

CHAPTER 13

*On flexibility of future preference*

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The economist's traditional model of choice—whether consumer's choice or planner's choice—is based on an analytical separation of preference and opportunity.

PREFERENCE AND OPPORTUNITY

Preference is represented by an ordering on an all-inclusive set of alternatives, between some of which a choice might conceivably arise. The only qualification for inclusion of an alternative in this choice space  $\mathcal{X}$ , say, is that it is sufficiently meaningful to the chooser so that if called on to make choices between any two or more alternatives he is capable of making the choices in a manner consistent with an ordering of all of the elements (alternatives)  $x$  of  $\mathcal{X}$ . The ordering is assumed to indicate whether any two given elements  $x, x'$  are equivalent ( $x \sim x'$ ) and, if not, which is preferred<sup>1</sup> ( $x > x'$  or  $x < x'$ ). In the established theory of consumers'

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<sup>1</sup> The simplest definition of such an ordering is by a relation  $\succsim$  ("preferred or equivalent to") which is *complete* ( $x \succsim x'$  or  $x' \succsim x$ ) and *transitive* ( $x \succsim x', x' \succsim x''$  implies  $x \succsim x''$ ).

choice the elements  $x$  of  $\mathcal{X}$  are usually commodity bundles, that is, vectors of which the components are amounts of stated commodities, and the choice of a vector  $x$  is usually identified with the consumption of those amounts. The set  $\mathcal{X}$  then is a space of as many dimensions as there are commodities on the list, or some appropriate subset of that space that excludes physically impossible consumption processes.

Opportunity is, in turn, represented by a subset  $\mathcal{A}$  of  $\mathcal{X}$ , often called the opportunity set. It consists of those alternatives actually available at the time of choice. For a consumer dependent on the market this could be the set of all those commodity bundles that can be bought on a given budget at market prices. For the subsistence farmer or the economic planner it could be a set representing production possibilities under the control of the chooser, or it might represent what can be achieved by a combination of production and trading.

To apply this model, we need not assume that the chooser works out for himself the ordering of all elements of the choice space before he learns what his opportunity is. We merely assume that he would reveal such an ordering if presented with enough different opportunities by responding to each opportunity with the choice of a best element from it. By a best element is meant an element that is preferred or equivalent to all other elements in the opportunity set  $\mathcal{A}$ .

Such a model gives perhaps a reasonable approximation to reality with regard to choices of which the consequences are limited to the immediate future. Economists have derived useful insights from the use of this model in analyzing the effects of excise taxes on consumption, prices, welfare, and the distribution of income. When we turn to choices between alternatives of which the desired effects extend for a long period into the future, revision or refinement of the choice model is needed.

#### SEQUENTIAL CHOICES FOR AN EXTENDED FUTURE PERIOD

A straightforward extension of the choice space to such cases is obtained by regarding the *program* as the element of the choice space, that is, a sequence of successively dated commodity bundles. This is a natural generalization of the model of "timeless" choice, and as such it has been used frequently in the economic literature.<sup>2</sup> However, for long enough periods ahead choice alternatives do not present themselves in just that way in reality. The individual choosing an education for a profession does not spell out sequences of commodity bundles that he expects to consume for each choice of profession. He is guided instead, among other things,

<sup>2</sup> See, for instance, Ramsey (1928), Samuelson & Solow (1956), Koopmans (1960).

by the real income expectations associated with each choice, leaving the detailed consumption choices to be worked out later.<sup>3</sup> Likewise the planner will decide on the scale of a hydroelectric development without specifying, to himself or to others, to what precise bundle of uses the energy generating capacity to be created will be put in each future year. We can confidently assert that almost all choices occurring in real life are sequential, "piece-meal," choices between alternative ways of narrowing down the presently existing opportunity rather than "once-and-for-all" choices between specific programs visualized in full detail. The mere passage of time cuts down a decision maker's opportunity even in the case of inaction on his part. If we incorporate inaction among available alternatives, we can therefore look on economic choice at any one time as an inevitable choice between several or many specific *subopportunities*, that is, subsets of the opportunity set that are available at that time provided a choice is made right then. As time proceeds, a sequence of such choices will need to be made at successive moments of time.

#### SEQUENTIAL CHOICE ACCORDING TO AN ORDERING OF PROGRAMS

In principle, a sequential model of economic choice is compatible with the representation of preference by an ordering of completely spelled-out programs. If we limit the analysis to opportunity sets and subsets that contain a best program, we can order the subopportunities in the same way in which their respective best programs are ordered. The choice predicted by such a model could be described as follows. The decision maker selects one particular best program from the present opportunity set. Whenever the need for choice between alternative subopportunities occurs, then or later, he invariably chooses that subopportunity (or one such) that contains the not yet realized segment of the preselected best program.

Such a model of sequential choice over time ignores at least two kinds of uncertainty that affect real-life choices. In the first place, in representing the alternatives as sharply defined sets of completely spelled-out programs, the model ignores unforeseeable future enlargements of production possibilities by improvement of existing methods or by the discovery of new methods or resources—or, for that matter, future contractions of production possibilities by calamity or loss of knowledge. Second, in deriving choice between subopportunities from an ordering of programs

<sup>3</sup> In fact, some choices of education are made because they permit postponement of the choice of profession or occupation. It was observed by Becker (1961) that the study of philosophy is selected by many students on the basis of such considerations.

adopted once-and-for-all, the model ignores the possibility, much used and valued in real life, of having choices in a more distant future be guided by new preference orderings modified in the light of experience up to the time of choice.

The purpose of the present remarks is to draw attention to the kind of uncertainty which concerns only the chooser's own future preferences. In order to concentrate discussion on it, we shall continue the fiction of complete certainty with regard to future production possibilities.

#### FLEXIBILITY OF FUTURE PREFERENCE

There are several reasons why a decision maker should wish to retain some flexibility with regard to his future preference. In the first place, to be able to make consistent responses to hypothetical choice situations involving the details of preference with regard to consumption in a distant future would require a considerable effort of visualizing and evaluating alternative programs. There is therefore a natural desire, and indeed a need, for tapering off the amount of detail about consumption in a more and more distant future that a decision maker would be willing to contemplate at a given time.

Second, taste evolves with experience. A model that freezes preferences by the adoption at an initial point in time of an ordering of programs for a future period of indefinite duration is likely to become an unacceptable straight jacket as time proceeds. At what age would the individual consumer be supposed to embrace the ordering that is to guide all his consumption choices for the remainder of his life? And the economic planner, who presumably attempts to aggregate the preferences of the population—perhaps with some admixture of his own values—wouldn't he wish to retain flexibility so that he could respond in the future to newly perceived currents of taste and desire? In fact, would it be morally defensible for one generation to presume, and act on, a very definite specification of the next generation's preferences?

One might be tempted to ignore or at least to play down these objections if technological alternatives were to be such that much higher levels of desired outputs could be achieved by fixing the commodity composition of output long in advance. It would seem, however, that the remarkable adaptability of the modern plant and equipment causes the cost of flexibility of preference, in terms of amounts of output foregone, to be greatly outweighed by its value to the chooser, in terms of outputs being of the kinds most desired at the time they become available. It therefore seems worthwhile to explore the idea of flexible preference further.

## TERMINOLOGY AND NOTATION

We shall somewhat widen the meaning in which the term "opportunity" is used. In the static nonsequential model of choice the term "opportunity" was used for the set of alternative bundles  $x$  available to the decision maker, from which one best bundle was to be selected by a single act of choice. If we now want to consider sequential choice, we need a term for any set of programs that may be selected as one link in the chain of successive sequential choices. Although "subopportunity" has already been used in this sense, it will be simple from here on to use the term "opportunity" in this more general sense as well. We shall still use the word "subopportunity," however, if we want to emphasize the relation of an opportunity to another containing it. Whenever we want to refer, in particular, to the set of programs to which the first choice in the sequence is confined, we shall call it hereafter the initial opportunity. It corresponds to the "opportunity set" of the static choice model.

Let a program  $x$  be denoted  $x = (x_1, x_2, x_3, \dots)$ , where the  $x_t$  form a sequence of (finitely or infinitely many) successive consumption vectors, all belonging to the same commodity space  $X$ . The set of all programs, denoted  $\mathcal{X}$ , then is a Cartesian product of identical spaces  $X$ . Let  $\mathcal{A}$ ,  $\mathcal{A}'$ ,  $\mathcal{A}''$  denote subsets of  $\mathcal{X}$  representing opportunities between which choices may conceivably arise. In particular, we denote by  $\mathcal{A}_t, \mathcal{A}'_t, \dots$  opportunities with the property that all programs  $x, x', \dots$  of any  $\mathcal{A}_t$  have the same values for the first  $t$  vectors,

$$x_s = x'_s = \dots = x_s(\mathcal{A}_t), \quad \text{say, for } s = 1, \dots, t.$$

Such sets will be called  $t$ -uniform. Clearly, if  $\mathcal{A}_t$  is  $t$ -uniform, it is also  $t'$ -uniform for all  $t'$  such that  $1 \leq t' < t$ .

## PARTITIONING OF OPPORTUNITIES AS TIME PROCEEDS

Perhaps the simplest model of the gradual narrowing of opportunities is as follows. Let  $\mathcal{A}$  be the initial opportunity, existing at the time  $t = 1$ . If  $\mathcal{A}$  happens to be at least 1-uniform, no immediate choice arises. If  $\mathcal{A}$  is not 1-uniform,  $\mathcal{A}$  partitions into finitely or infinitely many 1-uniform subopportunities  $\mathcal{A}_1, \mathcal{A}'_1, \mathcal{A}''_1, \dots$ , which can be labeled by the different values

$$x_1(\mathcal{A}_1), x_1(\mathcal{A}'_1), x_1(\mathcal{A}''_1), \dots,$$

assumed by  $x_1$  in all programs of the corresponding opportunity,  $\mathcal{A}_1, \mathcal{A}'_1, \mathcal{A}''_1, \dots$ , respectively. We assume that a choice between the opportunities  $\mathcal{A}_1, \mathcal{A}'_1, \mathcal{A}''_1, \dots$ , is then needed at time  $t = 1$ . If  $\mathcal{A}_1$

is chosen, say, and if  $\mathcal{A}_1$  happens to be at least 2-uniform, no further choice is yet required at time  $t = 2$ ; but if  $\mathcal{A}_1$  is not 2-uniform, it partitions in turn into 2-uniform subsets  $\mathcal{A}_2, \mathcal{A}_2', \dots$ , between which a choice is required at  $t = 2$ . In this manner choice proceeds sequentially over time.

When the initial opportunity consists of a finite number of programs only, this model of choice can be represented by a tree diagram (Figure 13-1). The opportunity  $\mathcal{A}_1$ , for instance, consists of all paths leading

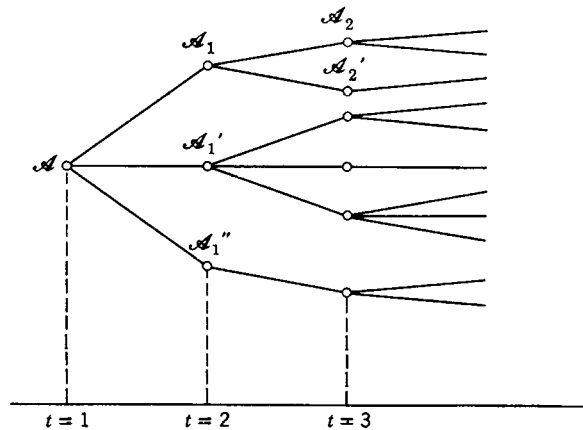


FIGURE 13-1

from the "source" node labeled  $\mathcal{A}$  through the node labeled  $\mathcal{A}_1$  and on from there. There is no significance to the relative positions of the nodes for any one value of  $t$ , except that different positions represent different consumption bundles for that period  $t$ . A choice needs to be made at time  $t$  whenever the last preceding choice is one that gives rise to further branching at  $t$ .

It is undoubtedly an oversimplification that the model of sequential choice described here puts the time of choice between subopportunities at the last possible moment before the consumption flows in the subopportunities begin to differ. Actually, investment choices occur frequently in which the effects on consumption are first felt several periods after the time of choice. It would not be difficult to introduce a refinement of the rules on the timing of required choices that takes this circumstance into account. What matters is that these rules be fully specified and that they be understood to be part of the description of the alternatives between which choice is to be made at any given time. For the present discussion, we shall adopt the foregoing simplified model.

PREFERENCE ORDERING OF OPPORTUNITIES

It is now proposed that a preference ordering be applied, not to all programs but to all sets of programs that may conceivably be opportunities. As in the static model the ordering of commodity bundles is not limited to the "opportunity set," so now the ordering of opportunities is not limited to the subopportunities of some given initial opportunity.

Whenever two opportunities are compared in this ordering, it is understood that in each case further choices between subopportunities will be needed at the times called for by the foregoing description. The outcome of these further choices is not prejudged by the ordering. To illustrate the point, suppose that a chooser is confronted on Monday

Opportunity	Monday	Tuesday	Each Remaining Day
<i>A</i>	Steak	Fish	Choice from a given menu <i>M</i>
<i>B</i>	Steak	Omelette	Choice from menu <i>M</i>
<i>C</i>	Steak	Choice of fish or omelette	Choice from menu <i>M</i>

with opportunities *A* and *B* regarding the dinners to be served to him during the coming week, and suppose he prefers *A* to *B*. After this preference is revealed he is again asked to choose between *A* and *C*. It is then quite consistent with his revealed preference of *A* over *B* if he regards *C* as preferred rather than equivalent to *A*. The point is that in choosing between *A* and *B* he has to decide about the Tuesday dinner on Monday. In choosing *C* he obtains a postponement of the determination of his preference for the Tuesday dinner until Tuesday.

ATTITUDES TOWARD POSTPONEMENT OF CHOICE

Finally it is, of course, equally possible that he will declare himself indifferent between *A* and *C*, thus manifesting indifference to the timing of the choice of his Tuesday dinner. If he takes such a view in all possible choices, he indeed will have followed the preselected strategy described on page 245. His ordering of opportunities is derived from a once-and-for-all ordering of programs in which each opportunity is represented by the best program it contains.

It is conceivable that he would prefer *A* to *C*, thus expressing his preference for choosing Tuesday's dinner on Monday instead of on Tuesday.

The view has been expressed that in choices affecting a more distant future it is likely that there will be at least neutrality toward, and probably a certain preference for, postponement of choice. The following postulates are presented as exercises in giving formal expression to some of these possibilities. All postulates apply to the preference ordering  $\succsim$  applicable at time  $t = 1$ . This time is also referred to as "now."

- [1] If  $\mathcal{A}$  is not 1-uniform and  $\mathcal{A}_1$  is a best 1-uniform subset among all 1-uniform subsets  $\mathcal{A}_1, \mathcal{A}_1', \mathcal{A}_1'', \dots$ , into which  $\mathcal{A}$  partitions, then  $\mathcal{A}_1 \sim \mathcal{A}$ .

This postulate says, quite naturally, that augmentation of an opportunity  $\mathcal{A}_1$  by the addition of one or more alternatives  $\mathcal{A}_1', \mathcal{A}_1'', \dots$ , so that choice between  $\mathcal{A}_1, \mathcal{A}_1', \mathcal{A}_1'', \dots$ , is *immediately* needed, has no value to the chooser if none of the added alternatives  $\mathcal{A}_1', \mathcal{A}_1'', \dots$ , is by itself preferred to  $\mathcal{A}_1$  at that time.

The remaining postulates are concerned only with choice between  $t$ -uniform opportunities for  $t \geq 1$ . They represent alternative supplementations of [1].

- [2] If  $\mathcal{A}_t \supset \mathcal{A}_t'$ , then  $\mathcal{A}_t \succsim \mathcal{A}_t'$ .

This postulate says, quite cautiously, that a widening of the range of alternatives between which choice is not called for before some future time  $t$  cannot make an opportunity less desirable.

- [3] If  $\mathcal{A}_t = \mathcal{A}_t' \cup \mathcal{A}_t''$ ,  $\mathcal{A}_t' \sim \mathcal{A}_t''$ ,  $\mathcal{A}_t' \cap \mathcal{A}_t''$  is empty, then  $\mathcal{A}_t \succ \mathcal{A}_t'$ .

This says, somewhat more positively, that if a  $t$ -uniform opportunity  $\mathcal{A}_t$  can be subdivided into two nonoverlapping and equivalent opportunities  $\mathcal{A}_t'$  and  $\mathcal{A}_t''$ , then, because choice between and within  $\mathcal{A}_t'$  and  $\mathcal{A}_t''$  is not required before some future time  $t + 1$ , the original opportunity  $\mathcal{A}_t$  is preferred to either of its parts. It thus expresses a definite preference for postponement of choice between alternatives now deemed equivalent, even if choice is thereby delayed by only one period.

The requirement in [3] that  $\mathcal{A}_t' \sim \mathcal{A}_t''$  is somewhat restrictive. We feel that enlargement of future choice by an additional opportunity  $\mathcal{A}_t''$ , not now deemed equivalent to that already available ( $\mathcal{A}_t'$ ), may now be welcomed because of the possibility that at such a time  $t' \geq t + 1$  at which further choice is called for  $\mathcal{A}_t''$  will be found to contain a  $t'$ -uniform subset  $\mathcal{A}_{t'}''$  then deemed superior to the then best  $t'$ -uniform subset  $\mathcal{A}_{t'}'$  of  $\mathcal{A}_t'$ . The two remaining postulates go further than [3] in this respect.

- [4] If  $\mathcal{A}_t = \mathcal{A}'_t \cup \mathcal{A}''_t$ ,  $\mathcal{A}'_t \cap \mathcal{A}''_t$  is empty, and for some  $t' \geq t + 1$  the best  $t'$ -uniform subsets  $\mathcal{A}'_{t'}$ ,  $\mathcal{A}''_{t'}$  of  $\mathcal{A}'_t$  and  $\mathcal{A}''_t$ , respectively, satisfy  $\mathcal{A}''_{t'} \succeq \mathcal{A}'_{t'}$ , then  $\mathcal{A}_t > \mathcal{A}'_t$ .

This postulate accepts  $\mathcal{A}''_t$  as a welcome  $t$ -uniform enlargement of  $\mathcal{A}'_t$  on some sufficient evidence that  $\mathcal{A}''_t$  is a possible runner-up to  $\mathcal{A}'_t$ . The sufficient evidence is that at some future time  $t' \geq t + 1$  the now deemed best alternative  $\mathcal{A}''_{t'}$  then available within  $\mathcal{A}''_t$  is now deemed no worse than the now deemed best alternative  $\mathcal{A}'_{t'}$  then available within  $\mathcal{A}'_t$ .

- [5] If  $\mathcal{A}'_t$  is a proper subset of  $\mathcal{A}_t$ , then  $\mathcal{A}_t > \mathcal{A}'_t$ .

This says, much more strongly, that any enlargement of a  $t$ -uniform opportunity  $\mathcal{A}'_t$  that conserves its  $t$ -uniformity is desirable, no matter how poorly the added opportunity  $\mathcal{A}_t - \mathcal{A}'_t = \mathcal{A}''_t$  would be rated if it had to be compared now with  $\mathcal{A}'_t$ . A chooser who adopts such a postulate is telling himself that one can never know how drastically one's preferences may have changed when the time of choice arrives. Obviously, [5] implies [2], [3] and [4]. A postulate intermediate between [5] and the conjunction of [2], [3], [4] could be formulated if some measure of the strength of preference of  $\mathcal{A}'_t$  over  $\mathcal{A}''_t$  were available or were introduced by postulate.

#### PREFERENCE AND OPPORTUNITIES

Let us stop to consider what has become of the separation of preference and opportunity characteristic of the static model of choice. This separation is still present in the sense that what we have now called the *initial opportunity* is given by objective circumstances of technology and resources, or of market and purchasing power, independently of the ordering. What has changed is that the preference ordering itself now applies to all "conceivable opportunities," that is, to objects of the same kind as the initial opportunity. The only difference that stands out is one of timing. Whereas the initial opportunity does not need to be, and generally is not, even 1-uniform, the ordering that affects choice need apply only to at least 1-uniform opportunities.

#### THE ROLE OF JUDGMENT IN PREFERENCE ORDERING

Two views can be found in the literature concerning the relation of the idea of a preference ordering to actual choice. One of these expresses the *descriptive* interpretation of a preference ordering as a device for describing and predicting choices made by an individual with consistent

tastes. In the other, *normative* interpretation, the use of a preference ordering satisfying certain postulates is recommended to a decision maker as a device that can help him achieve greater consistency in choices made on different occasions than his own instinct unaided by analysis would be capable of. As the more subtle aspects of real-life choice situations are incorporated in our analyses, the descriptive interpretation becomes less convincing, whereas the normative interpretation gains in importance. A set of postulates imposed on a preference ordering then becomes a format in which the indispensable judgments that determine the ordering itself can be entered.

Although there are many programs in the program space  $\mathcal{X}$ , there are, in the appropriate mathematical sense, a great many more sets of programs, that is, opportunities, that can be formed from programs in that space. It may therefore be felt that the extension of the idea of a preference ordering from programs to sets of programs is going to be too unwieldy to be useful. Without prejudging the answer, it may be suggested that an ordering of opportunities be defined, not on the set of all mathematically definable opportunities, but on some suitably restricted set of opportunities that correspond in some manner to the kind of opportunities between which actual choices may conceivably occur. Such a restriction of the set of opportunities being ordered would facilitate the expression of the judgments underlying a particular ordering. Since preference itself is the fruit of experience, we cannot expect to obtain useful judgments of preference between alternatives too dissimilar from those involved in choice experience.

#### ASSETS VIEWED AS OPPORTUNITIES

Assets have been difficult to fit into the theory of consumer's preference. In the case of durable consumers' goods we can, of course, replace a good by the flow of its services. However, a decision to acquire an automobile does not imply a decision about the number of passenger miles to be consumed in a year by the use of that car. Nor does a decision to improve land by drainage imply a simultaneous choice of crops to be grown on that land as improved.

A point in favor of applying the idea of a preference ordering to opportunities instead of to programs is that physical assets fit very naturally into such a scheme. An automobile, a record player, a tract of land, a machine shop, and the entire capital equipment and natural resources of an economy all represent opportunities in the precise sense developed here. Each of these assets defines a set of consumption flows obtainable by its use, with sequential decisions about that use being

called for continually to narrow down or determine the actual use as the future draws nearer.

Even nonphysical assets, claims to income from productive property or to interest and repayment from money loans made to governments or individuals, can be looked on as opportunities requiring sequential decisions about the uses of the income and possibly of the proceeds from sale of the asset itself at or before its maturity. However, if we wish to include such assets as well, we shall have to generalize the notion of an opportunity. We shall have to consider it as a set of programs the availability of which is subject to gradually diminishing uncertainty as time of choice draws near. This applies even if we are maintaining the fiction of complete certainty about future production possibilities. The reason is that our admission of uncertainty with regard to future consumers' preferences introduces uncertainty into the market valuations which in turn affect the opportunities represented by stocks, bonds, good will, and other nonphysical assets.

#### THE PLANNING HORIZON

Viewing physical assets as opportunities resolves one awkward problem in the application of the theory of economic choice: the problem of choosing the length of the planning period. If assets are not represented in the preference ordering, a planning model is likely to recommend maximizing consumers' satisfaction during the planning period by failing to ensure an appropriate capital stock at the end of the period. Specifying a "terminal" capital stock as a constraint in such a maximization avoids this gross error. It is still open to the objection that the opportunity represented by the terminal capital stock is predetermined rather than allowed to find its proper magnitude by being weighed against consumers' satisfactions during the planning period. Once terminal assets are themselves entered into the preference ordering as opportunities, the choice of the length of the planning period becomes a matter of degree of approximation or coverage of detail. In principle, the choices predicted or recommended by the model no longer depend on the length of the planning period. In practice, they might be somewhat improved by the greater effort of specification and evaluation required if a longer planning period is selected.

#### REFERENCES TO FLEXIBILITY IN THE ECONOMIC LITERATURE

The idea of flexibility has been discussed in the economic literature in connection with investment choices that enable the firm to profit from the

satisfaction of uncertain future consumers' preferences. An early example is Hart's discussion (1940, Chapter IV) which emphasizes that it may increase profit expectation to choose capital equipment that permits relatively low-cost production over a wider range of outputs, compared to capital equipment that will permit absolutely minimum cost production at one specific anticipated level of output but relatively higher cost production at some other levels that could come about because of the unpredictability of consumers' preferences or other factors.

I do not know of earlier attempts to incorporate the uncertainty of future preferences into the model of preference itself, except for one brief discussion of some of the ideas of this chapter (Koopmans, 1950).

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