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ABSTRACT

In this paper we assume that rents cannot be differentiated from one tenant to another even though the value of different types of tenants may differ for landlords. On the other hand, there is uncertainty about the true characteristics of tenants when choises are to be made. However, landlords can classify tenant candidates into classes using some identifiable characteristic which is expected to be related to the value of lease. We assume two classes (like households with and without children) such that landlord's expected maintenance costs of his rental unit can be taken to differ in the classes. The landlord also has subjective conceptions of the arrival rates of the two types of tenant candidates. We solve the landlord's optimal policy for choosing a tenant to his vacant unit assuming a finite (intended) lease duration. In our first model the optimal policy is simply characterized by a time-point, t_2, such that before it only "good" tenants are acceptable whereas after it any type is acceptable. When expected costs of getting rid of tenants at the end of intended lease period are taken into account optimal policy becomes different. Assuming differences in the latter costs we can get two switches in optimal policy, too. The basic model is applied to discuss the effects of inter-urban mobility on discrimination under rent control and to consider the determination of bribes that make different types of tenant candidates equal from the landlord's point of view. Finally, we present some empirical evidence on discrimination as experienced by Finnish housing allowance recipients.

In the following we shall formulate a simple discrimination model the purpose of which is, among other things, to show that discrimination is not necessarility of absolute type: never rent to certain type(s) of tenants. Rather, in addition to differences among landlords, the same landlord may be discriminatory first and non-discriminating later. In our model discrimination (when it emerges) is based on differences in monetary rewards in case of different kinds of tenants. In effect we assume that tenant candidates differ by expected maintenance costs, only.[1] The model will be extended to cover differences in the costs of getting rid of different types of tenants at the end of intended lease period in section 3. To keep our model simple, let us assume that the landlord classifies applicant households into two classes w.r.t. expected maintenance costs. Let the low maintenance cost type be labelled with index 1 and the high maintenance cost type by 2, resepectively.

Consider the following situation. A landlord has a single vacant unit to which it is looking for tanants. As for the landlord´s search technology we may think that he either answers ads of households searching for such (in broad sense) rental units he has or places his own ads with associated costs. As for the asking rent, we assume that the landlord cannot differentiate it according to the type of household as he obviously tells it e.g. in phone not knowing the characteristics of the inquirer.[2] The landlord´s decision problem is, what kind of tenant applicants should it accept at each point of time

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1 Note that pure discrimination can also be analyzed with our model if we interprete the maintenance costs to include the monetary equivalant of tolerating the race of the tenant.

2 In Arrow /1973/ the author adresses himself specifically to racial discrimination in the labour market and considers the emergence of wage differentials. He notes that for the most part the analysis extends e.g. to sexual discrimination. Referring to housing, insurance and capital markets he notes, however, that the operation of these markets has led more often to simple exclusion and less to price differentials. In our analysis rents cannot be differentiated and we study the nature of "exclusion".

during search as its objective function is to maximize expected discounted net profits. In order to make the choice of tenant type endogenous, we assume that the landlord can refuse to rent (in a way or another) his vacancy to either type of candidate if he wants it.

Above we recognized the problem of choosing among different types of tenants. More generally there are, however, the options of keeping the vacancy idle and not seacrhing and finally the one of selling the dwelling in order to invest elsewhere. In order to concentrate on the discrimination problem, only, and neglect the other options, here, we assume that the landlord plans to own the dwelling for the purpose of renting it till some fixed point of time in the future. Further, to simplify we assume that to keep the vacancy idle is always less advantageous than to search for a tenant during the relevant horizon.

At this stage we note that our problem is similar to that of Lee and Warren /1976/ who consider a landlord's problem of choosing between white and black tenants. Here the landlord makes a rental decision for a vacant unit at $t_0 = 0$ at which he makes two decisions: when to let the unit and to whom to let it assuming that a) he preferes white to black tenants and more to less wealth b) the duration of the lease (once it begins) is fixed, the decision horizon in itself being infinite c) black tenants are abundant whereas white ones are scarce. The authors solve the problem as a non-sequential decision problem by employing a somewhat special utility function.[1] The solu-

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[1] Lee and Warren solve the optimal t by maximizing landlord's utility function, $U = U(W(t),P(t))$ w.r.t. t. Here W(t) is the present value of rental income (evaluated at $t_0=0$) received by renting the unit at time t to anyone, black or white, and P(t) is the landlord's estimate of the probability of finding a white tenant by t assuming a Poisson process behind the rate of arrival of whites. The U-function is assumed to have positive and decreasing marginal utilities. At optimal t the marginal rate of substitution of W for P, $(\partial U/\partial W)/(\partial U/\partial P)$, is equal to the ratio of the increase in the probability of finding a white tenant by t to the decrease in the present value of rental income necessary for the increase in P at t, $-(dP/dt)/(dW/dt)$.

tion to this decision problem is summarized by a single time-point t (measured in real time) at which the landlord plans to rent the tenancy to anyone, black or white, $(t-t_0)$ being the lenght of time he plans to wait for a white tenant.

As we shall also derive a critical time-point at which landlord´s acceptance policy changes, we point out some implications of using a non-sequential formulation like Lee and Warren. First, in a sequential decision framework (which we shall employ below), there would not be a policy change in L&W´s (infinite horizon, fixed lease duration) case if the "dis-taste" for blacks were related to <u>having</u> a black tenant and not to some ex ante probability (c.f. footnote 1 on previous page). Namely, then the landlord would either always or never discriminate. Secondly, suppose the landlord "forgot" the optimal t and recalculated it the next day. But now he would get a different solution and he would discriminate blacks one more day as compared to the original solution if he were unsuccessful in finding whites.

The <u>plan</u> of our paper is as follows. In section 1. we present our basic sequential model in which there are two types of tenants which are expected to differ by maintenance costs (of the rental unit), only. In section 2. we apply this model to discuss the effects of inter-urban mobility on landlords discriminatory behaviour under conditions of rent control. Further, we discuss the determination of bribes which would make a "bad" tenant equal to a "good" one. In section 3. we extend the model to take into account differences in expected costs of getting rid of the two types of tenants. In section 4. we present some empirical evidence on discrimination experienced by Finnish housing allowance recipients. Finally, section 5. offers some conclusions.

1. THE MODEL

For the purpose of formulating our sequential decision model we introduce the following notation:

i	=	index referring to the type of household ($i= 1,2$)
R	=	gross rent
C_i	=	expected maintenance plus other running costs of the rental unit for type i tenant
r	=	landlord's costs of searching for a tenant plus the costs of keeping the tenancy idle
α	=	landlord's subjective rate of time preference
t	=	(reversed) time concept measuring the remaining duration of intended lease period
$B(t)$	=	$(1/\alpha)\ (1 - \exp(-\alpha t))$ = discount factor
$u_i(t)$	=	expected (Poisson) intensity that type i household visits the offered rental unit and finds it acceptable at t
$V(t)$	=	expected discounted net profits when <u>searching</u> for a tenant at time-point t
$W_i(t)$	=	expected net profits of <u>having</u> a type i tenant at t

Note especially that we use a reversed time concept such that it measures the remaining duration of intended lease period. Thus, at $t= 0$ the landlord plans to use the rental unit for some other purpose that letting it. On the other hand the lease will last uninterruptedly from the moment an acceptable tenant has been found till $t= 0$. Secondly, we shall assume that

$$(1) \qquad u_i(0) = 0;\ \dot{u}_i(t) > 0 \qquad (i= 1,2)$$

i.e. the longer the lease (the greater t), the easier it is to find a tenant.

Assuming that the landlord is risk neutral, the optimization problem of the model can now be formulated as follows: Assuming that the landlord is searching for a tenant to his vacant rental unit at time-point t, one has to determine what types of tenant candidates are acceptable such that V(t) is maximized. As for the parameters of the problem (listed above) we shall assume that they are invariant over time. I.e. our model will be formulated in stationary conditions and we confine ourselves to non-adaptive behaviour.

Assume that it is costless to get rid of any type of tenant at the end of intended lease period (at t=0). Then

$$(2) \qquad W_i(0) = V(0) = A \ (=\text{constant}) \qquad (i= 1,2)$$

During $t > 0$ the present value of net profits of having a type i (i= 1,2) tenant can be written as

$$(3) \qquad W_i(t) = (R - C_i)\, B(t) \qquad (i= 1,2 \ ; \ t > 0)$$

As we assumed that

$$(4) \qquad C_1 > C_2$$

this implies that we also have

$$(5) \qquad W_1(t) > W_2(t) \qquad (t > 0) \ .$$

By differentiating (3) w.r.t. t we get

$$(6) \qquad \dot{W}_i(t) = (R - C_i)\, \exp(-\alpha t) > 0 \qquad (i= 1,2; \ t \geq 0)$$

Next, consider the expected present value of net profits, V(t), of a landlord searching for a tenant to his vacant rental unit. For V(t) we get the following functional equation for $t \geq 0$

$$(7) \qquad \dot{V}(t) = - r - \alpha V(t) + \sum_{i=1}^{2} \sigma_i(t) \left\{ u_i(t) [W_i(t) - V(t)] \right\}$$

where $\sigma_1(t)$ and $\sigma_2(t)$ are control (and landlord's decision) variables.

To construct the optimization problem we, to be genearal, assume that $0 \leqq \sigma_i(t) \leqq 1$, $(i = 1,2)$ and write the Hamiltonian of the problem as

$$(8) \qquad H(\lambda, V, t, \sigma_1 \sigma_2) = \lambda(t) \left\{ - r - \alpha V(t) + \sum_i \sigma_i(t) \left(u_i(t) \cdot [(W_i(t) - V(t))] \right) \right\}$$

For optimal values of control variables $\sigma_i(t)$, $(i = 1,2)$, i.e. values that maximize V(t), we have

$$(9) \qquad H(\lambda, V, t, \sigma_1, \sigma_2) = \max_{s_1, s_2} H(\lambda, V, t, s_1, s_2)$$

As the RHS of (8) is linear w.r.t. $\sigma_i(t)$ $(i = 1,2)$, this implies that the optimal controls will be of bang-bang-type having values 0 and 1 only. Further, as $u_i(t)$ $(i = 1,2\ ;\ t>0)$ is assumed to be positive, in order to the Hamiltonian to be maximized optimal policy must be of the following form

$$(10) \qquad \sigma_i(t) \left\{ \begin{matrix} = 0 \\ \\ = 1 \end{matrix} \right\} \text{ when } W_i(t) - V(t) \left\{ \begin{matrix} \leqq 0 \\ \\ \geqq 0 \end{matrix} \right\} \quad (i = 1,2)$$

The switches of optimal bang-bang controls take place when $W_i(t) = V(t)$. We assumed above that if the landlord is unsuccessful in his search, it is more advantageous to search till t= 0 rather than stop searching and keep the rental unit idle. This implies that at least the best type of tenants (i= 1) must be acceptable for all t>0. Accordingly, we must have $\sigma_1(t) = 1$ for all t>0, too, such that the nontrivial optimization problem is actually related to $\sigma_2(t)$.[1]

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[1] If $\sigma_i(t) = 0$ for $i = 1,2$, then $V(t) = -rB(t) < W_2(t) < W_1(t)$, when A in (2) is set equal to zero without loss of generality.

Further, we note thet if the landlord expects to get (and gets during search) tenant candidates of type 1 at each point of time with certainty, then $\sigma_1(t) = 1$ and $\sigma_2(t) = 0$ for all $t>0$. Thus, to have a real problem (or an interior solution) at all there must be at least some uncertainty of getting a type 1 tenant, i.e. for $t>0$, $0<u_1(t)<\infty$ as we shall assume below.

Referring to optimal policy rule (10) we note that $\sigma_2(t)$ switches from 1 to 0 (or vice versa) at time-point(s) where

$$W_2(t) - V(t) = 0 \tag{11}$$

applies. In the following we shall show that there is maximally one time-point at which such switch takes place and we shall denote it by t_2. Further, we shall show that $\sigma_2(t) = 0$ for $t \geqq t_2$ and $\sigma_2(t) = 1$ for $0<t \leqq t_2$.

First, referring to (2) above, we can set $A= 0$ under the assumptions em-ployed without any loss of generality such that

$$W_2(0) = V(0) = 0. \tag{12}$$

Then, using (6) and (7) we get the following inequality for right hand side derivatives evaluated at $t= 0$

$$\dot{W}_2(0+) = (R-C_2)\exp(-\alpha t) > - r = \dot{V}(0+) \ . \tag{13}$$

(12) and (13) above imply that at least for "small" positive values of t we necessarily have

$$W_2(t) > V(t) \qquad \text{(for "small" positive t).} \tag{14}$$

This implies that if the landlord has been unsuccessful in his search for an acceptable tenant, at the end of the decision horizon there is at least a phase during which both types of applicants ($i= 1,2$) are acceptable.

I.e. if at the last moment a type 2 candidate appears (and no type 1 candidate is available) he gets the (short) lease.

For later purposes and in order to clarify the nature of optimal policy we note that V(t) refers to the maximal expected present value of net profits. Let us denote the expected present value of net profits when type 1 household alone is regarded as acceptable during all t>0 by $V_1(t)$. Respectively, let $V_{1,2}(t)$ refer to expected discounte net profits when both types, 1 and 2, are regarded acceptable during all t>0. Thus generally we have the relations, $V(t) \geqq V_1(t)$ and $V(t) \geqq V_{1,2}(t)$.

Equations (13) and (14) imply that at least for "small" t we have the following relations (c.f. Figure 1)

$$W_2(t) > V(t) = V_{1,2}(t) > V_1(t) \quad \text{(for t small positive)} \tag{15}$$

If there is a (first) switch in optimal policy at, say t_2, then we have at t_2 the following

$$W_2(t) = V(t) = V_{1,2}(t) > V_1(t) \qquad (t = t_2). \tag{16}$$

Further, assuming that t_2 exists, (15) and (16) above imply that at t_2 we necessarily have

$$\dot{W}_2(t_2) \leqq \dot{V}_{1,2}(t_2) \ . \tag{17}$$

On the other hand, exactly at t_2 where $\sigma_2(t)$ switches from 0 to 1, according to (7), (10) and (16) we have

$$\dot{V}(t) = \dot{V}_1(t) = \dot{V}_{1,2}(t) \qquad (t = t_2) \ . \tag{18}$$

To prove that $\sigma_2(t) = 0$ for all $t>t_2$ we have to show that V(t) never intersects $W_2(t)$ during $t>t_2$ any more (c.f. (10)). Having (16) - (18) it suffices

to show that if $\dot{V}(t) - \dot{W}_2(t) = 0$ at some t', $t' \geq t_2$, then we always have $\ddot{V}(t') - \ddot{W}_2(t') > 0$, too.

Assume that at some time-point t', $t' \geq t_2$, we have

$$\dot{V}(t) - \dot{W}_2(t) = 0 \qquad (t = t' \geq t_2) \; . \tag{19}$$

On the other hand, using (7) and noting that at t' we have $\sigma_2(t) = 0$ we get the difference of second derivatives as follows

$$\begin{aligned} \ddot{V}(t) - \ddot{W}_2(t) = & -\alpha \dot{V}(t) + \dot{u}_1(t) \, [W_1(t) - V(t)] \\ & + u_1(t) \, [\dot{W}_1(t) - \dot{V}(t)] - \ddot{W}_2(t) \qquad (t = t') \; . \end{aligned} \tag{20}$$

Noting from (6) that $\ddot{W}_2(t) = -\alpha \dot{W}_2(t)$ and using (19) we can write (20) evaluated at t' as

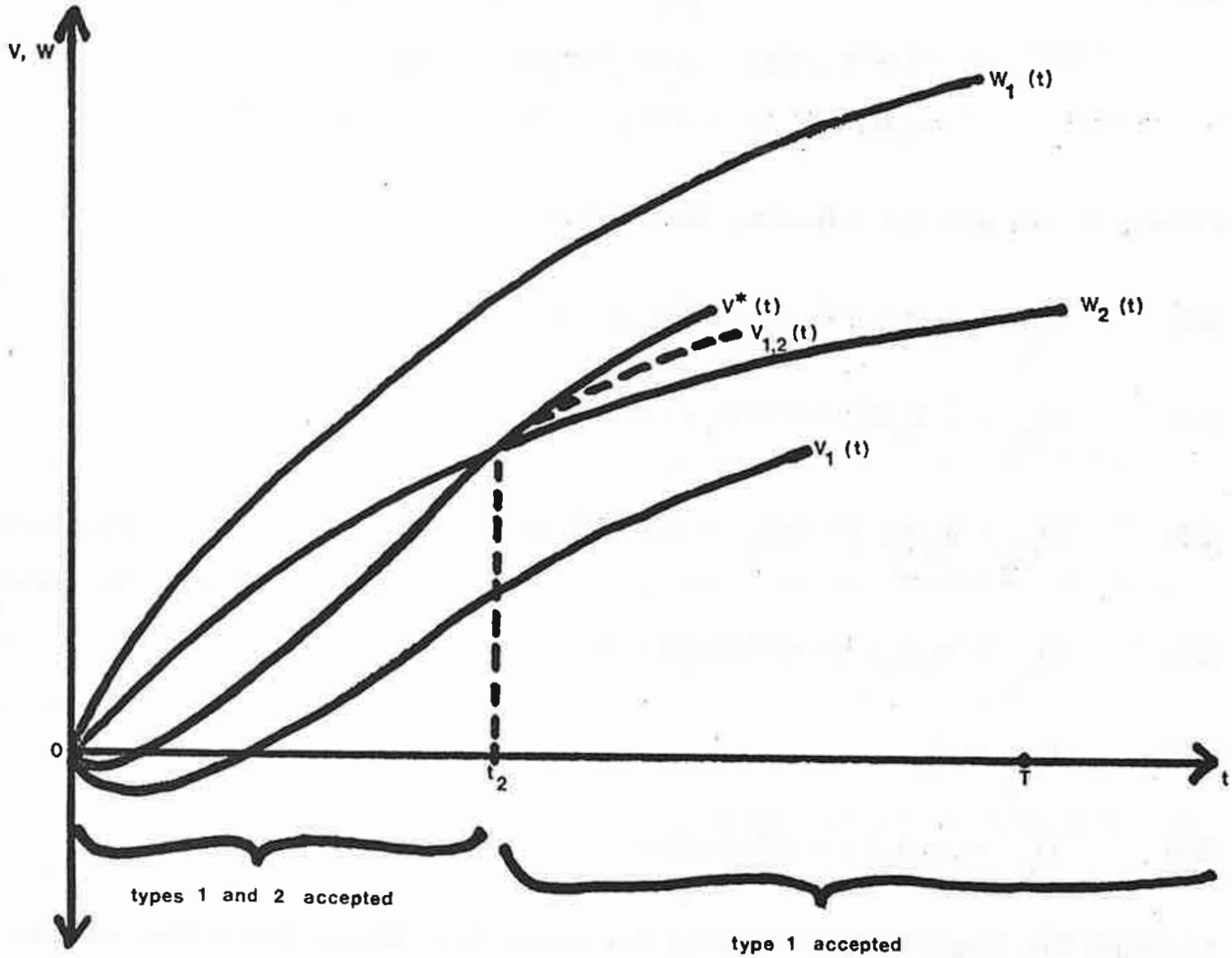
$$\begin{aligned} \ddot{V}(t) - \ddot{W}_2(t) &= -\alpha [\dot{V}(t) - \dot{W}_2(t)] + \dot{u}_1(t) \, [W_1(t) - V(t)] \\ &\quad + u_1(t) \, [\dot{W}_1(t) - \dot{W}_2(t)] \qquad (t = t') \\ &= \dot{u}_1(t) [W_1(t) - V(t)] + u_1(t) \, (C_2 - C_1) \exp(-\alpha t) \\ &> 0 \qquad (t = t') \end{aligned} \tag{21}$$

as we assumed that $C_2 > C_1$, $\dot{u}_1(t) > 0$ (c.f. (4) and (1)) and $W_1(t) \geq V(t)$ as type 1 is the best you can ever get.

To describe verbally what kind of behaviour our model implies, assume first that the landlord's decision horizon is T such that $T > t_2$. Then, at the early stage of search the landlord is willing to accept the first type 1 household that is willing to rent the tenancy whereas type 2 tenants are regarded unacceptable. If the landlord is unsuccessful in getting a type 1 tenant till time-point t_2, then from that on also type 2 tenant candidates are regarded to be acceptable.

Secondly, if $T \leqq t_2$, the landlord is willing to accept from the very beginning the first tenant candidate who regards the rental unit acceptable.

Figure 1: Landlord's optimal acceptance policy over time



The above analysis indicates that discrimination is not necessarily of absolute type. An initially discriminatory landlord may become non-discriminatory implying that one cannot necessarily make inferences concering discriminatory behaviour from observed behaviour of a landlors. Secondly, not only the expected differences among tenants affect the extent of discriminatory behaviour, it is affected by differences among landlords, too.

To be able to discuss how discriminatory behaviour is affected by different factors we study below how t_2 depands on the parameters involved. First, denote $D = \dot{V}_{1,2}(t) - \dot{V}_1(t)$ such that using (18) and (16) we have at t_2 the following

$$(22) \qquad D = 0 = -r - \alpha V(t) + \sum_{i=i}^{2} u_i(t)\,[W_i(t) - V(t)]$$

$$+ r + \alpha V(t) - u_1(t)\,[W_1(t) - V(t)]$$

$$= u_2(t)\,[W_2(t) - V(t)] \qquad (t = t_2)\ .$$

From (22) we get the following derivatives

$$(23) \qquad D_{t_2} = u_2(t_2)\,[\dot{W}_2(t_2) - \dot{V}(t_2)] < 0$$

$$(24) \qquad D_{C_1} = -u_2(t_2)\,(\partial V/\partial C_1) > 0$$

$$(25) \qquad D_{C_2} = u_2(t_2)\,[-B(t_2) - (\partial V/\partial C_2)] < 0$$

$$(26) \qquad D_{u_1} = u_2(t_2)\,[-(\partial V/\partial u_1)] < 0$$

$$(27) \qquad D_{u_2} = 0$$

$$(28) \qquad D_{r} = u_2(t_2)\,[-(\partial V/\partial r)] > 0\ .$$

Applying the implicit-function rule the above derivatives imply that switch-point t_2 is

a) an increasing function of landlord's search cost (r) [1] and the maintenance cost of type 1 tenants (C_1) and

b) unaffected by the arrival rate of type 2 tenants (u_2), and

c) a decreasing function of the maintenance costs of type 2 tenants (C_2) and the arrival rate of type 1 tenants (u_1).

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[1] Note that r contains both the cost of undertaking search plus the cost of keeping the tenancy idle.

The above results imply that landlords´ discriminatory behaviour may differ e.g. because their search costs or conceptions of maintenance costs across household types differ. Naturally the intended duration of lease affects choices, and this element can vary across landlords, too. In this connection we also note that if the intended lease duration is infinite, there is no switch in landlord´s choice behaviour in our non-adaptive model. Then either the landlord always or never regards type 2 tenants acceptable.

2. ILLUSTRATIVE APPLICATIONS

To give an application of the above considerations, assume that under conditions of rent control (or rent regulation) there is an incerease in the inflow of inhabitants to a city. Secondly, assume that landlords get informed of the structure of the inflow of new inhabitants in broad terms. Then, if the newcomers are mainly families with children which landlords regard as "high maintenance cost" type tenants (type 2), the optimal waiting time for type 1 tenants is unaffected. However, single people or childless couples (type 1) who are old inhabitants of the city will now experience it harder to find an available rental unit, too. This is because some landlords will not find a type 1 tenant during $t > t_2$ and thereafter both types are acceptable and after the inflow of new inhabitants the arrival rate of type 2 candidates has increased. Naturally old type 2 households in the city find their market opportunities worsened after the inflow of similar new households.

Continuing the above example, assume that the inflow of inhabitants consists of single or childless couples (type 1), mainly (or to the extent that landlords notice it). Now the optimal waiting time for type 1 tenants increases and the housing market opportunities of "old" type 2 inhabitants get even worse

than in the first case. As for old type 1 inhabitants, the optimal waiting time for this type has increased but on the other hand the arrival rate of this type has increased, too. These two effects operate to opposite directions and we cannot determine generally wheather the "old" type 1 inhabitants are now worse or better off than before as for their housing market opportunities.

As a second application of our framework we can determine the minimun key money or bribe a type 2 household has to pay in order to make it equally advantageous as compared to type 1 tenant. First we note that during $0<t \leqq t_2$ type 1 tenant is still more advantageous than type 2 tenant, but as both are regarded as acceptable, no bribes are involved. Positive bribes can emerge during $t > t_2$ when type 2 candidates are discriminated. The minimum bribe from a type 2 tenant, b(t), is determined as

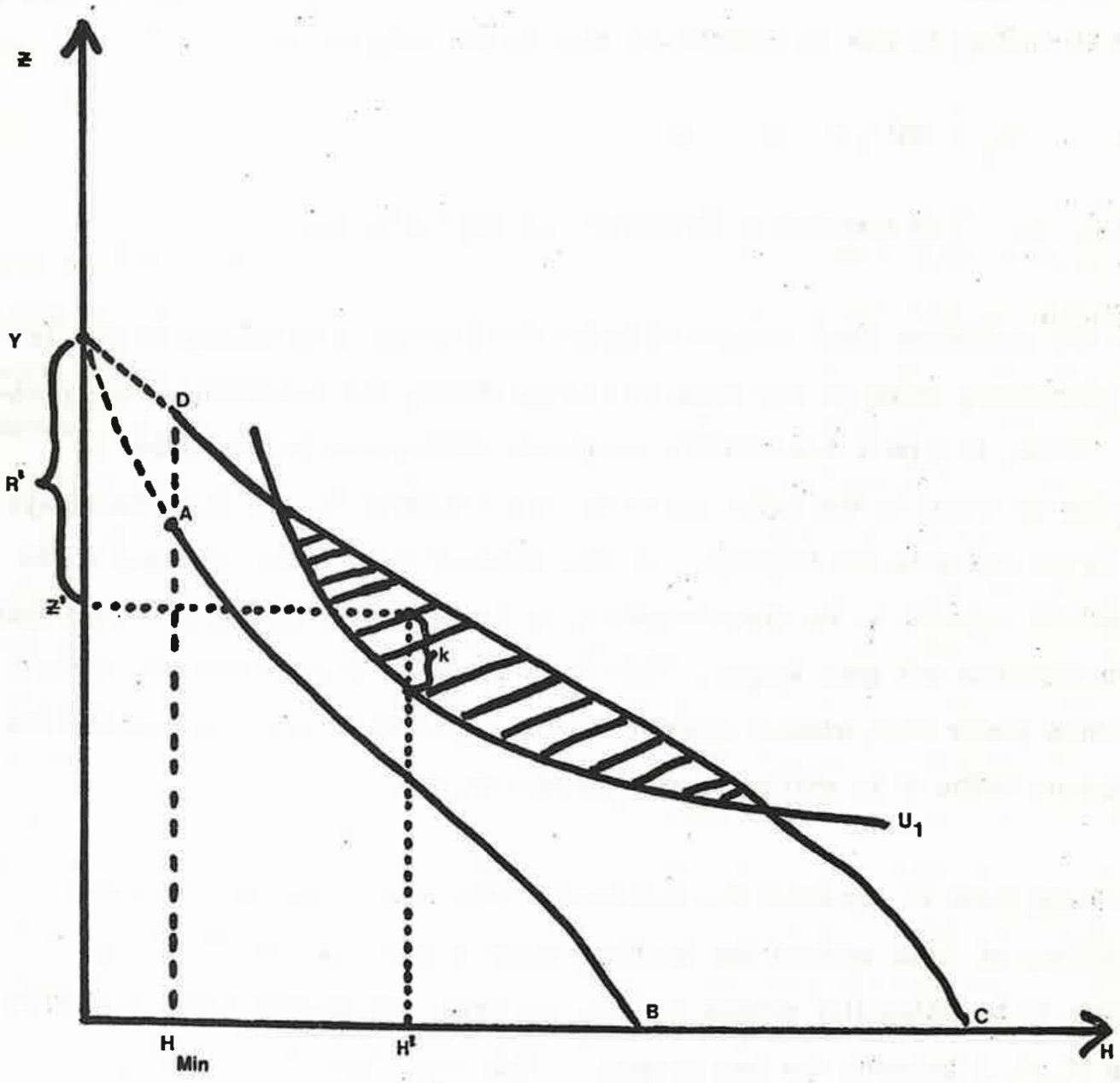
$$(29) \qquad b(t) = \begin{cases} 0 & (0 \leqq t \leqq t_2) \\ V(t) - W_2(t) & (t > t_2) \end{cases}$$

According to (29) the amount of bribe which makes type 2 candidates equal with type 1 ones is the difference between expected discounted net profits attainable when following optimal acceptance policy in which bribes are not expected to be received and the respective profits following from the acceptance of type 2 tenant candidate.

At this stage we may ask wheather the type 2 household which is asked to pay a bribe in addition to rent is willing to do so. To be able to answer this question we first note that in Loikkanen /1980/ we consider the optimal policy of a household facing a perfect market for non-housing (Z) and an imperfect market for rental housing. The latter is i.a. characterized by rent dispersion at each housing quality (H) level (given lease duration, t). If in such a situation the household is in disequilibrium (an active searcher) it faces a stochastic budget boundary set (for leases of duration t), ABCD in

Figure 2, the upper (lower) boundary CD (AB) of which is determined by a fixed price for Z normalized to unity, and the expected minimum (maximum) price (or rent) spectrum for H. The actively searching household's reservation utility level for tenancies with lease duration t can be expressed by an indifference curve in (H,Z)-space (see U_1 in Figure 2).[1] The shaded

Figure 2: The mazimum bribe per unit of time, k, a household is willing to pay for a tenancy of quality level H', rent R' and lease duration t. The reservation utility curve U_1 (and the stochastic opportunity set ABCD) applies for tenancies with lease duration t.



[1] When deriving the optimal equilibrium and acceptance sets in Loikkanen /1980/ the duration of leases is assumed implicitly to be either infinite or at least as long as the decision makers time horizon. Here we are introducing the lenght of lease as an additional housing characteristic. Without any formal analysis (which could be done), it is immediate that we now have separate acceptance sets for tenancies of each lease duration.

area in Figure 2 is the acceptance set consisting of (H,R)- or implied (H,Z)-combinations the household is willing to accept in order to stop search.

Now assume that the landlord´s rental unit is of quality H´ and its rent is R´ without the bribe. Our household with (instantaueous) income Y, utility function u= u(H,Z) = u(H,Y-R) and reservation utility level U_1 in Figure 2 comes to see the unit. The maximum bribe per unit of time, k, the household is willing to pay in addition to rent is the solution of

$$U_1 = u(H', Y - R' - k) \tag{30}$$

w.r.t. k. The solution is illustrated in Figure 2, too

Now the maximum total amount of bribe the household is willing to pay is the discounted value of per time-unit bribe during the remaining lease period. Thus, if type 2 household´s maximum willingness to pay bribe is greater or equal to the bribe asked by the landlord, b, the household pays the bribe and gets the tenancy. In this connection we also note that if the household expects to be discriminated, in Loikkanen /1980/ it is shown that its acceptance set gets larger. This is because its reservation utility level becomes lower than without discrimination expectations and consequently the maximum bribe it is willing to pay increases, too.

Returning back to consider the landlord´s behaviour, assume that under conditions of rent control the landlord expects part but not all of type 2 tenants to be (illegally) willing to offer as bribe the maintenance cost difference (C_2-C_1) between the two gropus.[1] But then these "bribepaying" type 2

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[1] Note that this offered bribe is not equal to the one the landlord asks from a discriminated type 2 tenant candidate.

households become equal to type 1 ones from the landlord's viewpoint and the share of "law-obeying" type 2 households decreases. The outcome of landlords' bribe expectations is that the optimal waiting time for type 1 or bribe-paying type 2 candidates increases and the chances of getting a new tenancy gets worse for law-obeying candidates.

3. THE ROLE OF COST DIFFERENCES IN GETTING RID OF DIFFERENT TYPES OF TENANTS

Our model in section 1. was based on the assumption that there were no costs related to getting rid of either type of tenants at the end of intended lease duration. Formally this assumption made it possible to employ (2) above, i.e. $W_1(0) = W_2(0) = V(0) = A$ where A is a constant. The modification of having the same positive costs related to getting rid of tenant at t= 0 would only affect the value of A leaving the implications for discriminatory behaviour unaffected.[1] Below, our purpose is to allow for the following two cases: the lump-sum cost of getting rid of type 2 (high maintenance cost) tenant is greater than that of type 1 (low mantenance cost) tenant and vice versa. Note that in the following we still consider two tenant types at a time labelling them with index i (i= 1,2) which refers to their type w.r.t. maintenance costs, just like before. Under these assumptions we show that now there may be more than a single switch in acceptance policy, and further, the nature of these switches depends on how the costs of getting rid of type 1 and 2 tenants differ.

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[1] Note that in section 1. we did not allow for the option of keeping the tenency idle during t>0 to simplify the model and to concentrate only on discrimination among tenants. Obviously positive costs related to getting rid of tenants lengthen the period during which it is not optimal to search for a tenant any more, when this option is allowed for.

Formally the basic structure of our model remains much the same as above when we introduce the costs of getting rid of tenants. These costs can be taken into account by defining the expected discounted net profits of search at t= 0 as

$$V(0) = 0 \tag{31}$$

whereas the respective net profits of having a type i tenant at t= 0 now becomes

$$W_i(0) = - A_i \qquad (i= 1, 2) \tag{32}$$

such that $A_1 \neq A_2$. Omitting the option of not searching during t>0 (as in section 1.), equations (7) - (10) still apply when initial conditions (31) and (32) are substituted for (2) in section 1.

In the following we shall illustrate some solutions graphically without considering them formally in detail. To make the graphical analyses understandable the folloing results from section 1. are worth recalling: First, there is a switch in optimal policy when $W_i(t) = V(t)$. Secondly, when $W_i(t)$ is greater (smaller) than V(t), type i households are acceptabele (not acceptable). These "rules" are implied by (10) in section 1. As for switch points of optimal policy, we shall employ the following notation in connection of the figures below. E.g. ${}_1t_{1,2}$ denotes a switch-point such that to the left from that point it is optimal to accept type 1 tenants, only, and to the right, respectively, both types 1 and 2 are acceptable.

First, consider the case in which $A_2 > A_1$. Without loosing anything essential we can set $A_2 > A_1 = 0$. Two possible solutions related to this case are depicted in Figures 3a and 3b. In panel a optimal expected discounted net profit path, V(t) is equal to $V_1(t)$ for all $t > 0$. Accordingly, type 2 tenants are never acceptable and there is no switch in policy.

Panel b illustrates another possibility when $A_2 > A_1 = 0$. Here, proceeding from right to left along the (reversed) time axis, i.e. moving pari passu with real time, first only type 1 candidates are acceptable. Then from ${}_{1,2}t_1$ on both types 1 and 2 are acceptable till time-point ${}_1t_{1,2}$ from which on only type 1 is acceptable again. The last phase emerges because at the end of intended lease duration the landlord wants to avoid the costs of getting rid of type 2 tenant which are now high relative to expected rental net income.

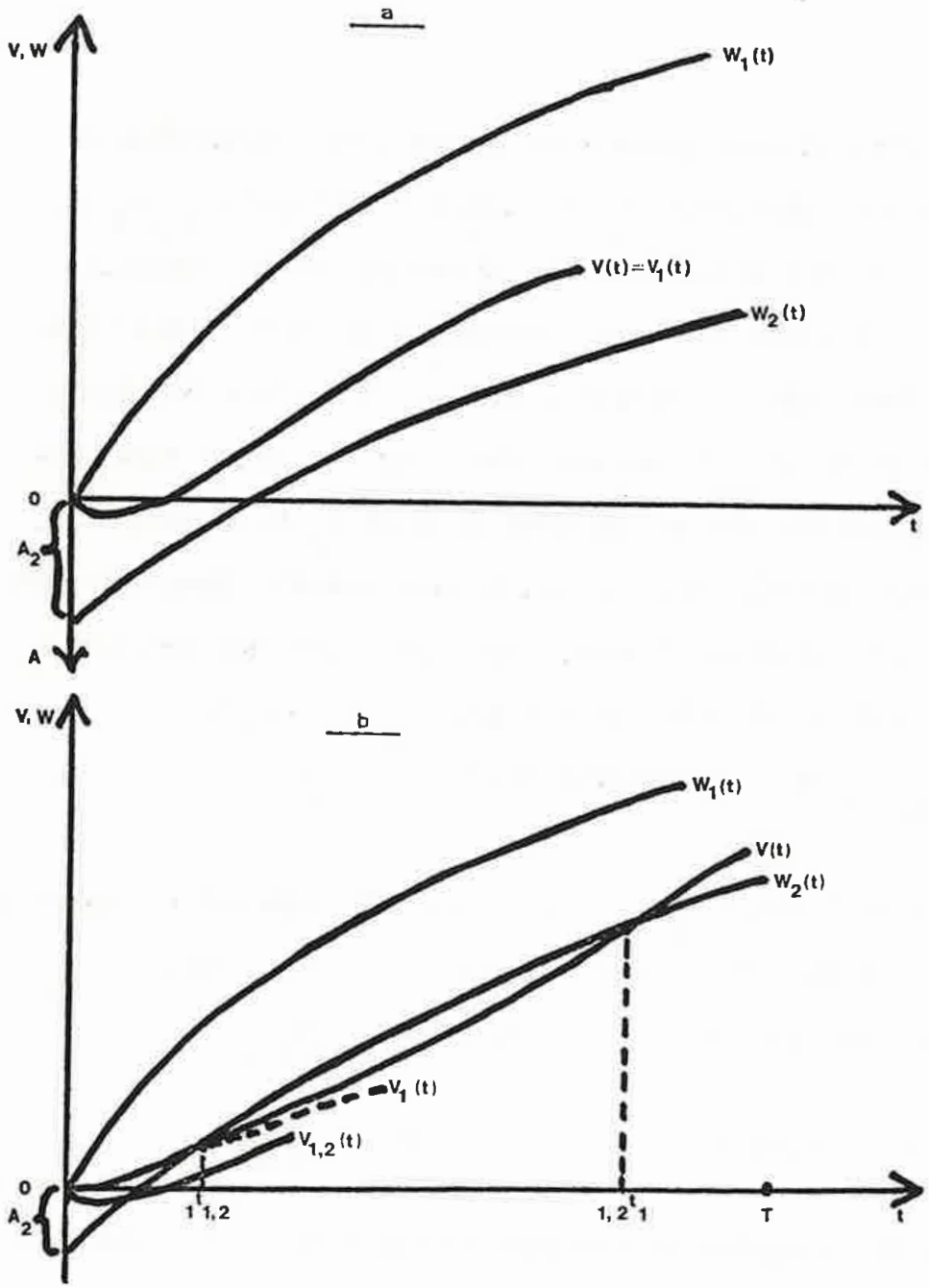
What about the comparative statics properties of the case illustrated in Figure 3b?. First we note that point t_2 in Figure 1 and point ${}_{1,2}t_1$ in Figure 3b are analogous in the sense that the dynamics of the optimal solution is governed by the same functional equations to "both sides" from these points, although their initial conditions differ. This has two implications: First, given that point ${}_{1,2}t_1$ exists, there are no other switches during $t > {}_{1,2}t_1$. Our proof for the uniqueness of point t_2 in section 6.1. can be applied with slight modifications to show this result. Secondly, the comparative statics results derived in equations (22) - (26) and (28) for t_2 apply for ${}_{1,2}t_1$, too. Instead of (27) we now get $D_{u_2} = -u_2(t) \cdot (\partial V/\partial u_2) < 0$ such that ${}_{1,2}t_1$ is a decreasing function of $u_2(t)$.

As for how the other switch-point, ${}_1t_{1,2}$ in Figure 3b depends on different parametres, we first note that equations (22) and (24) - (28) apply at ${}_1t_{1,2}$, too. Insteat of (23) we now get from (22) evaluated at ${}_1t_{1,2}$

$$(33) \qquad D_{{}_1t_{1,2}} = u_2(t) \left[\dot{W}_2(t) - \dot{V}(t)\right] > 0 \qquad (t = {}_1t_{1,2})$$

i.e. the sign becomes the opposite as compared to that in (23). But then this implies that the comparative statics results that apply for ${}_{1,2}t_1$ apply with opposite signs at ${}_1t_{1,2}$ except that it is unaffected by a change in $u_2(t)$, now.

Figure 3: Landlord's optimal acceptance policy when $A_2 - A_1 = 0$. In panel a only type 1 is accepted and there are no switches in policy. In panel b first type 1 is acceptable (at T), then types 1 and 2, and finally type 1.



What remains to be considered referring to the solution of 3b is the effect of a change in the cost of getting rid of type 2 tenant, A_2. Applying (22) we get

$$(34) \qquad D_{A_2} = u_2(t) \left[\frac{\partial W_2(t)}{\partial A_2} - \frac{\partial V(t)}{\partial A_2} \right].$$

At ${}_1t_{1,2}$ we have $V(t) = V_1(t)$ implying that

$$(35) \qquad D_{A_2} = u_2(t) \frac{\partial W_2(t)}{\partial A_2} < 0 \qquad (t = {}_1t_{1,2}).$$

Then (35) together with (33) implies that ${}_1t_{1,2}$ increases as A_2 grows.

At ${}_{1,2}t_1$ equation (34) applies as such since the last term $\partial V/\partial A_2$ is now negative. In absolute terms it is, however, smaller than $\partial W_2/\partial A_2$ because an increase in A_2 affects W_2 at t= 0 with certainty, whereas following optimal policy (giving V(t)) the increase in A_2 comes true with a probability less than one. On the other hand, substituting ${}_{1,2}t_1$ for t_2 in (23) the equation still holds and this together with (34) implies that ${}_{1,2}t_1$ is a decreasing function of A_2. Accordingly, if A_2 increases successively the phase during which both types (1 and 2) are acceptable gets shorter until it finally disappears bringing the solution similar to that of Figure 3a.

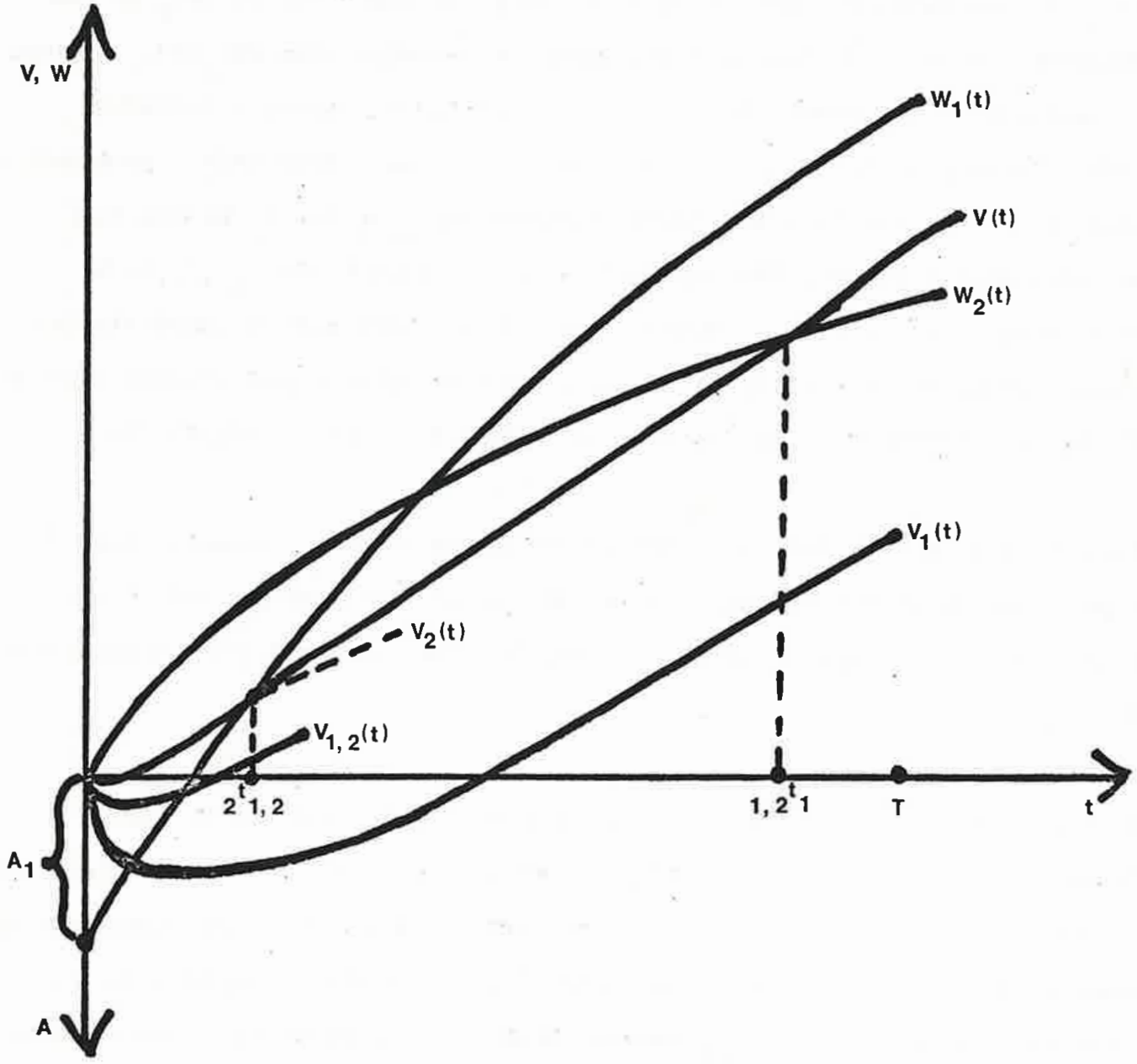
To conclude this section, we reverse the above case by assuming here that type 1 (low maintenance cost) tenants are more costly to get rid of at t= 0 than type 2 (high maintenance cost) tenants. Accordingly, assume that $A_1 > A_2 = 0$.

A representative two-switch solution of this case is depicted in Figure 4. Beginning from time-point T and proceeding to the left, first only type 1 is acceptable. From time-point ${}_{1,2}t_1$ on both types 1 and 2 are acceptable till time-point ${}_2t_{1,2}$. Thereafter only type 2 is acceptable. Again it is straightforward to prove that if ${}_{1,2}t_1$ exists, there are no switches in policy during

$t > {}_{1,2}t_1$. Secondly, at the end of intended lease duration there is necessarily at least a phase during which type 2 is acceptable, only.

As for the comparative statics properties of the critical time-points in Figure 4, we derive the following results for time-point ${}_2t_{1,2}$ in Appendix 1: Time-point ${}_2t_{1,2}$ is

Figure 4: Landlord's optimal acceptance policy when $A_1 > A_2 = 0$. Beginning at T, type 1 is acceptable till ${}_{1,2}t_1$. Thereafter both types 1 and 2 are acceptable till ${}_2t_{1,2}$, from which on only type 2 is acceptable.



a) an increasing function of the maintenance cost of type$_1$ tenants (C_1), the costs of getting rid of type 1 tenants (A_1) and the arrival rate of type 2 tenants (u_2),

b) unaffected by the arrival rate of type 1 tenants (u_1), and

c) a decreasing function of the maintenance cost for type 2 tenants (C_2) and the landlord's search cost (r).

As the dynamics of optimal policy around time-point ${}_{1,2}t_1$ is governed by the same functional equations as those of t_2 in section 1. (and in Figure 1), the comparative statics results on page 15 for t_2 apply for ${}_{1,2}t_1$, too, except that now ${}_{1,2}t_1$ becomes a decreasing function of u_2. In addition to these results it is straight-forward to show that ${}_{1,2}t_1$ is an increasing function of A_1. Accordingly, as the cost of getting rid of type 1 tenant (A_1) increases successively, the phase during which both types are acceptable comes earlier, but the phase at the end of inteded lease duration, during which only type 2 is acceptable, gets longer, too.

To conclude, our all comparative statics results concerning switch-points of optimal policy in different cases are summarized in Table 1.

Table 1: How switch-points of optimal policy are affected by parameter changes in different cases[1]

The eccect of an increase in	Different cases				
	$C_1 < C_2$				
	$A_1=A_2=0$	$A_2>A_1=0$		$A_1>A_2=0$	
	t_2	$1t_{1,2}$	$1,2t_1$	$2t_{1,2}$	$1,2t_1$
r	+	-	+	-	+
C_1	+	-	+	+	+
u_2	±	±	-	+	-
C_2	-	+	-	-	-
u_1	-	+	-	±	-
A_2		+	-		
A_1				+	+

[1] The comparative statics results apply assuming that the optimal policy switch-points considered exist before the parameter change.

4. ON DISCRIMINATION EXPERIENCES OF FINNISH HOUSING ALLOWANCE RECIPIENTS

In previous sections we have given a rationale for landlord's discriminatory behaviour in some specific cases. Obviously similar results may be derived by employing somewhat different assumptions, too. Despite the theoretical considerations one may still doubt wheather there is disrimination e.g. in the Finnish rental housing markets. Unfortunately we do not have any objective evidence to offer. Instead, in this section we present results on discrimination which are based on search experience of Finnish housing allowance recipients.

Our results are based on a questionnaire which was directed a sample of housing allowance recipients.[1] One of the questions included was the following (translated into English): "Would you say that when you searched for a new dwelling you would have wanted to rent some vacant unit but the landlord refused to lease it for a reson which was related to your 1) age 2) sex 3) marital status 4) race 5) source of income or occupation 6) chil dren or being a family with children, or 7) we did not experience any of the above forms of discrimination". One or more of the alternatives could be chosen. The answers of 218 household which had searched actively for a new tenancy are presented in Table 2.

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[1] The empirical part (Ch. 7) of Loikkanen /1981/ is based on the use of a three year panel data consisting of new housing allowance recipients in three cities in Finland. The panel data is constructed using annually filled housing allowance form information. Questionnaire technique was used to get supplementary information on search and mobility behaviour of the households. A description of the data and its construction is presented in Loikkanen /1981/, too. In this connection we also note that this paper is actually based on Chapter 6. of that study.

The results on experienced discrimination indicate that the phenomenon seems to exist in the Finnish rental housing market. Approximately one third of the cases involved maintain to have experienced discrimination. As for the forms of discrimination it has been associated to marital status of the head of the family and especially to the feature that the tenant candidate has children. In this connection we note that all households in our population had at least on child because childless families could not get the allowance.

Table 2: Information on discrimination experienced by 218 actively searching housing allowance recipients

Experienced discrimination or the landlord refused to rent his vacant tenancy because of a reason related to	
- age	3
- sex	0
- marital status	21
- race	0
- source of income or occupation	5
- children or towards a family with children	46
- no discrimination	145
	220

5. CONCLUDING COMMENTS ON DISRIMINATION

As long as there are such differences among tenant candidates which are of importance for the landlords and cannot totally be accounted for by pricing, our model retains some importance. Besides in an imperfect market, rele-

vant circumstances can emerge e.g. when discriminatory pricing is legally prohibited or when prevailing prices (our rents) equal undifferentiated regulated maximum prices and "customers" are heterogenous from the view-point of "sellers". In these circumstances one comes across with the phenomen that it may "pay" to wait for a certain type of customer and discriminate other ones for some time at least.

Referring to our housing market considerations, on may ask the following types of questions: Is price discrimination socially worse than "availability" discrimination when tenants are heterogenous? If rents cannot be differentiated among tenant types, should the government pay subsidies to landlords if they lease to non-preferred tenants (like families with children)?

To conclude, we refer to "disguised discrimination" which operates via self-selective rent contracts. Assume that there are households the mobility rates of which differ the low mobility ones being preferred by landlords. Now it may be hard to separate the low and high mobility types from each other but a self-selective scheme can be used to separate them. If a landlord wants long-time tenants he offers the unit with a "high key money" which is compensated with somewhat lower rent. Mobile households have no incentive to accept such offers whereas permanent tenants find them competitive.

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Appendix 1: How time-point $_2t_{1,2}$ depends on different parameters.

At $_2t_{1,2}$ we have $V(t) = V_2(t) = W_1(t)$ and $\dot{W}_1(t) > \dot{V}_2(t)$. By denoting $S = W_1(t) - V_2(t)$ we get the following derivatives evaluated at $_2t_{1,2}$

(1´) $S_{_2t_{1,2}} = \dot{W}_1(t) - \dot{V}_2(t) > 0 \qquad (t = {}_2t_{1,2})$

(2´) $S_{C_1} = (\partial W_1/\partial C_1) < 0$

(3´) $S_{C_2} = -(\partial V_2/\partial C_2) > 0$

(4´) $S_{u_1} = 0$

(5´) $S_{u_2} = -(\partial V_2/\partial u_2) < 0$

(6´) $S_r = -(\partial V_2/\partial r) > 0$

(7´) $S_{A_1} = (\partial W_1/\partial A_1) < 0$

Applying implicit-function rule of differentiation the above derivatives imply that $_2t_{1,2}$ is an increasing function of C_1, u_2 and A_1, independent of u_1, and a decreasing function of C_2 and r.