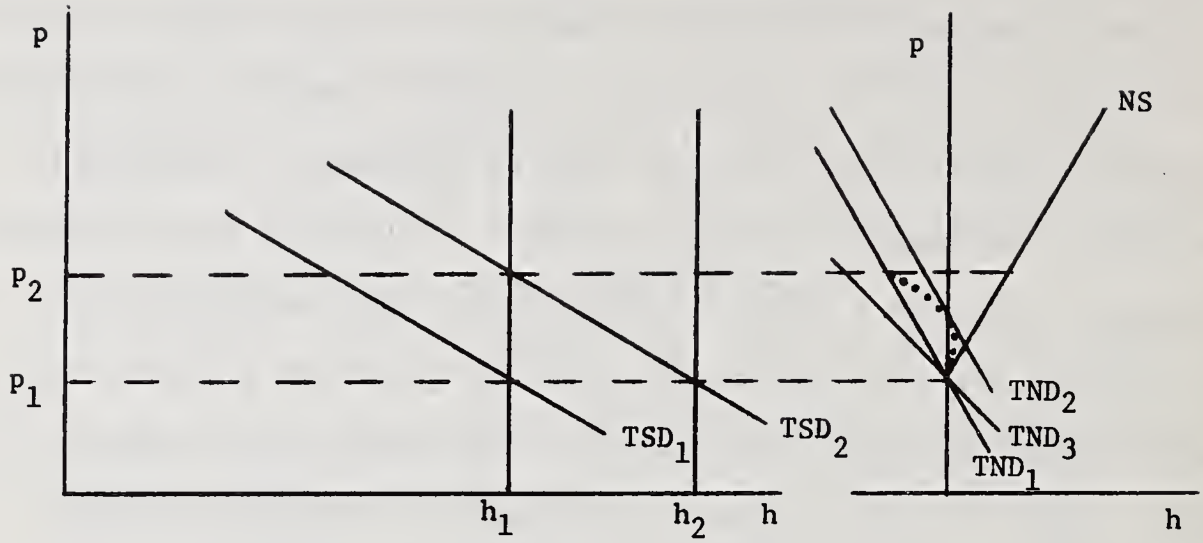

Figure 2.12 The effect of an increase in total stock demand on the total net depreciation curve.

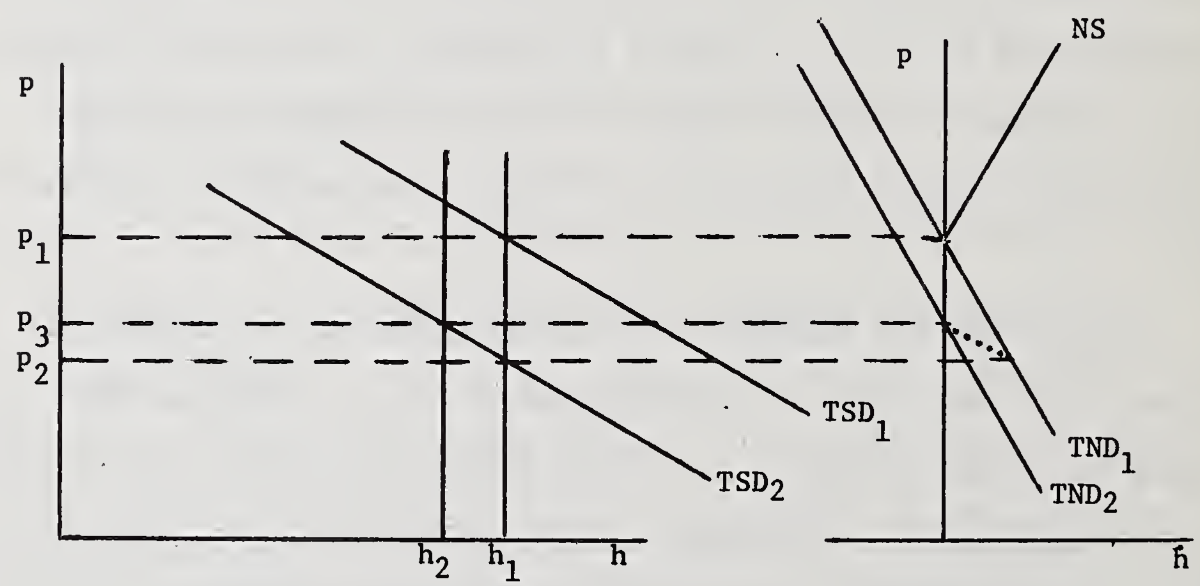

Figure 2.13 The effect of a decrease in total stock demand on the total net depreciation curve.

An increase in the discount rate would initially have two effects. Both the total net depreciation curve and the new supply curve would shift upward (i.e., TND would shift to the right from TND_1 to TND_2 and NS would shift to the left from NS_1 to NS_2) as shown in Figures 2.14 and 2.15. TND would then begin to shift back to the left, stock would begin to decline, and price would begin to rise. Figure 2.14 shows the new supply curve as being too high to become relevant. The new equilibrium price, p_2, and stock, h_2, are approached directly. In Figure 2.15, the new supply curve does become involved in the analysis. The price reaches a maximum, p_2, and the stock reaches a minimum, h_2, in Figure 2.15. From that point, price begins to decline and stock increases as TND continues its leftward movement until TND_3 is reached. The result of the increased discount rate is higher price, p_3, than p_1 and a lower stock, h_3, than h_1.

A decrease in the discount rate might result in a situation shown in Figure 2.16. We know that TND would shift leftward and NS would shift to the right. At the first price, p_1, the horizontal distance between TND_2 and NS_2 is large. This indicates that the stock would begin increasing rapidly and the price would fall rapidly. Meanwhile, TND would be shifting to the right. Whether the actual path of the rate of total net depreciation would like the dark, dashed line or the dotted line in Figure 2.16 is uncertain. Nevertheless, the decline in the discount rate would result in a lower price, p_2, and a higher stock, h_2.

Suppose that the cost of investment function becomes steeper (i.e., the real cost of maintenance and rehabilitation increases). The total net depreciation curve initially shifts to the right as from TND_1 to TND_2 in Figures 2.17 and 2.18. The stock begins to decline as the total net depreciation curve begins its equilibrating leftward movement. The price begins to rise. In Figure 2.17, the new supply curve is very

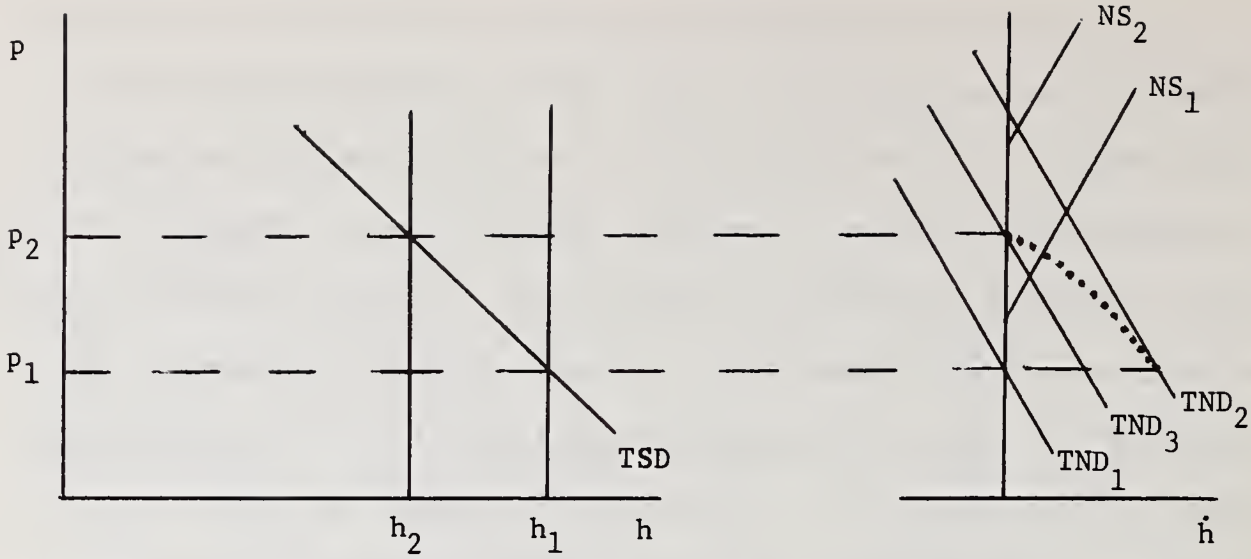

Figure 2.14 The effect of an increase in the discount rate when the new supply shift is greater than the shift in total net depreciation.

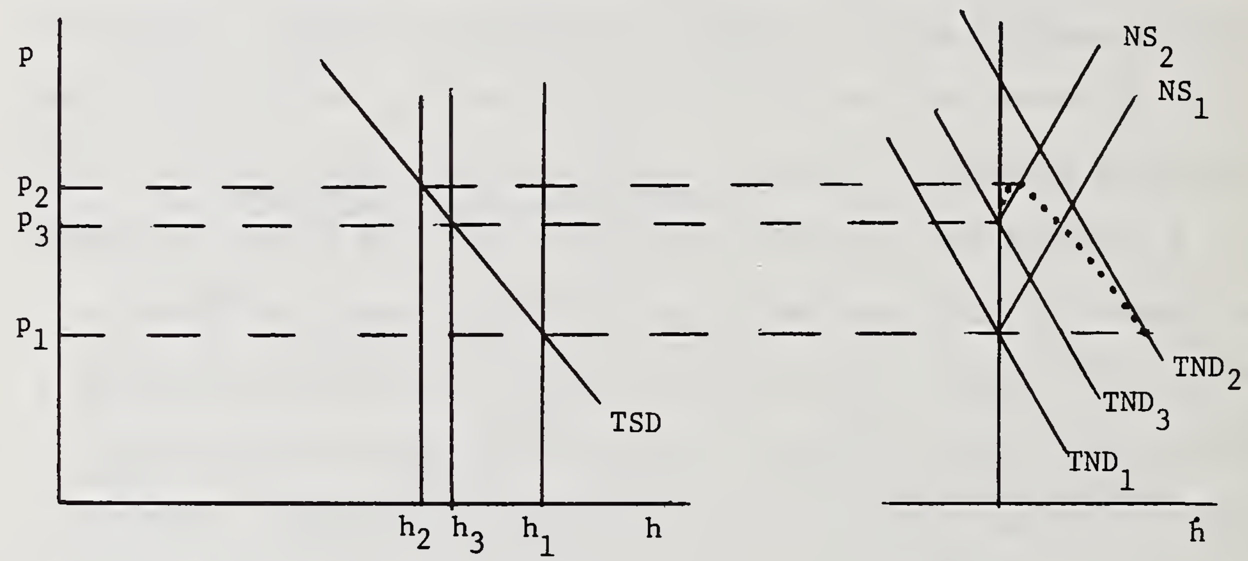

Figure 2.15 The effect of an increase in discount rate when the new supply shift is less than the shift in total net depreciation.

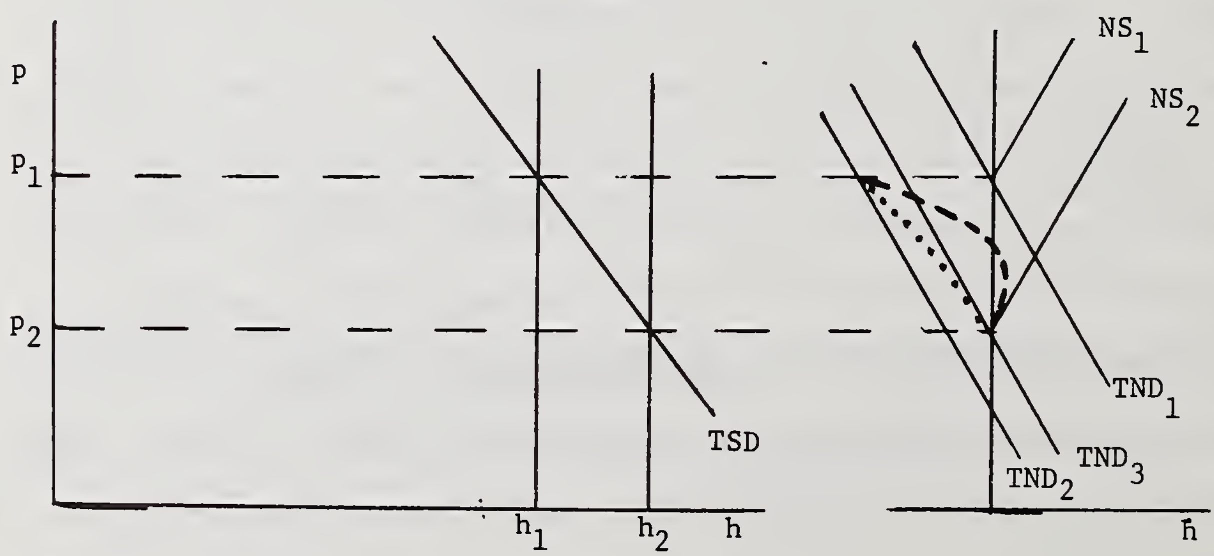

Figure 2.16 The impact of a decrease in the discount rate on total net depreciation and new supply.

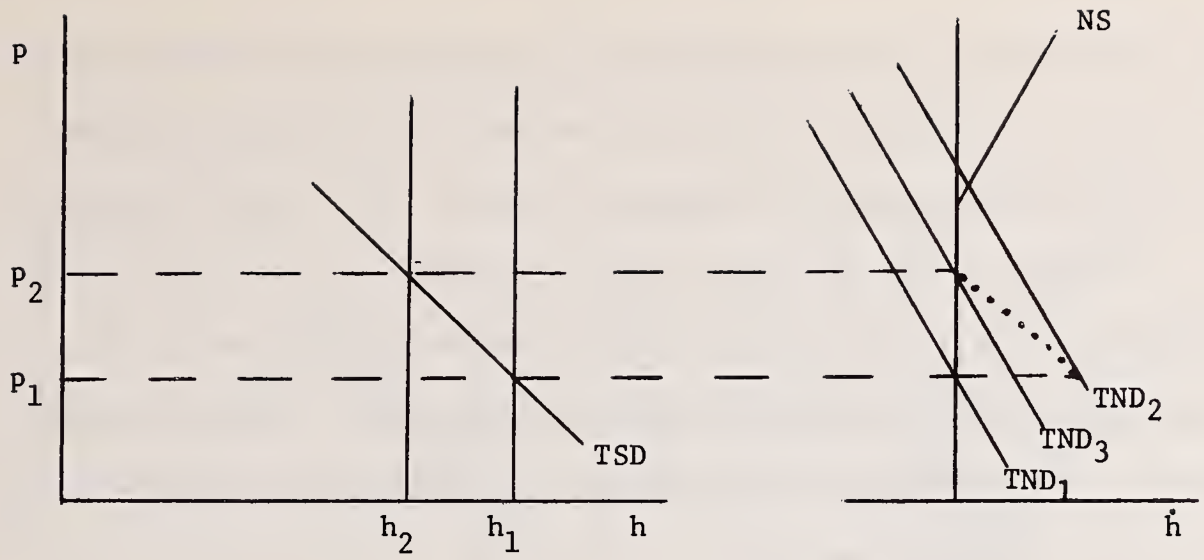

Figure 2.17 The effect of an increase in the cost of investment when new supply is high.

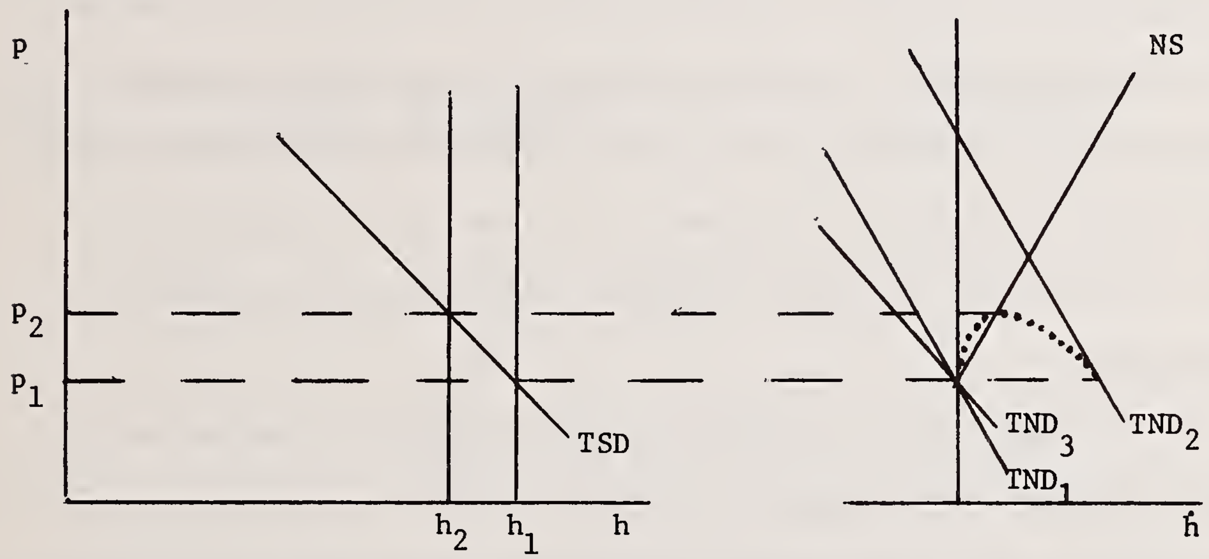

Figure 2.18 The effect of an increase in the cost of investment when new construction can occur.

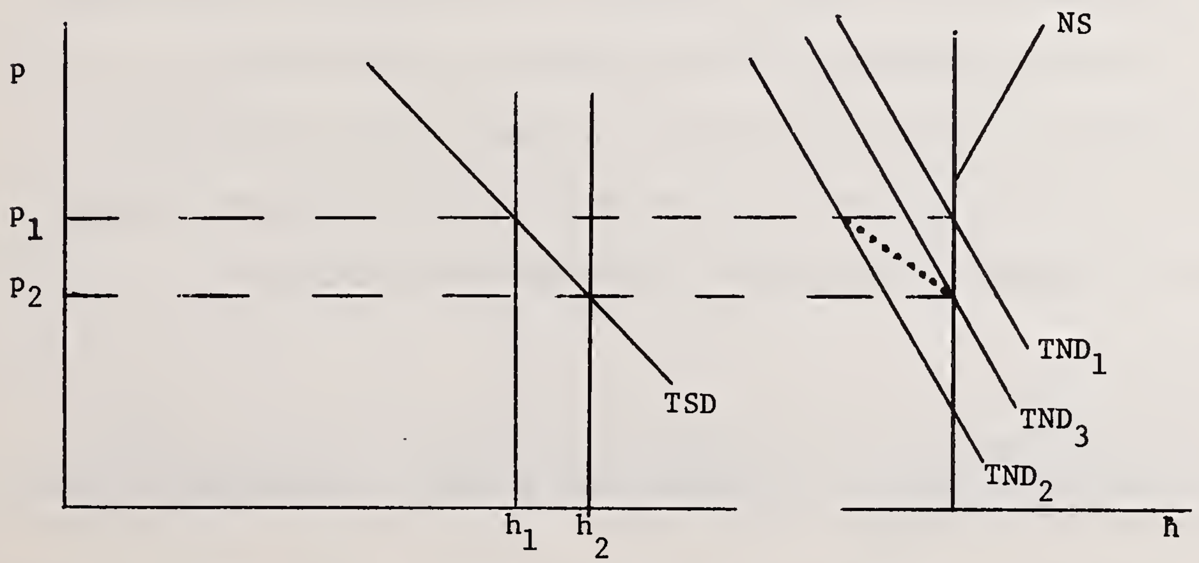

Figure 2.19 The impact of the flattening of the cost of investment function on total net depreciation.

high. As a result, a new equilibrium is reached without there being any new construction. Thus, the shift in the cost function increases the price to p_2 and decreases the aggregate stock to h_2 as shown in Figure 2.17. In Figure 2.18, the price reaches a maximum at p_2 and the stock reaches a minimum at h_2. Then the price declines and the stock increases until they have reached their initial levels. Thus, the aggregate stock is unaffected, but the stock per dwelling unit is reduced by the shift in the cost function.[1]

A flattening of the cost of investment function would cause the total net depreciation curve to shift to the left. This is illustrated in Figure 2.19 by a shift from TND_1 to TND_2. The total net depreciation curve would then begin to shift to the right as the stock increases. Increased stock causes the price to fall. The new equilibrium would be where TND_3 crosses the vertical axis. The new equilibrium price is lower and the stock is higher than their initial levels, p_1 and h_1 respectively.

If the costs of new construction were to decrease causing the new supply curve to shift downward (see Figure 2.20), initially there would be net additions to the housing stock due to new construction. This would, in turn, cause the price to begin falling. The falling price would then result in a leftward movement in the total net depreciation curve. The new equilibrium would be found at a lower price, p_2, with a larger stock, h_2, and with the total net depreciation curve, TND_2, to the left of the initial one. If construction costs increase with the market in equilibrium, the market will remain in equilibrium.

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[1] In equilibrium, all firms have the same stock unless an assumption is introduced such as a dwelling unit's cost of investment function becomes steeper as it ages.

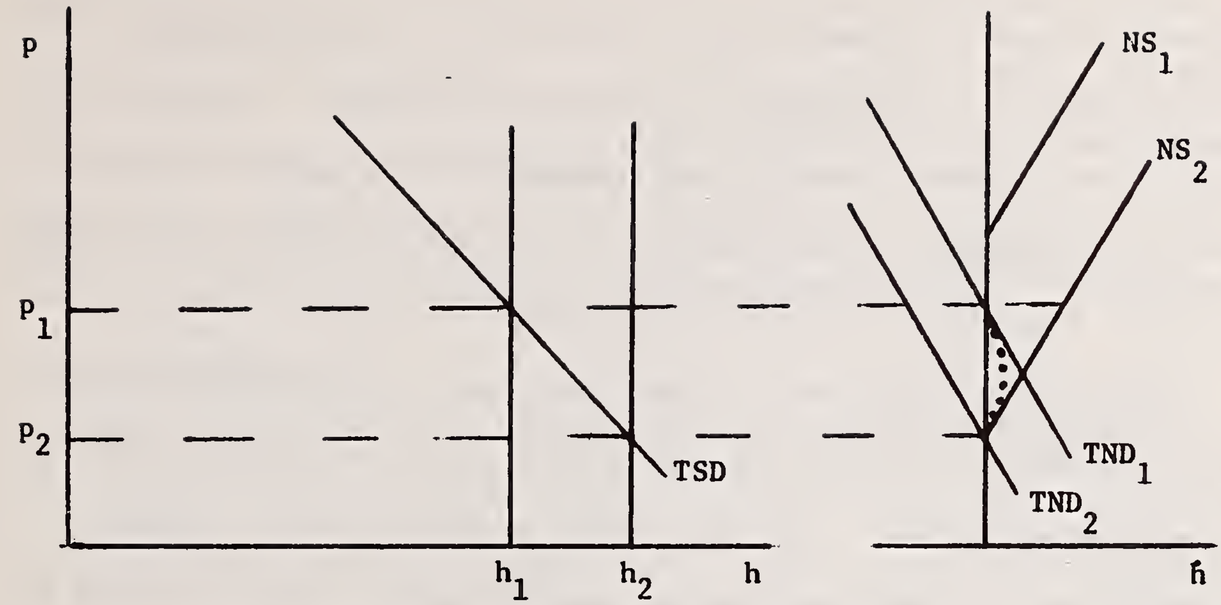

Figure 2.20 The effect of decreases in the cost of construction on the housing market.

3. APPLICATIONS AND EXTENSIONS

It is the purpose of this chapter to apply the model developed in Section 2 to several issues which are relevant to the maintenance, rehabilitation, and abandonment of residential property. In order to analyze some of these issues in the framework of the models we have previously developed, it is necessary to extend the models so that they may better describe more specific situations.

This chapter begins with a simple application requiring no extension of the model, and procedes through applications requiring more and more complex extensions. The first issue dealt with is the impact of low growth and no growth policies on rehabilitation. Next, the role of technological change and filtering down is examined. Rent control, which is generally believed to play a large role in creating New York's abandonment problem, is the third issue analyzed. The fourth issue dealt with is the impact of the property tax on investment decisions. The fifth and final issue in this section is externalities and efficiency. This last issue leads us into the fourth chapter.

3.1 Low Growth and No Growth Policies

Low growth and no growth policies are most likely to be implemented against a backdrop of increasing demand pressure. Generally, low growth policies are based on making new construction more costly. One way to accomplish this is to increase the minimum lot size from, let's say, a quarter of an acre to one or even five acres. In terms of the aggregate housing market model, this would result in a decrease in new supply (i.e., a shift to the left). A no growth policy generally means stopping all new construction. No growth may be accomplished by no longer issuing building permits or no longer allowing sewer hookups while disallowing septic tanks. In terms of the aggregate housing model, a no growth policy means that there is no new supply curve.

Figure 3.1 illustrates the impact of a low growth policy which occurs in the context of an increase in total stock demand. The new equilibrium price, p_3, would be higher than would result from the same shift in demand in the absence of a low growth policy. While the stock would increase over the pre-demand shift level with part of the increase coming from new construction, the new equilibrium stock would be less than that which would result from the same demand shift in the absence of a low growth policy.

Figure 3.2 illustrates the impact of a no growth policy which is implemented in response to an increase in total stock demand. Like the low growth situation, the no growth policy would result in a higher price and a lower stock than would be generated by no policy at all. Of course, none of the increase in stock comes from new housing in the no growth policy case.

3.2 Technological Change and Filtering-Down

Thompson, in his book A Preface to Urban Economics, says that "one of the more intriguing possibilities in the fight against urban blight is the promotion of greater research and development in housing technology." While we agree that it is an intriguing possibility, we disagree that it is a weapon to be used in the fight against blight. In fact, we suggest that more rapid technological change would increase blight by accelerating the filtering-down process.

The simplest definition of filtering-down is a decline in the real price of a house. Definitions usually indicate that as a house filters down it becomes more affordable by lower income households. Although houses typically do filter down through their life cycle, it is possible for houses to filter up (i.e., increase in real price). Where the term filtering-down is used to descibe the succession of ever lower income

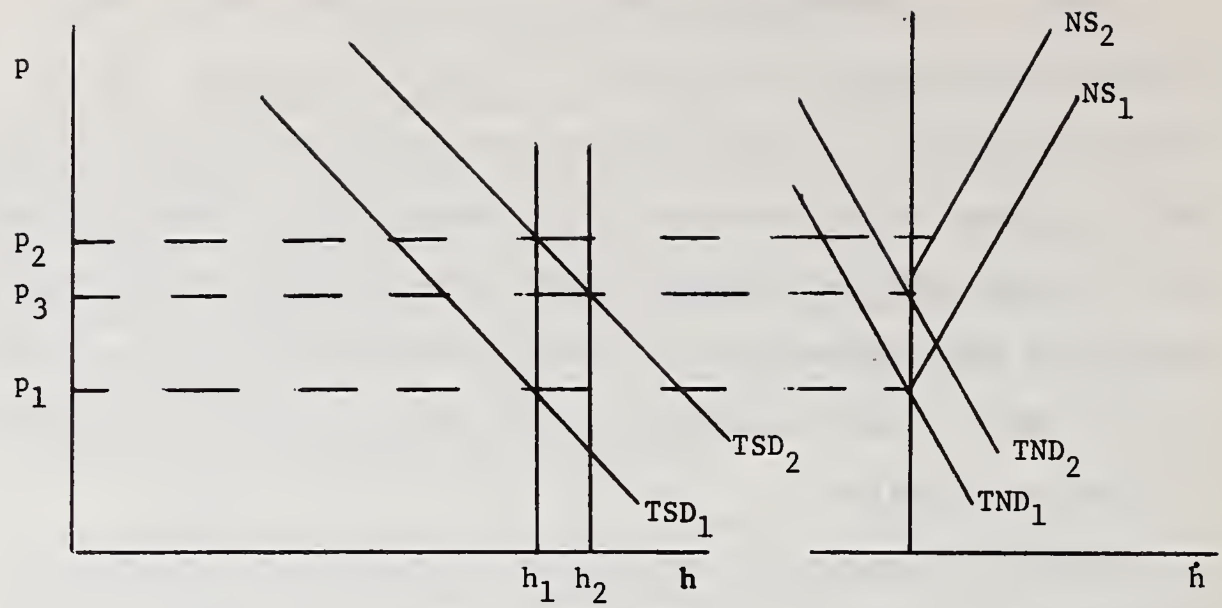

Figure 3.1 The impact of a low growth policy on the housing market.

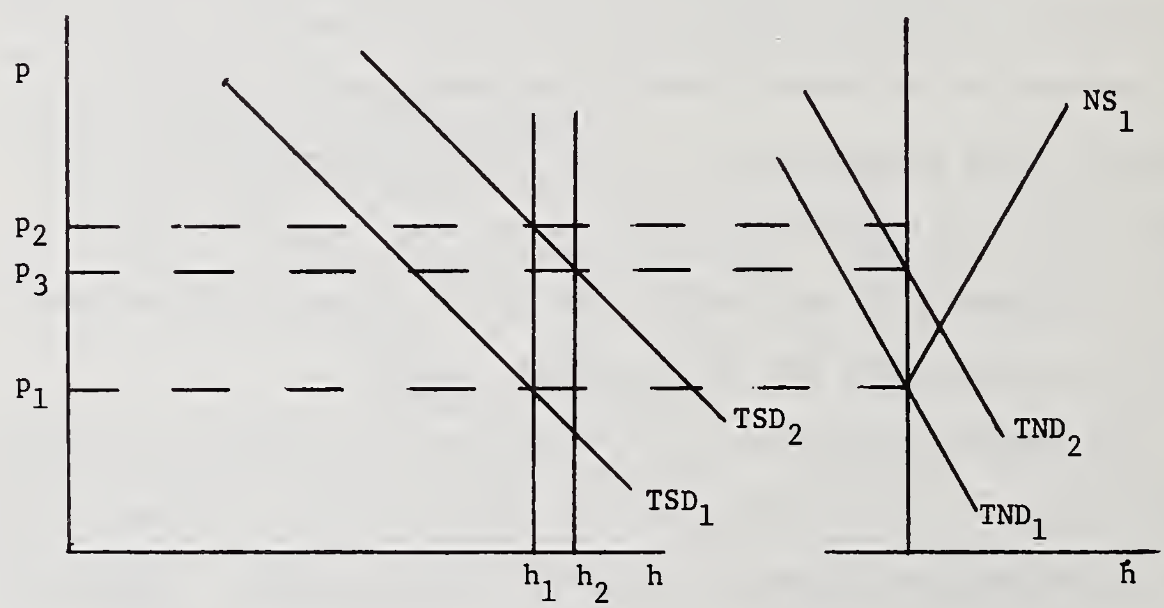

Figure 3.2 The impact of a no growth policy on the housing market.

households occupying a house, it is useful to define filtering-down as a decline in the relative price of a house.

Thompson uses the market for automobiles to illustrate how an increased rate of technological change works to accelerate filtering-down.

> "Rapid product improvement has made new cars become out of date very quickly, thereby inducing higher-income households to trade in their new car on a newer one frequently. This has put a large number of only slightly used secondhand cars in the hands of lower-income families, cars which they never could have afforded without the value deflating force of rapid technological and style changes."

It may be useful to continue the automobile analogy to explain that the rapid filtering-down in the automobile market has led to rapid rates of physical deterioration and abandonment. Thus, if more rapid filtering-down existed in the housing market, we would expect that blighted and abandoned neighborhoods would be more extensive than in the current Volkswagen-like (i.e., slow change) housing market.[1]

In the context of the aggregate housing market model, a technological change might be interpreted as causing a downward shift in the new supply curve (i.e., if the technological change allowed the same product to be produced at lower cost). The new equilibrium would be at a lower price and a higher stock. The TND curve would have shifted leftward as a result of firms having experienced positive net depreciation. All this is illustrated in Figure 3.3 below. Filtering down occurs as the

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[1]Whether the poor are advantaged by a policy of accelerating the rate of filtering-down is a question well beyond the scope of this paper. Thompson feels that "product improvement ... would contribute to an upgrading of housing all the way down the line, not just among the higher-income buyers of the new and improved units." See Thompson, p. 302. Lowry, on the other hand, feels that this may not be the result. See Ira S. Lowry, "Filtering and Housing Standards: A Conceptual Analysis," Land Economics, November 1960, pp. 362-370.

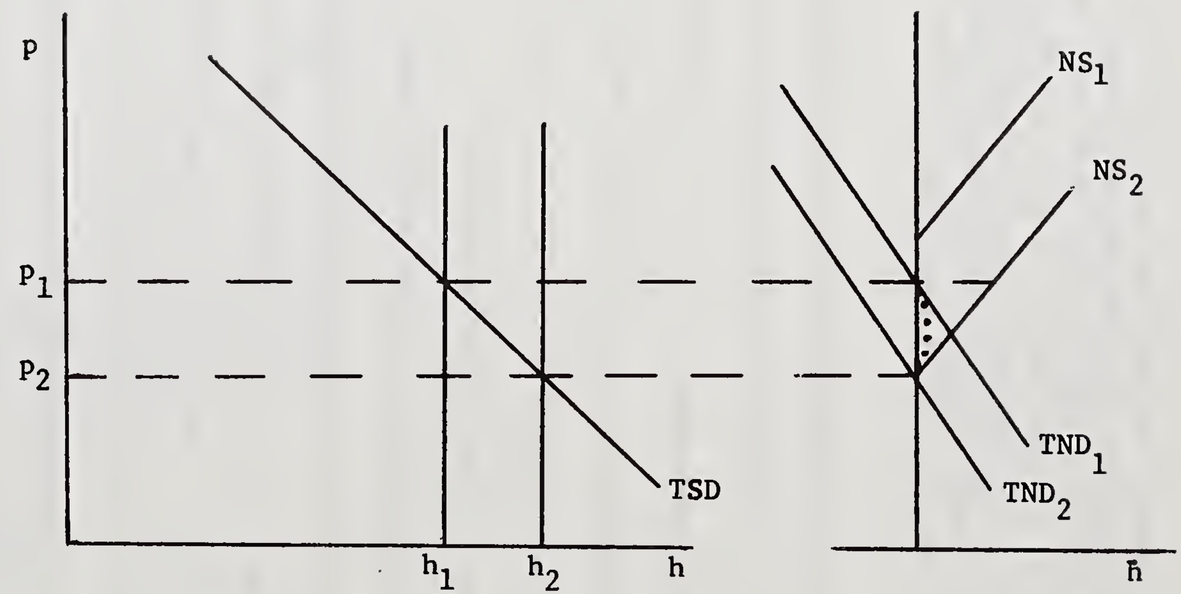

Figure 3.3. The impact of technological change on the housing market.

stock is depreciated on net. The lowering of the price can be viewed as accelerating the rate of filtering down during the adjustment process. It is clear that, in this model, filtering down is a disequilibrium process.

While it is true that the rate of new housing construction becomes positive as a result of the technological change, one cannot expect that the impact of extra blight which is generated by positive total net depreciation will be offset by the additional new construction. This is because positive rates of total net depreciation and new construction have spatial dimensions. That is, we would expect much of the deterioration and new construction to be separated in space.

It is possible to extend the housing market model to illustrate the importance of space. Although we have chosen to limit the breakdown to two spatial submarkets (i.e., central city and suburbs), more detailed breakdowns are feasible. In Figure 3.4, central city net depreciation, $CCND_1$, is shown as being to the right of suburban net depreciation, SND_1, at low prices and to the left at high prices. This may be because there is more housing stock in the central city initially. The central city new supply curve, $CCNS_1$, is shown to be much higher than the suburban new supply curve, SNS_1. This is intended to represent the extra costs of redeveloping previously developed land (e.g., land assembly difficulties, purchasing and demolishing net income producing properties).

If there were downward shifts in the new supply curves due to technological change as shown in Figure 3.4, there would be positive net depreciation in both central city and suburbs. However, it is unlikely that there would be any new construction in the central city. At least, it would take a very substantial technological change to shift CCNS

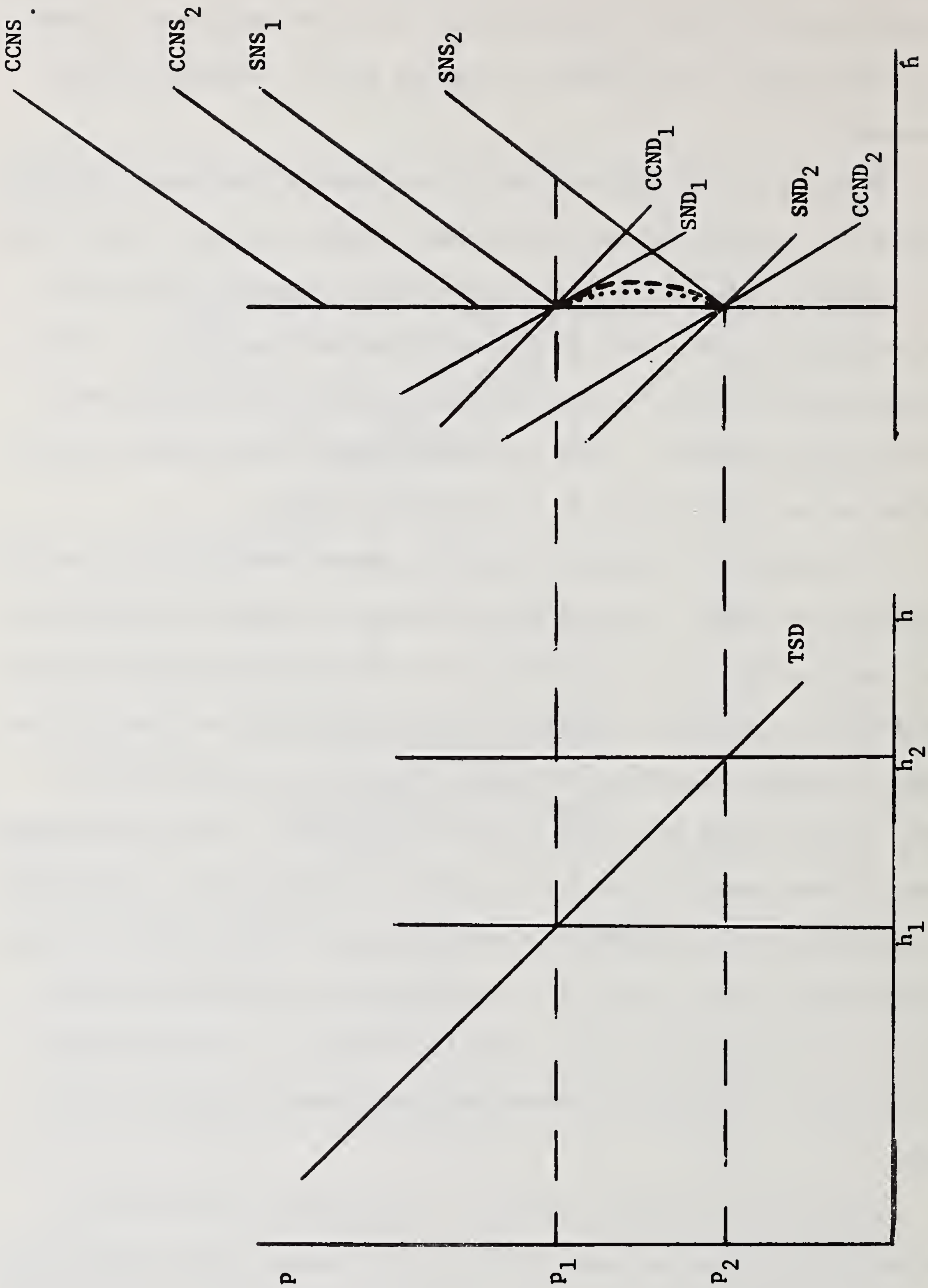

Figure 3.4 The impact of technological change on spatially defined submarkets.

downward enough to bring new construction to the central city.[1] The dotted and dark-dashed lines in Figure 2 represent our speculation on the paths of the rates of net depreciation in the suburbs and central city, respectively. The new equilibrium is, just as before disaggregation, at a lower price and at a higher stock. However, stock only declines in the central city. Thus, on net, stock must have increased in the suburbs.

A technological change may be interpreted as a change in housing style or design which results in an increase in ϕ, the unit rate of depreciation. As a result of an increase in ϕ, both the TND curve and the NS curve will shift. The TND curve shifts to the right for two reasons. First, the slope of the rent function is lower. Thus the desired rate of gross investment is lower at each and every price after the increase in ϕ. Second, the rate of depreciation is increased by an increase in ϕ (i.e., $d_o = \phi h_o$). The supply curve shifts to the left because each service price corresponds to a lower stock price after ϕ increases. The shifts in the TND and NS curves will result in a higher equilibrium price and a lower equilibrium stock as shown in Figure 3.5 below.

If technological change has elements of both style or design change and technical change (i.e., in the sense of doing the same thing with fewer inputs), the net effect of such technological change on price and stock is indeterminate. It depends on the relative magnitudes of these two types of technological change. However, a technological change will result in filtering-down regardless of these relative magnitudes. That is, the equilibrating process will involve positive net depreciation.

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[1]One effect of urban renewal may be to temporarily shift CCNS downward by eliminating the land assembly problem.

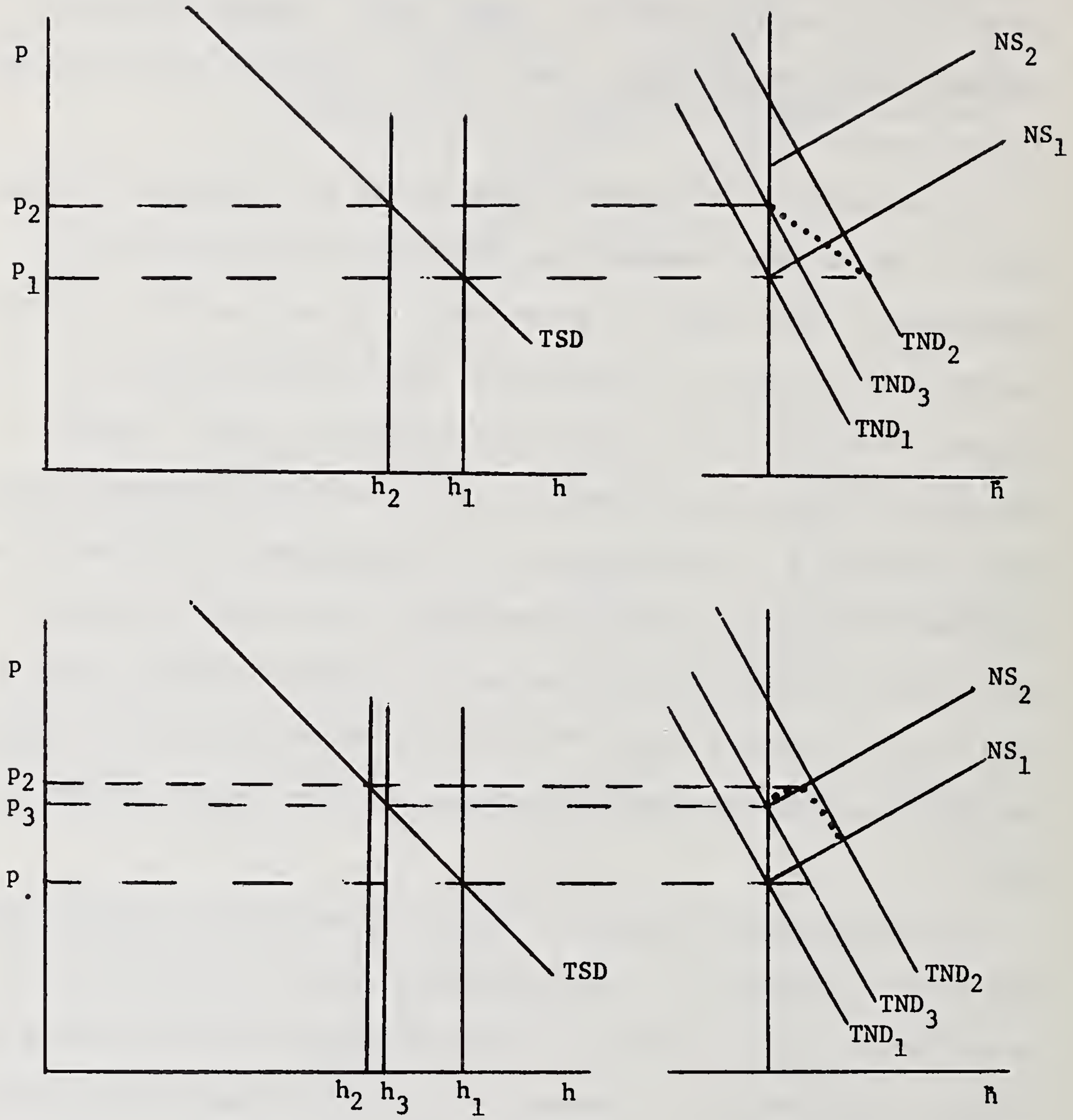

Figure 3.5 The effect of an increase in the unit rate of depreciation on the housing market.

One might ask how government can get a policy handle on filtering-down.

Thompson has indicated that promoting larger firm size in the construction industry might result in higher rates of technological change and more rapid filtering-down.

> "Since the residential construction industry is characterized principally by small firms and easy entry into and exit from the industry, the typical firm lacks both the capital resources and the extended life expectancy prerequisite to a serious research and development effort. And the spectacular success, or at least reputation for success, of the large corporation in research and development-electronics, aircraft, automobiles, metals, chemicals, petroleum, and so forth - strongly suggests applying the lessons learned about the relationship between firm size and product improvement in those industries to the housing industry. Moreover, the fact that the housing industry is widely regarded, fairly or unfairly, as an industry of slow technological change strengthens the feeling that firm size is our best point of entry into policy-based research on residential construction."[1]

Another possibility is government research into building technology.

3.3 Rent Control

Many economists believe that rent control reduces the stock of housing and increases the cost of housing services.[2] By rent control we mean a legal ceiling on the gross receipts of landlords. For the purpose of demonstrating the impact of rent control, we will examine a housing market in which there are no additions to the stock as a result of new supply. We will assume that all consumers have identical demand curves, all the firms are landlords, and all firms are subject to rent control. Furthermore, all the firms are assumed to face the same value

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[1] Wilbur R. Thompson, A Preface to Urban Economics, The Johns Hopkins Press, Baltimore, 1965.

[2] Douglas M. Brown, Introduction to Urban Economics, Academic Press, N.Y., 1974, pp. 156-157. Heinz Kohler, Economics and Urban Problems, D.C. Heath & Co., Lexington, 1973, pp. 57, 267-270, 286.

and investment cost functions and have the same housing stock and depreciation rate (i.e., they have identical net depreciation functions). While in reality a rent control law may be more or less effective, we shall begin by assuming that such a law is completely effective (i.e., the law will not be broken or circumvented).

Suppose a rent control law puts a ceiling on real gross receipts allowing nominal receipts to rise at the same rate as the general price level. It is possible to construct a curve on the stock side of the housing market model which represents the collective constraint placed on the landlords: real gross recipts may not rise above a legal ceiling. This ceiling curve (K) defines all the combinations of p and h which result in a constant gross revenue (i.e., along K, $p \cdot h \cdot \gamma(p) =$ constant gross receipts). A ceiling curve will take the same shape as a demand curve which exhibits unitary price elasticity at every point along its length. If the rent control ceiling is imposed at the current level of real gross receipts, K will intersect the stock at the same point as total stock demand. This situation is illustrated in Figure 3.6.

No problem would arise from the situation in Figure 3.6 if there were no increase in total stock demand or total net depreciation. However, if such a change occurs, a persistent shortage would develop. Suppose that an increase in total stock demand does occur as shown in Figure 3.7. As a result of the shift from TSD_1 to TSD_2, demanders are willing and able to purchase the services associated with h_b housing units at p_1. However, there will continue to be only h_a units available. The shortage is $h_b - h_a$. The landlords will continue to receive p_1, but households will pay $p_1 + s$. The difference between these prices is the search costs which serve to ration the short housing stock. In

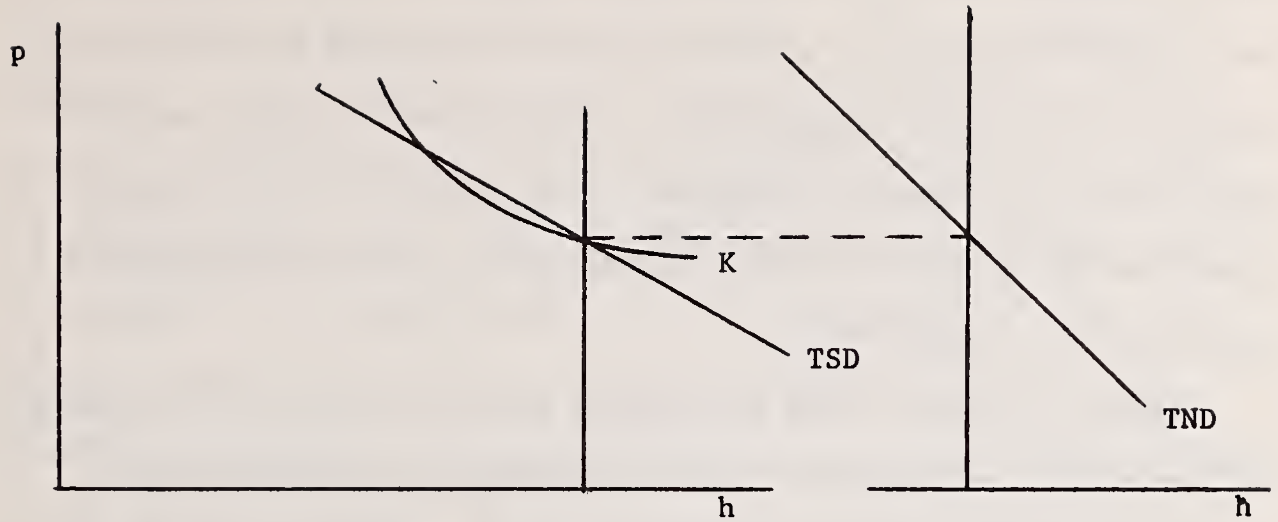

Figure 3.6 The rent control ceiling curve imposed on a market in equilibrium.

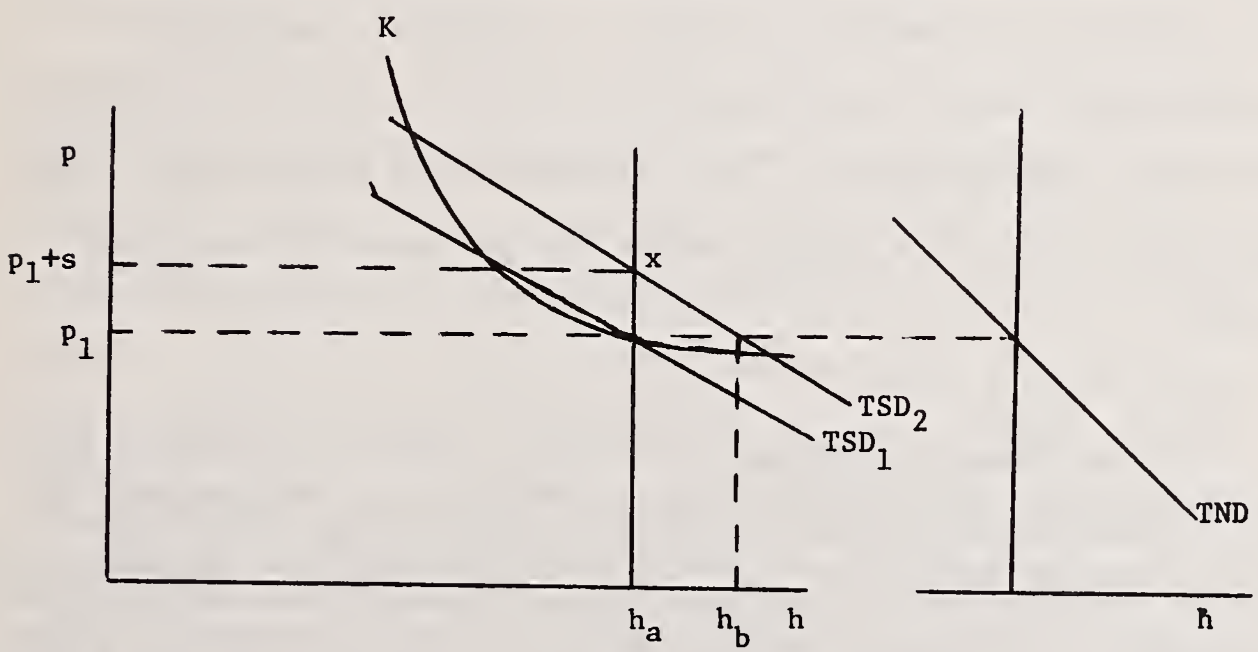

Figure 3.7 The effect on the housing market of an increase in total stock demand when rent ceilings are enforced.

the light of this analysis, New York's rent control law may be seen as being responsible for the exceptionally high search costs prevalent in its housing market (e.g., a household member searching full-time for months before finding an apartment). In the absence of rent control, the stock would increase in response to an increase in total stock demand and the price, including search costs, faced by the households would rise less dramatically.

Household demand curves for housing service include the willingness and the ability to pay search costs. In order to make serach costs comparable with the price of housing services, search costs which are incurred prior to occupancy are multiplied by a capital recovery factor to evenly spread out the search costs over the expected occupancy period. Search costs will not be borne by households which occupy dwelling units prior to the imposition of rent control and the exogenous hangers (e.g., an increase in demand, an increase in total net depreciation, or an increase in the general price level). A reasonable search model should probably admit to the possibility of some searchers being lucky and others being unlucky (i.e., to a distribution of search costs). The magnitudes is really the maximum search cost per unit of housing services.[1]

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[1]We have assumed that there are no search costs in equilibrium (i.e., landlords receive what households pay). While this is not precisely correct, it does serve to illustrate the differences in magnitude between search costs in equilibrium and search costs generated by a shortage. Not only the magnitude but also the distribution of search costs differs from equilibrium to shortage. Landlords bear a portion of the search costs in equilibrium. In equilibrium, one can imagine a natural vacancy rate deriving from a landlord's optimal search period for a tenant. A shortage substantially reduces the landlords' search period and costs.

We recognize that there is no explicit search model here and that a rationale for referring to s as the households' search costs has not been developed. The search model or models which are implicit may be a bit odd. Nevertheless, we believe that the concept of search costs as a function of the difference between equilibrium and fiat prices is useful here.

Suppose that after a real gross receipts ceiling is imposed at the current level, the total net depreciation curve shifts from TND_1 to TND_2 as shown in Figure 3.8 (e.g., as a result of ϕ or r changing). Initially, the stock will decrease at the rate $\dot{h}_1$. As the stock decreases, the price will rise along the lower of the curves, K or TSD. The decreasing stock also causes the TND curve to shift leftward. If K falls below TSD as shown in Figure 3.8 (i.e., if demand is price inelastic) there will be a persistent shortage equal to h_3-h_2. Again, households would pay in rent plus search costs more than landlords would receive in rent payments. If the rent control were eliminated, the stock would increase but not as far as h_3. The landlords' receipts would rise and the households' costs would fall.

Instead of assuming that the rent control law consists of a ceiling on real or constant dollar gross receipts, suppose that it is a ceiling on nominal or current dollar gross receipts. It can be shown that this policy will lead to a persistent shortage if there is an increase in the general price level.[1] At higher general price levels, constant nominal gross receipts would be represented by lower ceiling curves. Figure 3.9 illustrates a shift from K_1 to K_2. Initially, the shift in K results in a reduction in the real price from p_1 to p_2 and a rate of net depreciation of h_1. The stock begins to decline and the price rises along K_2. Because the stock declines, TND shifts to the left. A final position will be found at a lower price received by landlords, p_3, than the pre-rent control price and at a lower stock, h_2. The households will be paying a higher price, p_3 + s, because of the shortage, h_3-h_2, induced search costs. If both the inflation and the rent control persist, the K

[1]This is the same ploicy as requiring a rollback in real gross receipts.

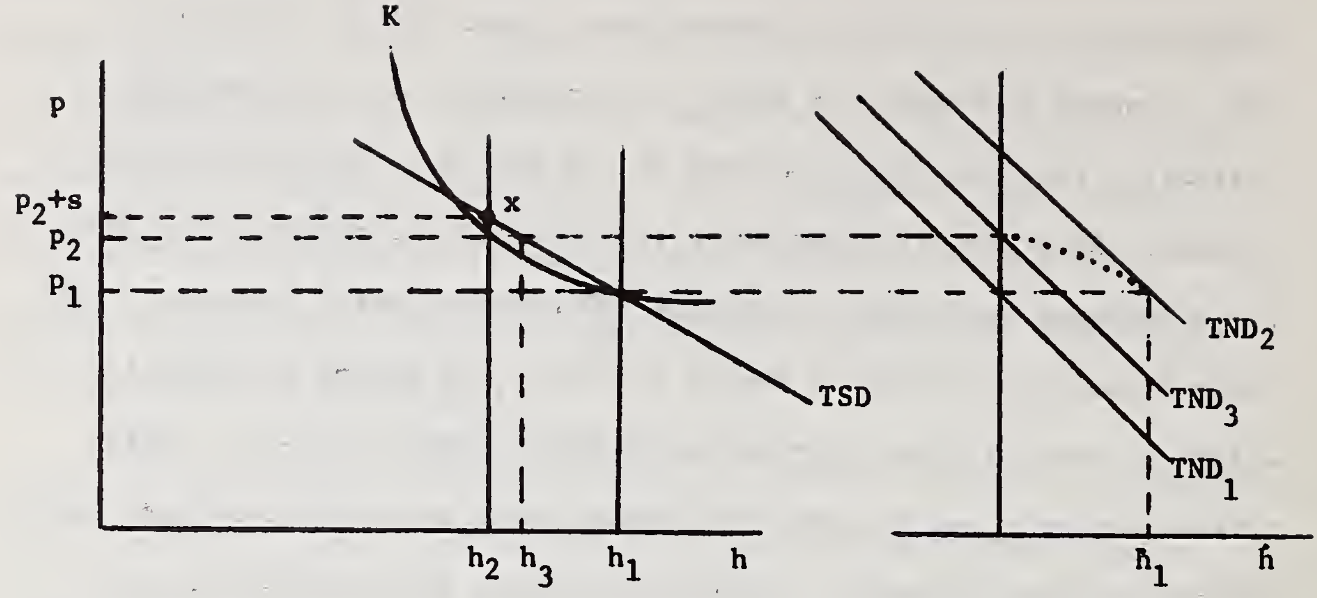

Figure 3.8 The housing market impact of rent ceilings when total net depreciation increases.

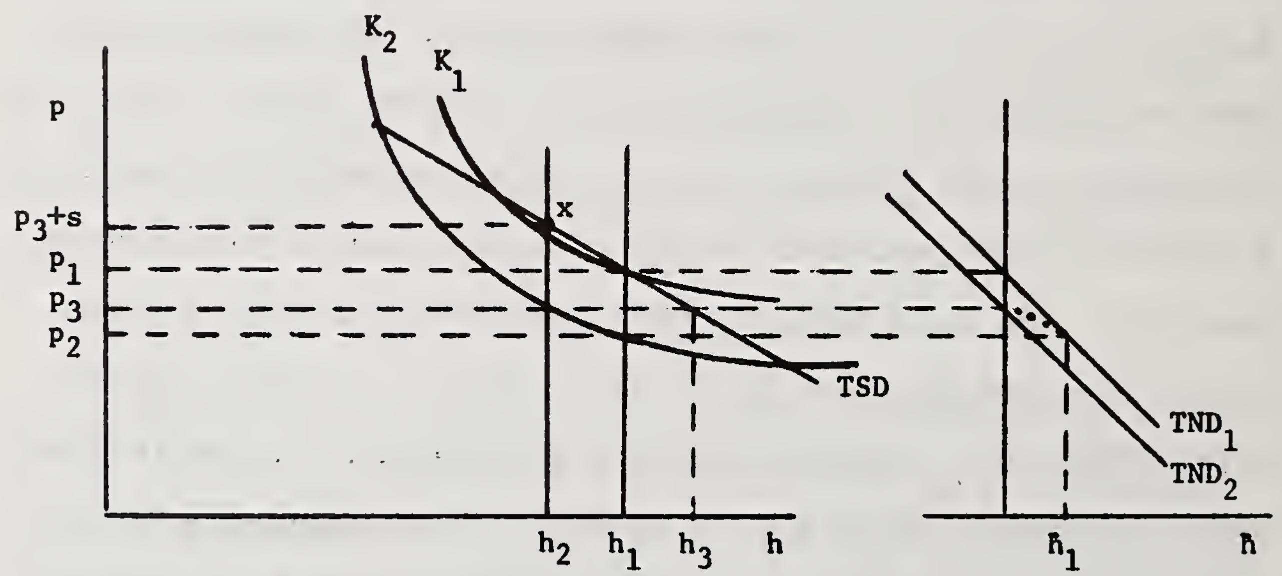

Figure 3.9 The effect of nominal ceilings on rent receipts when the general level of prices increases.

curve will continue to shift downward, and the shortage, as well as the search costs, will increase.

Up to this point, we have assumed that the ceiling on gross receipts is completely effective. However, we have seen that a ceiling on gross receipts does not imply that there is a ceiling on housing costs borne by tenants and prospective tenants. Note that in Figure 3.7, 3.8 and 3.9 the post-rent control housing costs borne by households are associated with a price and stock combination labeled x and that the x falls above the ceiling curve in each case. Rent control does not do what its supporters generally say it does. It does not control households' housing costs through even completely effective control of landlords' receipts. It is also clear that a completely effective control on gross receipts is likely to result in lower housing stock than would exist in the absence of such control. It is only possible to conclude from this analysis that a completely effective rent control law is likely to have harmful economic effects.

If we relax the assumption of complete effectiveness, we must slightly qualify our conclusions. For example, if a rent control law is completely ineffective, it by definition does nothing to the market solution and can only be faulted for fostering disrespect for law. Of course, we are not likely to find either extreme in the real world: complete effectiveness or ineffectiveness. In reality, silver often crosses the palms of landlords in the hopes that they will look favorably upon certain applications for apartments. "Supers" (i.e., building superintendents) may require large Christmas "gifts" in return for fixing leaky faucets, painting, etc. However, the range of under the table payments is generally limited. Therefore, rent control laws are to some extent effective, and we would expect shortages and concommitant high search costs to persist if rent control persists. In addition, we would expect rent control to restrict the stock to some extent.

3.4 The Property Tax

It is the conventional wisdom that the property tax is a disincentive to invest in improvements on land such as housing. There are many, expensive policies which are based on this wisdom. However, a satisfying theoretical demonstration of this wisdom's correctness is not to be found.[1]

The model of firm behavior in the previous section can be extended to show that an increase in the property tax rate will reduce the rate of optimal gross investment. The impact of the property tax can then be traced through the model of the aggregate housing market.

The value function may be written as follows:

$$\dot{V} = \left(\frac{y}{r + \phi} - T\right) I$$

where T is the present value of ad valorem tax on a unit of housing stock and $y = p\gamma - w\alpha$. Appendix II contains a derivation of T, namely

$$T = \frac{\Theta y}{(r + \phi)(r + \Theta + \phi)}$$

which shows that where Θ is the true ad valorem tax rate (i.e., the product of the assessed value to market value ratio and the tax on a dollar of assessed value). We may substitute the expression for T into the value function as follows:

$$\dot{V} = \left(\frac{y}{r + \phi} - \frac{\Theta y}{(r + \phi)(r + \Theta + \phi)}\right) I$$

An increase in Θ will decrease the slope of the value function as shown in Figure 3.10. This shift in the value function will result in a lower optimal gross investment rate if everything else is held constant. An

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[1]For an interesting approach, see Joseph S. Desalvo, "Effects of the Property Tax on Operating and Investment Decisions of Rental Property Owners," National Tax Journal, March 1971. This paper goes beyond Desalvo's by introducing depreciation as well as extending the analysis to the housing market.

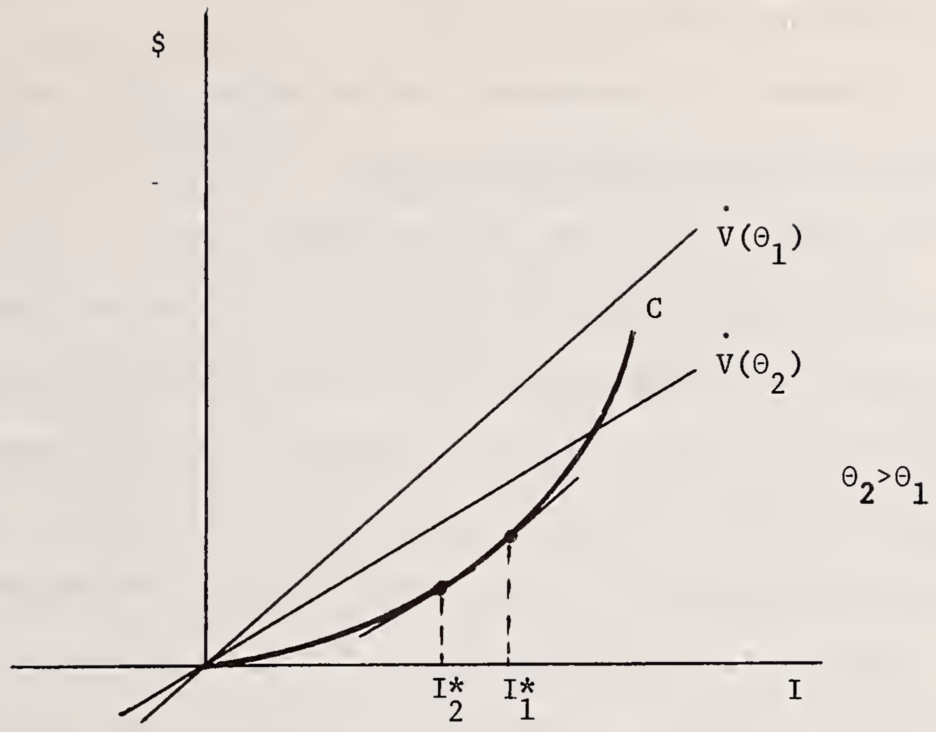


Figure 3.10 The effects of increasing the property tax rate on the gross investment rate.

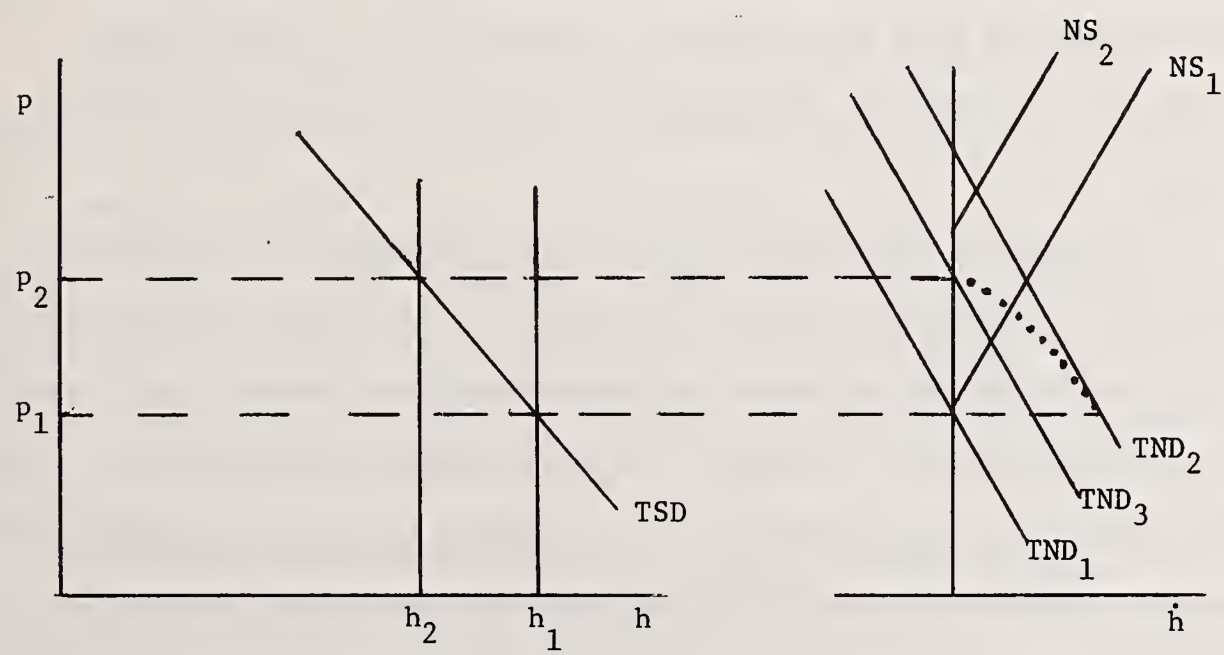


Figure 3.11 The initial effects of increasing the property tax on total net depreciation.

increase in Θ will, therefore, result in an initial rightward shift in the firm's net depreciation curve.

In terms of the aggregate housing market model, an increase in the property tax rate will initially shift the total net depreciation curve to the right. In addition, the new supply curve would shift to the left. This shift would result from the fact that new supply is a true function of the stock price while we have shown new supply as a function of the service price. After the increase in the tax rate, each flow price corresponds to a lower stock price, therefore our new supply curve shifts leftward while the true supply function remains stable.

Figure 3.11 illustrates the initial shift in the total net depreciation curve from TND_1 to TND_2 and the shift in the new supply curve from NS_1 to NS_2. As the stock declines and the price rises, the total net depreciation curve begins to shift to the left. The rising price and shifting total net depreciation curve result in rates of total net depreciation as shown by the dotted line in Figure 3.11.[1] Finally, a new equilibrium will be reached at a higher price, p_2, and a lower stock, h_2, and with TND_3 being the equilibrium total net depreciation curve.

If assessing practices are such that assessments are sticky downward (i.e., properties declining in value are not reassessed frequently or correctly and are increasingly overassessed as a result), the true ad valorem tax rate will be rising. We would expect an acceleration in the disinvestment in such properties. By deciding not to pay property taxes and thus counting on abandoning the property, the value function may

[1]The dotted path of the rate of total net depreciation illustrated in Figure 3.11 is not the only possibility. The path might rise to NS_2 and then fall while staying above NS_2 until equilibrium is reached. Regardless, the new equilibrium will be at a higher price and a lower stock.

shift upward and become steeper. This may grant the owner a reprieve from an even earlier abandonment.

3.5 Externalities and Efficiency

If other houses are in close proximity to the reference firm, the level of the reference firm's housing stock may directly affect the value of the surrounding stock of housing (i.e., the reference firm may produce external benefits or costs for surrounding firms). Assuming that the reference firm's dwelling unit is identical to those of other firms in the neighborhood, external benefits will accrue to the neighborhood if the reference firm's rate of investment is higher than its privately optimal rate. If, on the other hand, the reference firm's rate of investment is lower than its privately optimal rate, external costs are generated (i.e., negative external benefits). The reference firm's privately optimal rate of investment could be called the normal rate for its neighborhood. This normal rate can be shown to be inefficient.

To maximize the difference between the rate of change in total benefits (i.e., private plus external benefits) and the cost of investment results in higher rates of investment than would be optimal from a private viewpoint. This divergence between the private optimum and the social optimum is evidence of a problem of allocative efficiency. That is, not enough resources will be allocated to maintenance and rehabilitation.

An external benefits function, $\dot{EB}$, is shown in Figure 3.12.[1] A total benefits function, $\dot{TB}$, is also shown in Figure 3.12. $\dot{TB}$ is the vertical sum of $\dot{V}$ and $\dot{EB}$. It can be seen that the rate of investment

[1]Actually, the horizontal intercept of the $\dot{EB}$ function, the "normal" rate of investment, is not critical to the analysis. It is only important that $\dot{EB}$ be positively sloped.

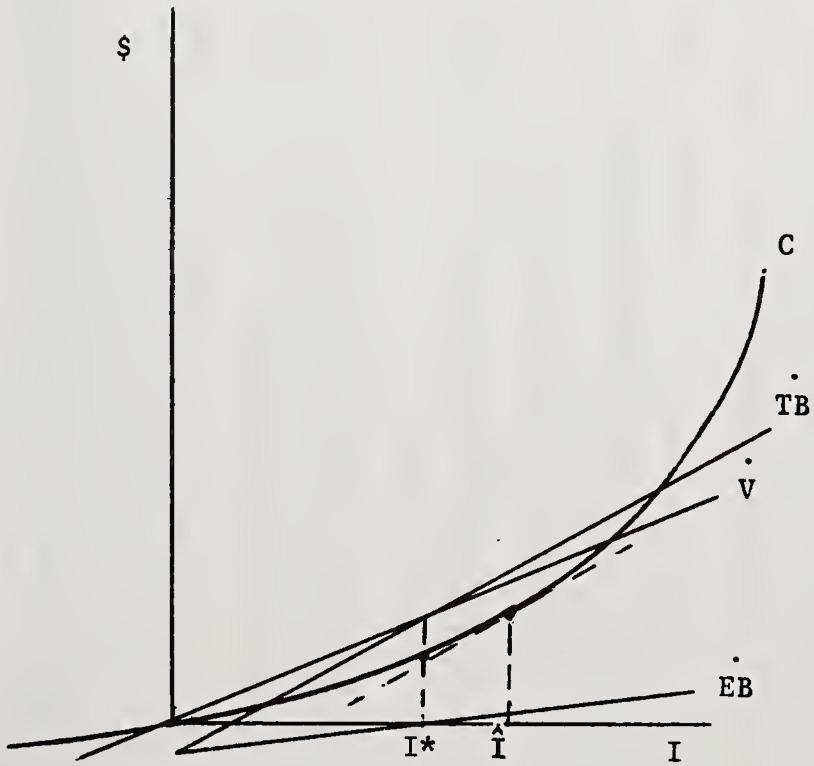
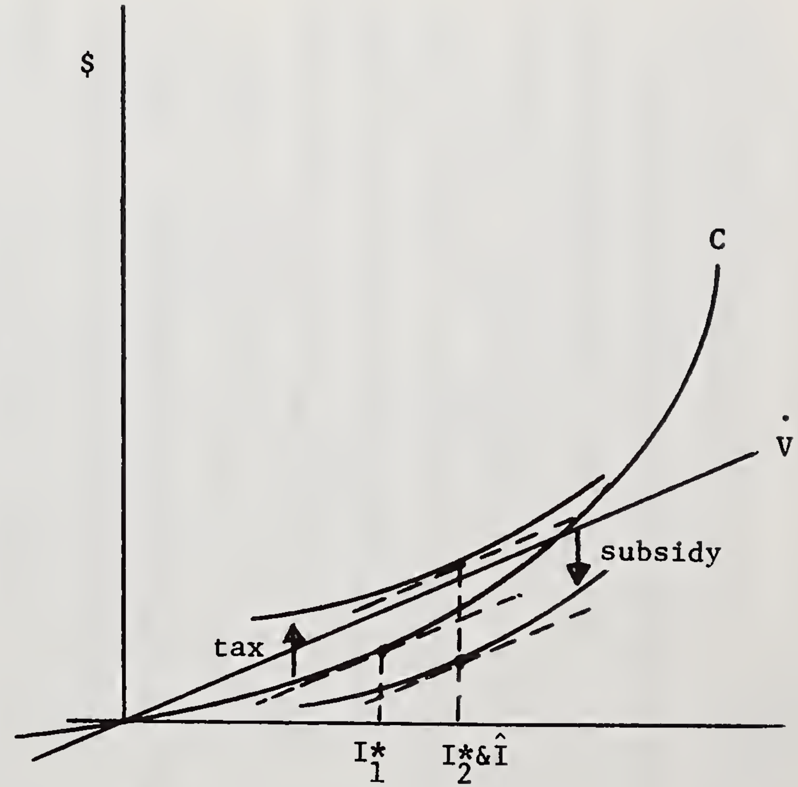


Figure 3.12 The effect of external benefits on the optimal rate of investment.



I_1^* = without tax or subsidy

I_2^* = with tax or subsidy

Figure 3.13 Achieving the socially optimum rate of net investment by altering the cost function with either a tax or subsidy.

which maximizes the vertical difference between TB and C, $\hat{I}$, is greater than the rate which maximizes the difference between V and C, I*.

If the cost function is made flatter by a technical innovation in maintenance and rehabilitation, I* will increase. However, there will still be a divergence between I* and $\hat{I}$, because $\hat{I}$ will also increase. There will still be a resource allocation or efficiency problem. Although there may be other positive effects, even a successful government research program into new and less expensive techniques for maintenance and rehabilitation cannot be expected to eliminate this efficiency problem. On the other hand, if the true cost function is unaltered but the cost function facing the firm is made flatter by a subsidy or a tax, it is possible that I* and $\hat{I}$ will be the same or, more likely, the gap will be narrowed. That is, it is possible for a tax or subsidy to eliminate the efficiency problem (see Figure 3.13). It may not be necessary for government to provide the tax or subsidy. Under certain conditions, these policies may be handled by the private sector. Neighbors can subsidize each other by providing help or tools and can tax each other through complaints or shunning. Unfortunately, this model is not flexible enough to handle this kind of behavior.

This model is not generally as useful for examining the externality question as we would wish. The model cannot comfortably handly more than unilateral externalities. That is, the reference firm may produce externalities received by surrounding firms, but it is difficult to allow for the surrounding firms to produce externalities which are felt by the reference firm.[1] Of course, externalities in residential neighborhoods are multilateral. Therefore, it is reasonable to turn to models which are more suited to dealing with multilateral externalities.

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[1]It could be done by allowing the value function and/or the cost functionto shift or by allowing the depreciation rate to change. However, these complications are awkward.

4. MODELS OF THE IMPACT OF NEIGHBORHOOD EFFECTS ON NEIGHBORHOOD QUALITY

This chapter deals with an efficiency problem (i.e., too few resources being allocated to neighborhood conservation) arising from neighborhood effects. The chapter begins with an analysis of strategic choice in the context of a simple model of two interdependent decision makers. This model is called the "prisoners' dilemma." Next, the chapter analyzes collective choice where there are a number of interdependent decision makers.

4.1 <u>The "Prisoners' Dilemma"</u>

The game situation commonly referred to as the "prisoner's dilemma"[1] has been used to apply to the problems of bilateral externalities and the blighting of residential neighborhoods.[2] Consider the case of two owners with contiguous properties. Each of these owners is confronting a decision of whether to invest or to not invest (i.e., to expend on maintenance and/or rehabilitation or not to expend). The payoff matrix is as follows:

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[1] This name comes from a situation faced by each of two partners in crime who are apprehended and separated. Because the prosecutor does not have independent evidence of their guilt which is persuasive, he talks to them separately and gives them the choice of confessing or not confessing. If neither confesses, they will go free. If both confess, they will both receive moderate sentences. If one confesses while the other remains silent, the confessor will receive a light sentence while the silent partner will get the maximum sentence. In the absence of collusion, both prisoners will confess. However, this is not optimum from the prisoners' point of view. "Social" welfare of the two prisoners is unambiguously maximized if neither talks. We would call this the most efficient position from the prisoners' points of view.

[2] Otto A. Davis and Andrew B. Whinston, "The Economics of Urban Renewal," <u>Law and Contemporary Problems</u>, Winter 1961, pp. 105-117. The payoff matrix from Davis and Whinston presented here is not precisely the same as the "prisoner's dilemma." Note that both prisoners are unambiguously better off if neither talks than if only one talks.

		Owner II: Invest	Owner II: Not Invest
Owner I	Invest	.07, .07	.03, .10
	Not Invest	.10, .03	.04, .04

Each owner has an investment in the property and an investment in corporate bonds on which each makes an overall rate of return of four percent. Thus, if neither invest further, they will both receive four percent as shown in the lower right corner of the matrix (i.e., the left hand figure refers to Owner I and the right referes to Owner II).

If both individuals sell their bonds and invest, both will make seven percent on total investment. This is shown in the upper left corner of the matrix. The two other corners of the matrix illustrate situations in which one owner invests and the other does not. In the lower left corner of the matrix, Owner I obtains some benefits from the investment of Owner II. That is, after Owner II improves his property, Owner I may raise his rent, thereby raising his rate of return to ten percent. Owner II will not be able to raise his rent by as much as he could in another location. We assume that Owner II's return on total investment falls to three percent. In the absence of cooperation between the owners, they will both choose to not invest.

It has been demonstrated that, in repetitive game playing, cooperative behavior is expected but is unstable.[1] This suggests that stability in neighborhood residents and owners may be an important element in

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[1] R. Duncan Luce and Howard Raiffa, Games and Decisions (New York: John Wiley and Sons, 1957), pp. 97-102.

generating repetitive "play" and thus private neighborhood conservation efforts. Buchanan has suggested that the incentive for cooperative behavior becomes "increasingly faint while the pressures toward 'anti-social' behavior become increasingly strong" as the size of the game playing grows.[1] Using a model of public goods[2] interaction which offers more choices than the "prisoner's dilemma" game, Buchanan shows that the size of the public goods consuming group is an important determinant of the existence of incentives for cooperative behavior. As the group grows, a member of the group has "less incentive to initiate cooperative action and more incentive to behave contrary to the whole group's interest."[3] All this implies that small neighborhoods may be more supportive of cooperative behavior than large neighborhoods. Buchanan has developed a model of public goods consuming groups and producing clubs which can be applied to problems relating to neighborhood quality.[4]

4.2 Collective Choice: Public Goods and Clubs[5]

Suppose there is a residential neighborhood substantially separated by buffers from other neighborhoods. This neighborhood has homogeneous residents with respect to preferences and initial income endowments. Figure 4.1 illustrates how private neighborhood conservation efforts may

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[1]James M. Buchanan, "Cooperation and Conflict in Public-Goods Interaction," Western Economic Journal, Vol. V, No. 2, March 1967, p. 115.

[2]Goods which are consumed collectively are public goods. For now, let it suffice to think "neighborhood quality" where "public goods" is used.

[3]Ibid.

[4]James M. Buchanan, "A Behavioral Theory of Pollution," Western Economic Journal; Vol. VI, No. 5, December 1968. A club, in this context, refers to an association of individuals which cooperatively produces a public good.

[5]The theoretical content of this entire section is based on James M. Buchanan, "A Behavioral Theory of Pollution," Western Economic Journal, Vol. VI, No. 5, December 1968.

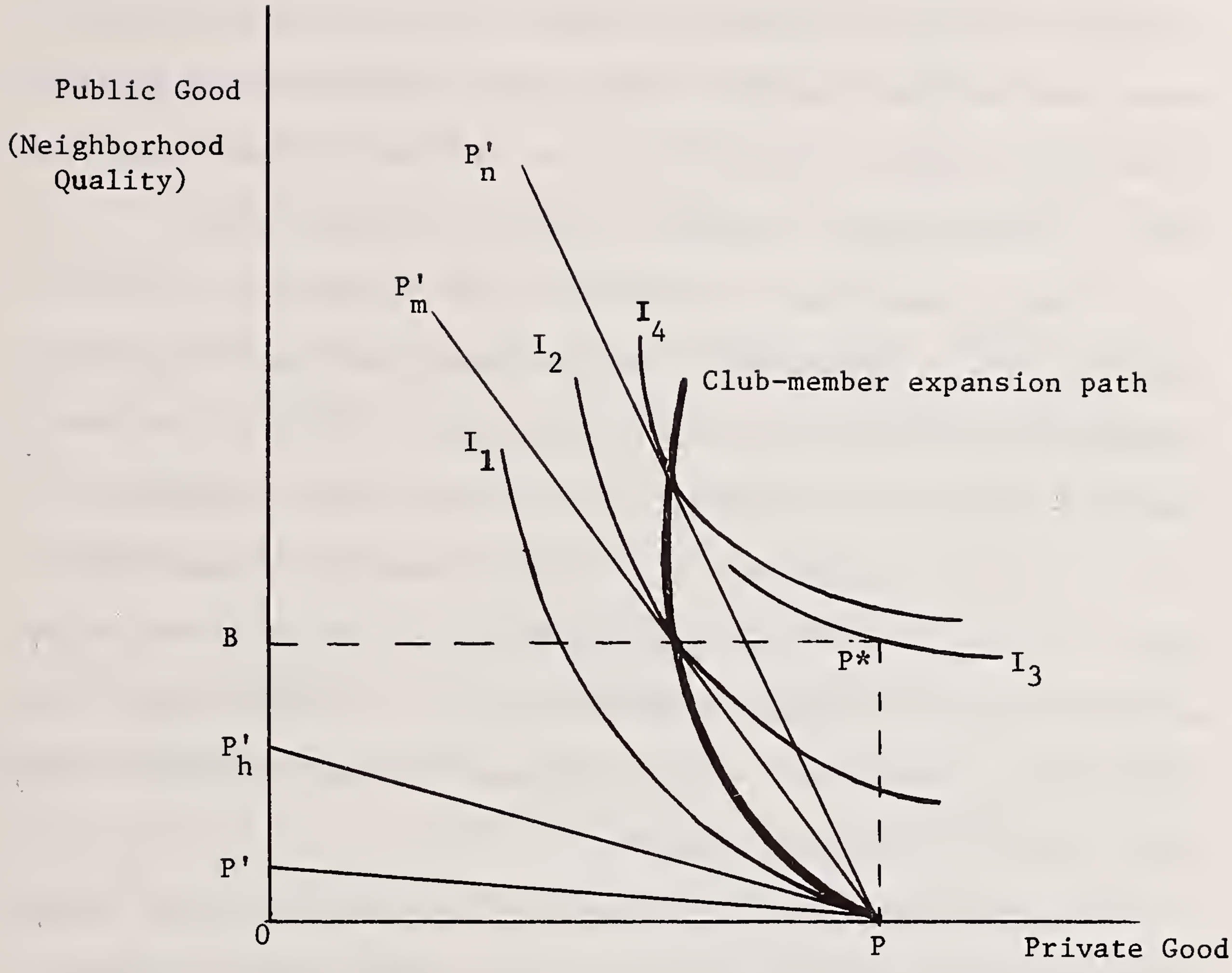

Figure 4.1 The effect of private neighborhood conservation on individual welfare.

unambiguously make society better off (i.e., may be efficient) and suggests why such efforts may be difficult to achieve. The production of a public good relating to some aspect of neighborhood quality is measured along the vertical axis.[1] Well tended flower gardens, cleaned and painted exteriors, garbage containment, rat eradication, reported crimes, and testimony against criminals are examples of goods which are to some extent public goods and which are related to neighborhood quality.[2] A private good is measured along the horizontal axis.[3]

To begin, assume that an individual finds himself at P. Let us assume that the private good can be transformed into the public good by independent action according to the transformation curve P'P which is shown as a straight line in Figure 4.1, for the ease of exposition (i.e., we might otherwise show it as being convex when viewed from above). Given the indifference curves shown in Figure 4.1, the individual would find no advantage in producing any of the public good (i.e., neighborhood conservation). This is because a higher indifference curve than I_1 cannot be reached along P'P.

If the individual were to voluntarily associate with other individuals to produce neighborhood quality (i.e., join a club), the club transformation curve would be steeper than P'P. For example, a single individual cannot very successfully eradicate Japanese beetles and

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[1]A public good is non-exclusive. One individual's consumption of it does not reduce another's. Obviously, a public good need not be produced by the public sector. Also, goods which are produced by the public sector are not necessarily public goods.

[2]These examples should be further qualified to achieve much precision. For example front lawns which extend relatively uninterrupted giving a residential street the look of a golf course are very much public goods, whereas lawns in walled courtyards are not.

[3]A private good is exclusive. This could be a composite private good.

thereby improve the production of roses in his yard and neighborhood (i.e., each dollar he spends on the effort is relatively ineffective). However, an association of all or a substantial portion of the neighborhood can be very successful (i.e., each dollar an association member spends in concert with the other members is quite effective). Similarly, if only one individual cleans up the junk in his front yard, the neighborhood still looks junky. If a substantial proportion of the neighbors do likewise, the overall or ambient look of the neighborhood may be radically transformed for the better.

Cost sharing also shifts the transformation curve. Cost sharing may consist of neighbors sharing capital (i.e., lawnmowers, ladders, rakes, and shovels), and sharing advice and labor (i.e., putting in a new sidewalk, babysitting to free someone for court testimony).

The larger the club, the steeper the transformation curve. However, any club size of h or less, indicated by $P_h'P$ or less steep transformation curves, is too small to achieve any welfare gain. The individual may rationally join clubs larger than h up to and including size n, the public good consumer-group. The club-member expansion path shown in Figure 4.1 shows the combinations of the public good produced by clubs and the private good consumed by club members. For example, at club size m, with transformation curve P_mP, each club member will reach indifference curve I_2 and OB will be the amount of the public good produced.

At club size m, there are (n - m) free riders or individuals who consume the public good but who do not contribute to its production (i.e., group members but not club members). These individuals will be better off than club members as shown in Figure 4.1. Because a free rider can maintain OP of the private good and will consume OB of the public good, he will achieve point P* on indifference curve I_3. Every club member is tempted to drop out and become a free rider. However, as they do so, club member welfare and free-rider welfare will decline. Club members will be driven back along the club-member expansion path and free riders will move along P*P. Of course, continued dropouts will eventually drive everyone back to point P and to indifference curve I_1.

Unfortunately, the situation is not even as favorable for neighborhood conservation as is suggested in the gloom of Figure 4.1. If it is possible for free riders to "sell" the public good (i.e., diminish neighborhood quality by exchanging it for more of the private good), the free rider can improve his welfare position by producing blight instead of just doing nothing. By neglecting building maintenance, the free rider exchanges or "sells" neighborhood quality for more private goods which he can consume exclusively. Fewer trash cans may be exchanged for an electric can opener. Not picking up garbage after dogs have spread it around the alley may allow time for watching sports on TV.

Eliminating the origin in Figure 4.1, B in Figure 4.2 indicates an initial level of neighborhood quality. P* indicates an initial position for all members of the group (i.e., consumers of the public good). An individual will increase his welfare position (i.e., reach a higher indifference curve) by moving along P' to R, selling the public for the private good. For example, neglecting exterior maintenance will free individual resources for more private goods. If all individuals in the group try to do this, however, they will all move along P_n, the group transformation curve, to R*. There is no possibility for individuals to achieve gains by shifting away from R* because R* is on the free-rider expansion path (i.e., the locus of tangency points between indifference curves and independent-action transformation curves). Recall that the reason for an individual wanting to shift from P* to R was to reach a tangency point and, thereby, maximize his satisfaction. Therefore, R*

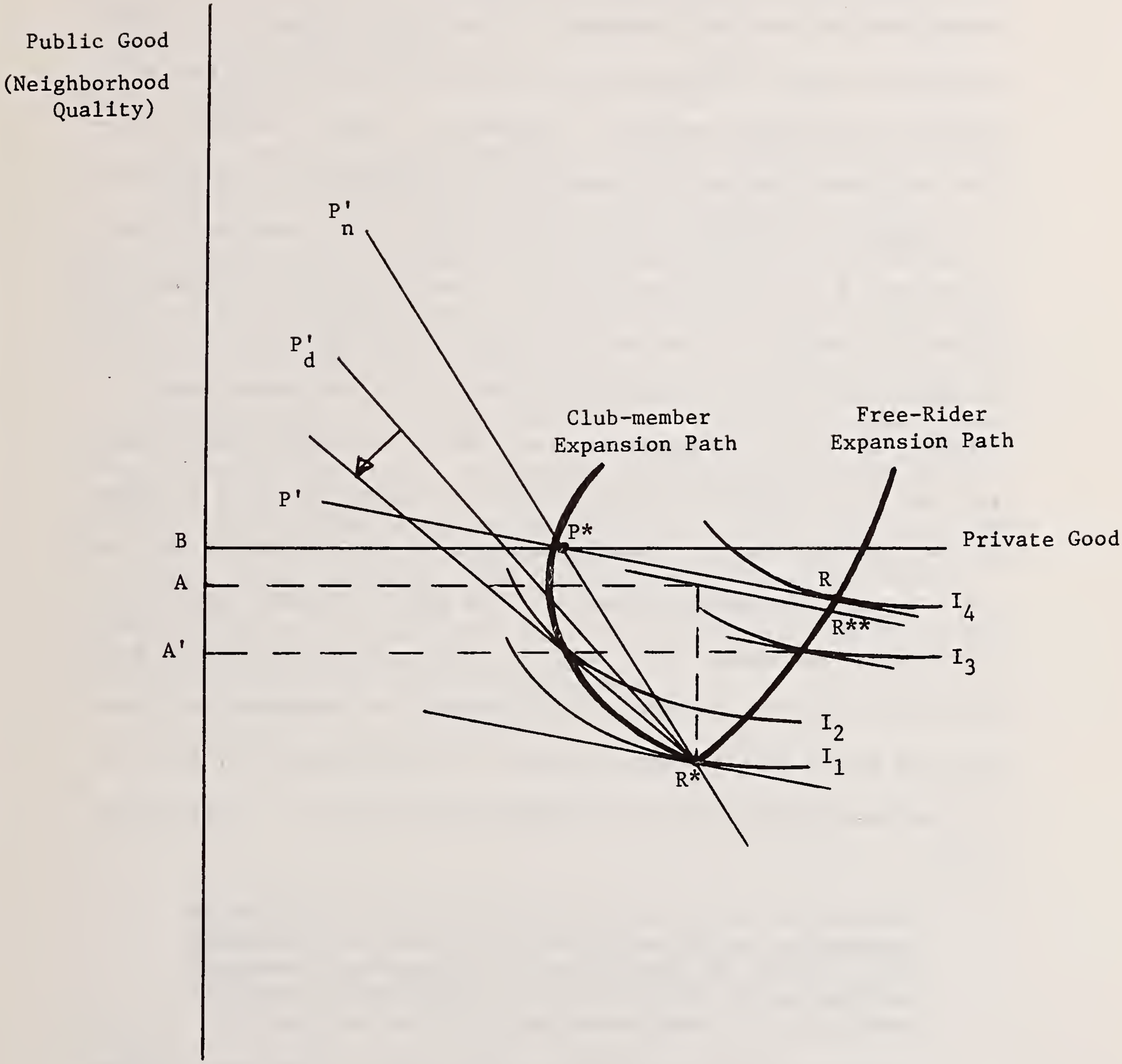

Figure 4.2 The impact on individual welfare as free riders sell a public good.

is a kind of equilibrium position. That is, if club formation does not take place, it is an equilibrium position.

Because an indifference curve is tangent to an independent-action transformation curve at R*, there is no minimum club size. Any steeper transformation curve will intersect I_1 and will be tangent to a higher indifference curve. Therefore, any club size will be sufficient to increase club members' welfare. This makes it likely that club formation will take place and will generate some neighborhood conservation.[1]

Suppose in Figure 4.2 that a club of size d is formed which produces level A of neighborhood quality. Free riders who find these will attempt to reach R** by moving along their independent-action transformation curves "selling" neighborhood quality for the private good. However, as this is attempted by free riders, the transformation curve for club size d shifts counter-clockwise, reducing the level of neighborhood quality like A'. This equilibrium is "final" only if the club can hold the line against dropouts. Free riders, however, will be on I_3, whereas club members will be on I_2. Thus, the temptation to drop out will be strong. However, if club members are persuaded that dropping out by all club members wil result in being driven back to R* on I_1, they may persist in their enlightened behavior (i.e., stay in the club).

> "The size of the total interacting group is important in influencing the pattern of behavior here. In critically large groups, the possibility of 'enlightened' behavior patterns may be remote and, even should this appear, the possibility of these remaining stable may be slight."[2]

Assuming that the free-rider expansion path is positively sloped, free riders can be counted on to frustrate neighborhood conservation by

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[1]In Figure 4.2, the club size required to achieve the initial level of neighborhood quality, B, is less than n. This is not the only possibility.

[2]Buchanan, "Cooperation and Conflict...."

allowing their own property to deteriorate. Under these circumstances, which are very general, it is reasonable for individuals to invent institutions and rules which will bring all or a large proportion of the group into the club (e.g., neighborhood improvement associations, deed restrictions, condominiums).

4.2.1 A Limitation

One of the most serious limitations of the preceding analysis is the assumption of constant tastes across all neighborhood residents. Some residents may be coerced into club membership when the club produces public goods which they do not appreciate to the same extent as the ruling "majority" of the club. In this case the analyst ought to be aware of the costs of coercion, sometimes called political externality costs, which are generated. Fortunately, the range and levels of coercive devices, which are discussed in Chapter 5, are very limited by law and custom. Thus, the most effective devices used to enforce club membership are not coercive, but relate to changing individuals' tastes and behavior through positive reinforcement.

5. IMPLICATIONS OF NEIGHBORHOOD EFFECT MODELS

The purpose of this chapter is to draw some implications from the models developed in Chapter 4. Section 5.1 is an analysis of the stability of the social contracts which generally hold a neighborhood club together. The concept of an optimal neighborhood size is dealt with in Section 5.2. Finally, the role of homeownership in promoting neighborhood conservation is analyzed in Section 5.3.

5.1 Club Success and Neighborhood Conservation

Chapter 4 showed that too few resources are allocated to neighborhood conservation because one does not have to contribute to the production of neighborhood quality in order to benefit from the production. The free rider will be better off than his more cooperative neighbors. Thus there is a tendency for neighborhood clubs to break down under the pressure of unenlightened self-interest. As more neighbors abandon the association to become free riders, the remaining club members become less productive. At the same time, the welfare of free riders declines. The neighborhood suffers a decline in quality making everyone worse off than they would be if they would all cooperate in the production of neighborhood quality.

To encourage club membership, well tended lawns and gardens elicit effusive compliments while those who free ride may face complaints or find their children and themselves shunned. Neighbors may wheedle and threaten one another to join and stay in the club. But unless the neighborhood has some characteristic which makes neighborhood approval or pressure especially effective, the level of neighborhood conservation is likely to be too low.

The more stable the neighborhood - the more stable the social contracts which bind together clubs producing neighborhood beauty. Long-time neighbors are more sensitive to pressure and more receptive to praise. Neighborhoods with social capital such as a school and/or a church and possibly an acknowledged neighborhood leader such as a priest appear to be the most stable of neighborhoods and are often extremely well cared for. Clubs are held together by very delicate social contracts which are easily disturbed by instability of tenure. The thesis here is that unfamiliarity breeds insensitivity to neighborhood approval and pressure.

Larger neighborhood size (i.e., in the sense of area, density, and number of owners) increases the difficulty of intra-neighborhood communication and negotiation and thereby destabilizes neighborhood clubs. One of the things that this suggests is that individual homeownership, at least when combined with large numbers of owners, is an obstacle to club success. However, there are counter arguments. Tenants are less likely than homeowners to be club members producing aspects of neighborhood quality other than maintenance and rehabilitation (e.g., testifying against criminals, picking up spilled trash in the alley) because it is less in their self interest to do so. In the best of circumstances, landlords are likely to have their club participation largely limited to maintenance and rehabilitation (i.e., direct investment in their own real property rather than involvement in producing other aspects of neighborhood quality). Landlords simply do not have control over many aspects of neighborhood quality (i.e., those aspects other than building and grounds quality). Absentee landlords may communicate explicitly in meetings or implicitly through repeated actions. However, their communication and club membership would generally be expected to be less than that among resident owners.

The implications of this analysis are that stability of tenure, neighborhood size, and ownership characteristics are important for neighborhood conservation. Where a number of circumstances unfavorable to club formation and stability are present together, there is little chance for significant neighborhood conservation.

5.2 Optimal Neighborhood Size

An optimal neighborhood size for neighborhood conservation may exist as the result of (1) the fact that there are advantages (i.e., benefits) to having larger size and also disadvantages (i.e., costs) to have larger size and (2) speculation that the benefits probably increase at a decreasing rate and the costs increase at an increasing rate. The primary costs of larger size come from the increased difficulty of making and enforcing the social contracts which bind together neighborhood clubs and which are often necessary to achieve high levels of neighborhood quality. The concentration and other characteristics of neighborhood ownership (e.g., resident versus absentee owners) may affect the expected value of social contracts. Nevertheless, it would not be surprising if these costs quite generally rise at an increasing rate as neighborhood size increases. The primary benefits from larger size come from cost reductions in providing the buffers (i.e., a reduction in cost is a benefit). The costs of providing effective buffers result from changing the spatial configurations of public and private capital through direct investment and regulation, respectively. The cost of buffers per protected acre declines with increased size. This is because the circumference of a neighborhood grows more slowly than its area, assuming that larger neighborhoods do not have much more convoluted shapes than small neighborhoods. Thus the costs of providing the buffer per acre of neighborhood probably fall as neighborhood area increases.

Governmental policies aimed at generating optimal neighborhood size are likely to be most effective prior to residential development. Once such policies have been undertaken, the ability of the private sector to produce neighborhood quality will be enhanced throughout the life of the neighborhood.

5.3 Homeownership

Some believe that "homeownership is a valid objective of public policy in and for itself."[1] Others believe that publicly provided incentives for homeownership are justified, because homeownership instills pride and generates socially advantageous behavior (e.g., higher levels of maintenance, rehabilitation, and other aspects of neighborhood conservation than would otherwise occur). Certainly, incentives for homeownership have been provided for a long time and they are substantial in magnitude. As early as the Civil War, income tax experiments provided that certain tax advantages should accrue to homeownership. Today, the income tax law allows deductions for interest and local tax payments, deferred capital gains tax, and no tax on imputed rental income. Through the years there have been many programs at different levels of government which have been aimed partly or wholly at making homeownership more advantageous (e.g., homestead exemptions). It is the purpose of this chapter to evaluate the strengths and weaknesses of homeownership programs as they relate to maintenance, rehabilitation, and abandonment. Two homeownership programs, (1) Section 235 of the 1968 Housing Act and (2) urban homesteading, were selected for examination.[2] It is possible to generalize about the role homeownership plays in neighborhood conservation from an analysis of these two programs.

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[1] Housing in the Seventies, National Housing Policy Review, Department of Housing and Urban Development, October 1973, Chapter 1, p. 2.

[2] There is no attempt made here to catalog all the sins and virtues of the 235 program or the urban homesteading programs. The intention is only to use 235 and homesteading as examples of homeownership programs and to determine, if possible, their effects on maintanance, rehabilitation and abandonment.

5.3.1 The 235 Program

Section 235 of the 1968 Housing Act was a below market interest rate (BMIR) program intended to encourage homeownership among moderate income families. The 235 program had important effects on neighborhood conservation. Initially, many houses were rehabilitated to be sold under the 235 program.[1] A large number of homes sold under the 235 program were later abandoned.

It is questionable as to whether the program was constituted so as to create in the homeowner the sense of having a stake in the quality of the housing unit and the neighborhood. That is, through a precise adherence to the requirements of the program only a very small down payment (i.e. $200) was needed. Suppose hypothetically that this modest requirement was circumvented. The seller simply could raise the price by $200 and slip the same $200 under the table to the owner to be. In this case, the owner would have no equity (i.e. value equals the balance due on the mortgage) in the property. Thus, he or she is the owner of the property in the sense of holding the title (in states where lien theory applies). However, this legal subtlety would be lost on a rational individual.

In Chapter 2 it was shown that buildings will be abandoned when they have zero value. Here we see another reason. If the balance due on the mortgage exceeds the value minus transaction costs to the owner-seller and the cost of default to the owner (i.e., damage to the owner's credit rating), a sale would inflict a greater loss on the seller than abandoning the building. Thus, a building with positive value will be

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[1] Technically there was no such thing as a 235 house, only 235 families. Therefore as a house appreciated and was sold, it would leave the 235 program if the market price exceeded the maximum price under the program. There was a schedule of maximum prices depending on family size.

abandoned if the above conditions are met at a time when the owner can no longer use the building (e.g., because of moving out of the region or the residence becoming uninhabitable). Once the dwelling unit is abandoned, it is likely to remain so because of the damage likely to be incurred between the time of abandonment and the time the taxing jurisdiction, the mortgage, or the mortgage insurer can be in a position to resell it.

Because of the low downpayment and the slow rate at which the balance due on a mortgage declines in the beginning, it is quite likely that abandonment would be the most rational (i.e., least cost) way for an owner to extricate himself. This is especially true if a house financed under the 235 program did not substantially appreciate prior to the owner having to move out. An owner might be forced out of his residence because of some major physical defect (e.g., a plumbing or heating system failure) rendering the building uninhabitable. It may be that many of the defects which led to abandonments under the 235 program were only cosmetically treated by "rehabilitation" prior to the sale to the 235 family.[1] Thus, the administration of the program may be partly responsible for the subsequent abandonment. However, the primary lesson to be learned from this is not that the rehabilitation would have made these abandoned units viable. In many cases, the level of rehabilitation is irrelevant, or nearly so. This is because abandonment may result from surrounding physical blight and crime (i.e., neighborhood effects) driving the value to zero or by any factors (e.g., neighborhood effects, inadequate rehabilitation, job change) which cause the owner to move. Moving results in abandonment where there is insufficient equity.

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[1]However, it is generally possible to point to some physical defect as the "cause" of an abandonment thus elevating this inadequate rehabilitation thesis by reference to an association which may not indicate causation.

Whether inadequate rehabilitation or crime or something else has been the most important in the owner's decision to leave is an interesting question but does not directly relate to the role homeownership plays in neighborhood conservation. The primary lesson here is that there is a problem inherent in the 235 program. That is that the low down payment provided the climate for abandonment (i.e., made abandonment in the owner's self-interest even when the residence has positive value). Thus, the 235 program has been the cause of accelerating neighborhood quality decline by generating abandonment.

5.3.1.1 An Alternative in the Same Spirit

If the mortgage is held to maturity, the 235 program works the same as simply reducing the price of the house. That is, the per period payments can be the same regardless of whether a below market rate is paid on a larger mortgage or a market rate is paid on some smaller mortgage. Therefore, if the federal government is willing to essentially do the same thing as reduce the price of a housing unit, it might as well do it directly. If the price were subsidized directly, the down payment could remain the same while equity would initially be much higher. Thus, abandonment would not be such a problem. Of course, this kind of program would have to control the proceeds of a sale so that participating families are not just extracting capital gains (i.e., immediately selling their house at its market value) at the expense of the general taxpayer.

5.3.2 Homesteading

Several city governments have initiated their own homeownership programs. These programs have been called urban homesteading because of having features which are similar to the price, residency, land clearing, and building requirements of rural homesteading.[1] A low initial

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[1]This is a reference to the original Homestead Act of 1862.

price is charged the urban homesteader who is required to live in the previously abandoned house for a specified period of time and also rehabilite within some time frame.

Philadelphia, Wilmington, Baltimore, and Washington, D.C. have initiated homesteading programs while other cities, like Detroit, have been said to be interested. Councilman Joseph E. Coleman of Philadelphia was instrumental in getting Philadelphia's homesteading program underway and in generating interest elsewhere.[1] Councilman Coleman expressed a concern with what this paper called an externality or efficiency problem by saying "We wouldn't put one family in a block with 15 abandoned houses." However, this statement of tactics may suggest an underestimate of the role of externalities in eroding property value and accelerating abandonment.

To be a success in the limited sense of not producing another round of abandonment, the homesteading neighborhood must be protected from external costs spilling in from surrounding neighborhoods.[2] In addition, the city must initially own all or nearly all of the properties in a homesteading neighborhood in order to ensure that there is sufficient uniformity of purpose and control. One might argue that the number of units must be sufficient to be a neighborhood in some social sense, otherwise a "state of seige" mentality may develop causing homesteaders to think that neighborhood conservation is hopeless.[3]

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[1]"Using Homesteaders to Restore the Cities," Business Week, September 1, 1973, p. 22.

[2]Buffers can be created by slum clearance and highway building. Such tactics are sure to be resented and opposed by surrounding residents. The distributional effects of this approach may be substantial and may be perverse (i.e., from lower to higher income groups).

[3]However, this viewpoint must be tempered, because a large scale neighborhood reduces the likelihood that private negotiations and transactions will be sufficient to produce optimal maintenance and rehabilitation levels. See Section 5.2 on the optimal neighborhood size.

If houses which have been abandoned but maintain positive value (i.e., the possibility discussed regarding the 235 program) are sold to homesteaders, the homesteading is a version of the price reduction subsidy discussed previously as an alternative to the 235 program. The difference is that residency requirements, instead of controlling the proceeds of a sale, keep the homesteader from achieving immediate capital gains.

If houses which have been abandoned because the owners perceive them to have zero value, are sold to homesteaders, it is important to ask why one would suspect that a homesteader will fare better than the previous owner who chose to abandon the building. How will the environment of the homesteader differ from that of the previous owner? If property tax treatment is substantially better, the point should be made that this treatment, if extended to the previous owner, might have turned the tide against abandonment or, at least, delayed abandonment. If the difference is that the homesteader will be surrounded by other homesteaders the question--even for this hardy breed--is whether the cluster is large enough and protected enough to survive the hazards of inner city living.

One could argue that the homesteader differs from the previous owner in that he is committed to rehabilitation. However, this commitment may only be a temporary aberation, because the homesteader may not be cognizant of the risks he faces. His commitment may be ended by his own abandonment of the building after becoming wiser and poorer as a result of the homesteading experience.

Generally there is a long time lag between abandonment and the acquisition of title by the city. In the intervening period, abandoned units can suffer great quality declines. Copper pipe and wiring may be stolen; fires may be started. Thus, the already high cost of rehabilitation is driven still higher, making successful rehabilitation by homesteading or by any other means highly unlikely. The rehabilitation of abandoned housing requires rapid acquisition of title by the public sector and protection from vandalism if cost are to be less than astronomical, and this is no small feat.

5.3.3 An Alternative to Homeownership Programs

A more reasonable course of public action may be away from encouraging homeownership (at least conventional homeownership). One alternative course in this direction is to encourage the ownership of entire neighborhoods by one party.[1] This alternative to homeownership programs certainly has problems of its own.[2] However, it is useful because it sets the problems of encouraging homeownership in high relief (i.e., the reason for discussing the single party ownership of neighborhoods (SPOON) is not as much to provide a viable alternative to homeownership

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[1] For this purpose, a neighborhood is a cluster of residences which is surrounded or nearly surrounded by some type of buffer zone.

[2] A devastating argument against such a program is that it requires land assembly. If there is a surplus (or plottage) to be gained by the land assembly, it will be extracted from the buyer-assembler by the sellers. As land assembly progresses, each seller tries to extract all the surplus to be gained by the assembly operation. The land assembly problem can be described in terms of monopoly power. Because contiguous plots are required, each plot acquires unique characteristics (positions in space) and monopoly power. The existence of this monopoly power is the most coherent argument for the use of the power of eminent domain. Eminent domain is the right of a state to take real property for public purposes. The exercise of this power requires that compensation be made to the property owner. This compensation is supposed to compensate the owner for his loss not the state's gain. Thus, the owner is not supposed to be able to extract monopoly profit from the assembly operation. However, there are serious questions as to whether eminent domain functions in practice as it is supposed to.

Another criticism of such a program which can be anticipated is that the single owners themselves would have monopoly power and would extract monopoly profits from their tenants. We admit to this possibility but suggest that a basic feature of this policy should be to create a sufficient number of neighborhoods so that the monopoly power is held in check. In large cities a number of neighborhoods can be identified. Public capital, e.g., roads, freeways, museums, universities, and hospitals, often serve to provide a buffer zone separating neighborhoods. Part of such a program could include consideration of how future public capital can divide the city into more neighborhoods and more identifiable neighborhoods.

programs as to illustrate certain failings of homeownership programs by examining positive features of a very different type of program). This acronym, SPOON,[1] and the policy itself are not expected to hold much popular appeal. Nevertheless, the policy, at least, is no more bizarre than homeownership programs.

The externalities which are so destructive to neighborhood conservation would be internalized by a SPOON (i.e., otherwise external costs produced by the undermaintenance of one building would accrue to the single owner). The efficiency of resource allocation would thus be improved. Maintenance and rehabilitation would be increased. Abandonment would occur less rapidly and less piecemeal, as individual buildings which are no longer profitable would very likely not be abandoned until the entire neighborhood becomes unprofitable and is abandoned. This is because piecemeal abandonment would accelerate the value decline and the need to abandon the entire neighborhood.

In addition to internalizing externalities, the SPOON would mean less fragmented power when dealing with municipal government on questions of municipal housekeeping (e.g., garbage collection and police protection. Furthermore, the SPOON would make economies of scale possible in maintenance and rehabilitation.[2]

5.3.4 Other Alternatives

Given instability in land tenure, condominium and cooperative ownership may generate higher levels of maintenance and rehabilitation than conventional homeownership. Condominiums and cooperatives may work like a SPOON if they are neighborhood wide; single building condominiums

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[1]Initially we referred to this policy as SNOP, Single Neighborhood Owner Program. However, SNOP proved to be an especially unpalatable acronym. Thus, we changed the name to SPOON.

[2]Economies of scale in maintenance and rehabilitation require both unified ownership and relatively uniform buildings. Thus nearly identical townhouses are more likely candidates than custom designed homes.

or cooperatives are generally not sufficient to prevent spill-ins and to capture all the benefits of maintenance and rehabilitation.

With condominium ownership, each housing unit may be owned privately by the occupant, but other property is owned in common. By buying a condominium, owners are voluntarily joining an association which will coerce them and their neighbors to maintain the common property at some agreed on level. The individual owners will be "taxed" for the operation and maintenance of the condominium. This may lead to higher levels of maintenance expenditure than would be the case under atomistic decision-making. There may be additional advantages like economies of scale in purchasing maintenance supplies and services, however, the main point is that individuals voluntarily join a public goods producing club from which dropouts or free-riders are not allowed.

Cooperative ownership is similar to condominium ownership with respect to how negotiation for neighborhood quality is formalized[1] and to the possibility for scale economies in maintenance and rehabilitation, however, there is an important difference. Since cooperative owners are merely renters of their individual units, more aspects of the entire property's maintenance and rehabilitation may be controlled by the owners acting in concert with cooperative ownership than with condominium ownership.[2]

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[1]"Taxes" or fees finance maintenance of condominums; generally rental payments finance maintenance of cooperatives.

[2]This analysis of a condominium and cooperative ownership should not be construed as suggesting that these ownership forms have only ameliorative effects. In fact, transition in land use may be significantly more difficult with condominium and cooperative ownership than with single party ownership of land. The problems of assembling rights would, of course, be much more severe than if entire neighborhoods were owned by a single party (i.e., SPOON). Cooperative or condominium ownership may pose such serious problems for assembly operations that abandonment or public taking is required before transition in land use can take place.

Neighborhood-wide condominiums and cooperatives are interesting ownership forms because they provide for the intra-neighborhood negotiations and transactions which are so essential for neighborhood conservation. Of course, it is recognized that a structured system of negotiations and transactions to achieve neighborhood conservation is more important in low income neighborhoods than in high income neighborhoods.

A similar way to attack allocative problems causing neighborhood quality decline is through deed restrictions. Again the idea is that the members of the club voluntarily submit to the requirement to produce public goods or not to produce public bads (i.e., external costs). Again the decision is made at the time of purchase. However, there are questions as to whether the coercion can be as complete with deed restrictions as with condominium or cooperative ownership. For example, nonpayment of the condominium "tax" will result in a lien on the property. However, violation of deed restrictions may be more difficult to redress. Of course, these tools can be used together controlling different aspects of neighborhood quality.

6. SUMMARY AND SUGGESTED DIRECTIONS FOR FUTURE RESEARCH

6.1 Summary

In Chapter 2, a model of individual owner or firm behavior is developed. In the model the owners' investment decisions are based on factors such as the price of housing services, the cost of operation, the cost of maintenance and rehabilitation (i.e., the cost of investment), and the technical relationship between the output, housing services, and the inputs, housing stock and operation. Certain conditions under which abandonment will take place are outlined using the model. This model is linked to a model of the aggregate housing market in which the stock of housing changes through net depreciation, rehabilitation (i.e., net investment in existing housing), and new construction. The workings of these models are illustrated by showing the impact of changes in factors such as stock demand, the rate of interest, the rate of depreciation, and the cost of new construction.

Chapter 3 uses variations of the models developed in Chapter 2 to analyze a number of issues. It is shown that accelerating the rate of technological change in new housing and thereby accelerating the rate of filtering-down may have some good effects, but it will exacerbate blight. Technological improvement which reduces the cost of maintenance and rehabilitation would increase maintenance and rehabilitation activities but could not end and might not even reduce problems of too little resources being allocated to these activities as a result of externalities. Rent control is shown to result in a decline in housing stock by using a demonstration which is very different from, and superior to the typical textbook demonstration of that proposition. An extension of the firm model is developed in order to show the impact of the property tax. The property tax is shown to be a disincentive to invest in housing and to accelerate the physical decline of buildings which are declining in value as a result of tax rates being inflexible downward.

Chapter 4 deals with the factors which are important to the creation and the disruption of the delicate social contracts essential for neighborhood conservation. Generally informal and even unspoken, these social contracts consist of agreements to paint at regular and frequent intervals, to repair when needed, to contain garbage, to testify against criminals, and do a myriad of other things which produce neighborhood quality. In the context of strategic choice as illustrated by the well-know, bilateral game situation called the prisoners' dilemma, cooperative behavior is shown to be highly unlikely without each of the owners having long experience in interacting with the other in order for them to be assured that the other is likely to cooperate. Going beyond strategic choice, Chapter 4 deals with the collective choice of neighborhood quality where there is interdependence among many decision makers. Stable neighborhood clubs are shown to be necessary for neighborhood conservation. Enlightened self-interest along with cost sharing, compliments, and ostracism are discussed in Chapters 4 and 5 as being the tools of enforcing club stability against the threat of free-riders.

In addition to exploring the general factors determining the chances of club success, Chapter 5 takes an in depth look at two types of factors: neighborhood size and the ownership characteristics. Neighborhood size is shown to be related to the cost of preventing spill-ins and to the chances of club success so that there may be an optimal size or range of sizes. It is argued that the public sector can influence neighborhood size through the spatial distribution of public capital. The analysis of ownership characteristics indicates that the conditions for conventional, individual homeownership promoting neighborhood conservation are more restrictive than conventional wisdom would have it. The 235 program and urban homesteading programs are analyzed. In addition, a number of alternatives to conventional homeownership programs are analyzed. These include a single neighborhood owner and a neighborhood-wide condominium.

6.2 Suggested Directions for Future Research

A number of theoretical and empirical directions for future research are suggested by the work in this paper. This section begins by pointing out several of these directions. Then this section turns to a discussion of two directions which are different from the analysis in this paper and which appear to be promising.

The models developed and applied in Chapters 2 and 3 provide a foundation for future econometric work related to maintenance, rehabilitation, and abandonment. Much needs to be done on providing estimates of how the housing market adjusts to changes in demand and the other exogenous factors described in Chapters 2 and 3.[1]

In terms of theory, the section in this paper on rent control may be viewed as an interesting but relatively undeveloped departure from conventional analysis. More should be done on the search and vacancy aspects of the model. The differential between what tenants pay and what landlords receive should be more tightly integrated into the theoretical structure.

The role of the income tax could be analyzed by extending the models developed in Chapter 2 to include the more significant aspects of the tax. While such an extension of the model would be somewhat difficult to achieve, it is feasible. Furthermore, this extension should prove interesting as it would provide some understanding of the impact

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[1]For an example of this type of work, see Lawrence B. Smith, "A Note on the Price Adjustment Mechanism for Rental Housing," American Economic Review, June 1974, pp. 478-81.

of the income tax on the frequency of ownership changes (i.e., turnovers) and on the rates of maintenance and rehabilitation which would be privately optimal. Chapters 4 and 5 of this paper have already provided a link from turnover rates to the level of neighborhood conservation activity where neighborhood effects are significant.

We need a greater understanding of the conditions under which voluntary associations of producers of neighborhood quality (i.e., clubs) are created, maintained, and broken down. This involves both theoretical and empirical research. For example, the determination of the optimal neighborhood size or range of sizes is an empirical question. However, more work of a theoretical nature needs to be done to specify models which will allow coherent empirical work to progress.

Many interesting research directions related to abandonment and rehabilitation are to be found outside the analytical confines of this paper. The role of the public sector in containing slums and the effects of anticipated eminent domain condemnations are two.

In many countries, slums are a suburban phenomenon, and they consist primarily of new structures rather than converted old structures. In this country, local governments' police powers such as zoning, building codes, and subdivision regulations have had the effect of eliminating the possiblity of the development of new slums in the suburbs. The impact of this slum containment policy on the rate of slum formation and neighborhood decline in the older parts of metropolitan areas is not well understood. Research in this area should be very rewarding.

It would be useful to know the extent to which rumors and more precise knowledge of impending highway building and urban renewal projects contribute to abandonment. In addition to estimates of this impact, a theory of why such an impact exists is necessary if policies are to be introduced which can counteract this impact. It may be that court accepted appraisal practices encourage landlords who anticipate that their property will be taken by the public sector to raise their net cash flow and appraised value. They do this by reducing costs, primarily maintenance costs. This is a risky game in which a long lag between rumor and the actual condemnation may cause the owner to abandon his uninhabitable property or at least allow it to become vacant. These abandoned and vacant hulks generate substantial external costs which accelerate the rate of decline of neighboring buildings and of neighborhood quality in general.

APPENDIX I: AN ALTERNATIVE MODEL OF FIRM BEHAVIOR

This alternative model differs with respect to the depreciation rate and, therefore, the value function, but the cost function is the same. In this version, depreciation is linear in time and all housing stock has the same life (T). The depreciation rate is a function of past levels of investment rather than the stock of housing as in the first version. The depreciation rate can be expressed in the following way:

$$d_o = \frac{1}{T} \int_{-T}^{0} I(t)\, dt$$

The life of a unit of housing stock (T) should not be confused with the life of a house (i.e., except when no maintenance is undertaken).

As in the first version, the slope of the value function is the present value of the residual cash flow which would accrue to a unit of investment made in the present. Therefore, the value function is as follows:

$$\dot{V} = I \int_{0}^{T} (p\gamma - w\alpha)\left(1 - \frac{t}{T}\right) e^{-rt}\, dt$$

The value function may be simplified as follows:

$$\dot{V} = [p\gamma - w\alpha] \left[\frac{e^{-rT} - 1}{Tr^2}\right] I$$

In this version, the rate of depreciation is not a function of the housing stock as in the previous version. Thus, this verison is more complex. However, it works much the same, and it offers the advantage of having a finite time horizon. Note that the time horizon in this version is T. Therefore, this version requires the expectation of constant prices only through T.

Also, this version may be more relevant for a model which envisions the possibility of abandonment. For example, continued zero gross investment would lead to zero housing stock and abandonment in a finite period (T).

APPENDIX II: IMPACT OF THE PROPERTY TAX

The variable T is the present value of the ad valorem tax on a unit of housing stock. In order to obtain an expression for T, we must first determine the value of an asset which faces an ad volorem tax as a function of net income y(t) excluding the tax cost. We know that the value of an asset is the present value, V(0), of the net income stream g(t) including the tax cost. That is,

$$V(0) = \int_0^\infty g(t)e^{-rt}\, dt$$

where $g(t) = y(t) - \Theta V(t)$ and where Θ is the true ad valorem tax rate which is the product of the assessed value to market value ratio and the tax on a dollar of assessed value. V(t) satisfies the differential equation:[1]

$$\frac{dV(t)}{dt} = -g(t) + rV(t).$$

By substitution, we obtain

$$\frac{dV(t)}{dt} = -y(t) + (r + \Theta)V(t).$$

The solution of the differential equation directly above is as follows:

$$V(t) = e^{(r + \Theta)t}(K - \int_0^t y(x)e^{-(r + \Theta)x}dx)$$

where K is set so that the present value of the asset tends toward zero as t approaches infinity.

$$K = \int_0^\infty y(x)e^{-(r + \Theta)x}dx.$$

To be consistent with our previous assumption about the negative exponential process of deterioration and obselescence.

$$y(t) = ye^{-\phi t}.$$

Therefore, $K = \frac{y}{r + \Theta + \phi}$, and $V(t) = \frac{ye^{-\phi t}}{r + \Theta + \phi}$.

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[1] This approach was suggested by Joel Levy, Economist, Building Economics Section, Center for Building Technology, National Bureau of Standards.

The present value of the ad valorem tax is as follows:

$$T = \int_0^\infty \Theta V(t)e^{-rt}\, dt.$$

By substitution, we obtain

$$T = \int_0^\infty \frac{\Theta y e^{-(r + \Theta)t}}{r + \Theta + \phi}\, dt.$$

Substituting the preceding statement of the present value of the ad valorem tax into the value function, we obtain

$$\dot{V} = \left(\frac{y}{r + \phi} - \frac{\Theta y}{(r + \Theta)(r + \Theta + \phi)}\right) I$$

Partially differentiating the difference between the value function and the cost function (e.g., $C = B_oI + B_1I^2$) with respect to gross investment yields the following expression:

$$\frac{\partial(\dot{V} - C)}{\partial I} = \frac{y}{r + \phi} - \frac{\Theta y}{(r + \phi)(r + \Theta + \phi)} - \beta_o - 2\beta I.$$

Setting the partical derivative above equal to zero maximizes the difference between the value and cost functions. Therefore, we can solve for the optimal rate of gross investment, I*.

$$I^* = \frac{\frac{y}{r + \phi} - \frac{\Theta y}{(r + \phi)(r + \Theta + \phi)} - \beta_o}{2\beta_1}$$

Taking the partial derivative of the optimal rate of gross investment with respect to the tax rate, we have

$$\frac{\partial I^*}{\partial \Theta} = - \frac{y}{2\beta_1(r + \Theta + \phi)^2}$$

The partial derivative directly above shows that the optimal rate of gross investment will decrease if the tax rate is increased. This demonstrates that the property tax is a disincentive to investment. In this light, tax exemptions may be rationalized.

BIBLIOGRAPHY

Bagby, D. Gordon, Housing Rehabilitation Costs, D.C. Heath and Company, 1973.

Brown, Douglas M., Introduction to Urban Economics, Academic Press, N.Y., 1974.

Buchannan, James M., "A Behavioral Theory of Pollution," Western Economic Journal, December 1968.

Buchanan, James M., "Cooperation and Conflict in Public-Goods Interaction," Western Economic Journal, March 1967.

Davis, Otto A., and Andrew B. Whinston, "The Economics of Urban Renewal," Law and Contemporary Problems, Winter 1961.

Desalvo, Joseph S., "Effects of the Property Tax on Operating and Investment Decisions of Rental Property Owners," National Tax Journal, March 1971.

Dildine, Larry L., and Fred A. Massey, "Dynamic Model of Private Incentives to Housing Maintenance," Southern Economic Journal, April 1974.

Friedly, Philip H., "Experimental Approaches to the Amelioration of Housing Abandonment and Neighborhood Decline," Paper presented at the 1971 Meetings of the AREUEA in New Orleans, December 1971.

Gould, J.P., "Adjustment Costs in the Theory of Investment of the Firm," Review of Economic Studies, January 1968.

Higgins, Richard S., "Microeconomic Foundations of Investment and Stock-Flow Analysis," Western Economic Journal, March 1972.

Hirshleifer, Jack, "On the Theory of Optimal Investment Decision," Journal of Political Economy, 1958.

Ingram, Gregory K., and John F. Kain, "A Simple Model of Housing Production and the Abandonment Problem," AREUEA Journal, June 1973.

Kohler, Heinz, Economics and Urban Problems, D.C. Heath & Co., Lexington, Mass., 1973.

Linton, Mields, and Coston, Inc., A Study of Abandoned Housing, NTIS PB No. 212198, February 1971.

Listokin, David, and George Sternlieb, Rehabilitation Versus Redevelopment: Cost-Benefit Analysis, Center for Urban Policy Research, Rutgers University, New Brunswick, N.J., 1973.

Lowry, Ira S., "Filtering and Housing Standards: A Conceptual Analysis," Land Economics, November 1960.

Luce, R. Duncan, and Howard Raiffa, Games and Decisions, John Wiley and Sons, New York, 1957.

Muth, Richard F., Cities and Housing: The Spatial Pattern of Urban Residential Land Use, The University of Chicago Press, Chicago.

National Housing Policy Review, Housing in the Seventies, Department of Housing and Urban Development, October 1973.

National Urban League and the Center for Community Change, National Survey of Housing Abandonment, New York, April 1971.

Olsen, Edgar O., "Competitive Theory of the Housing Market," American Economic Review, September 1969, pp. 218-224.

Real Estate Research, Possible Program for Counteracting Housing Abandonment, HUD, 1971.

Smith, Lawrence B., "A Note on the Price Adjustment Mechanism for Rental Housing," American Economic Review, June 1974, pp. 478-481.

Sternlieb, George, "Abandonment and Rehabilitation: What Is to Be Done?" Papers Submitted to the Subcommittee on Housing Panels on Housing Production, Housing Demand, and Developing a Suitable Living Environment, Part 1, Committee on Banking and Currency, House of Representatives, June 1971.

Sternlieb, George and Robert W. Burchell, Residential Abandonment: The Tenement Landlord Revisited, Center for Urban Policy Research - Rutgers University - The State University of New Jersey, New Brunswick, N.J., 1973.

Thompson, Wilbur R., A Preface to Urban Economics, The Johns Hopkins Press, Baltimore, 1965.

"Using Homesteaders to Restore the Cities," Business Week, September 1, 1973, p. 22.

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This paper is an analysis of market and governmental factors which lead to socially inefficient rehabilitation and abandonment decisions. Its purpose is to abstract from complex problems related to the rehabilitation and abandonment of residential buildings by identifying the essential characteristics of the problems and the role some past and existing social programs have had on aggrevating or mitigating these problems. Alternative programs are analyzed for their potential effects on these problems, however policy recommendations are not made.

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