An Experimental Investigation of Buyer Behavior in the First Days After Price Liberalization

PhD Thesis

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CONTENTS

I. SUBJECT OF INQUIRY

One of the main features of the so-called socialist economy that existed in most of the second half of this century in what was at that time Czechoslovakia, was that every transaction within the economy had to be made at the price determined by a central planning authority as obligatory for that kind of transaction. Using this way of determining prices, together with other (malfunctioning) regulatory principles, had by the end of the 1980s led to long-lasting gross discrepancies in the Czechoslovak economy between the demand for and supply of a large number of goods and services. In a market economy, on the contrary, prices are usually set by individual sellers in view of buyers's response. As soon as a substantial discrepancy between the demand and the supply in a given market is spotted by the sellers, they have incentives to start to change the price in the appropriate direction, thus weakening the discrepancy.

Quite naturally then, price liberalization - together with introduction of competition into the mostly oligopolized/monopolized economy - was among the basic steps that had to be made at the beginning of the 1990s to transform the Czechoslovak economy into a standard market economy.

Most prices were freed on January 1st, 1991. In the following days, almost all subjects in the economy faced new prices of their inputs. The new prices were new to the buyers in two respects: (1) for each input, most sellers of the input started to charge a price that was different from their old price and (2) for virtually all inputs, different sellers of the input charged different prices.

Most firms knew the new prices in advance because they had signed contracts containing the new prices to be charged by their suppliers from January 1991 on. Consumers, on the other hand, knew very little about what prices they would find in the shops after January 1st, 1991. All information they had before entering the first store in 1991 was the old price of the good they would want to buy and possibly a vague idea of how on average the general price level would change, an idea based on the predictions made by various experts and politicians and published in the media in the preceding months.

This considerable lack of information in markets for consumer goods led subsequently to serious problems in the coordination of supply anddemand in these markets. If we understand, however, how demand and supply in consumer goods markets behave in the particular situation of the first weeks after price liberalization, we may be able to suggest accompanying measures which would ease the short-run problems that price liberalization unavoidably brings. (Also, such understanding might help us study and understand the behaviour of consumers in less non-standard cases in which they have more but still not much information, such as when they buy a car.)

We deal here obviously with a very complex disequilibrium process with many feedbacks which in some respects resembles bargaining - sellers (through the price they charge) and buyers (through buying/not buying) bargain over what prices the market should settle at. Each member of the market „negotiates“ with only those members of the other side with whom she gets into a „transaction contact“ by which I mean that the buyer sees the price the seller charges. But since many members of each side of the market get into a transaction contact with a given member of the other side, there are externalities to the „negotiation“ efforts of each member of both sides of the market, externalities felt mutually by each of those members of one side of the market who get into a transaction contact with the same member of the other side: e.g., when a buyer buys from a seller at a high price, she makes it less likely for her fellow buyers to „negotiate“ (by not buying at a high price) with this seller a low price, since this seller is now encouraged to charge a high price. In relatively settled, equilibrated markets the externality has little impact because the ideas of an adequate price that transaction-contact parties have prior to the transaction contact are usually close. In highly disturbed markets such as those after price liberalization, the externality has tremendous importance because there the adequate-price ideas differ very much within the group of buyers, within the group of sellers and between the two groups.

In the course of this bargaining process, both sides of the market try to improve their bargaining behaviour by strengthening its informational basis: sellers try to get more informed about the market demand (by looking at how much is bought at what price in their own store or in other stores) so that they have a better idea of the maximum price they can venture to charge if they want to have a high rebate but do not want to risk repelling too many buyers, and buyers try to get more informed about the supply (by looking at what prices are charged in various stores) so that they have a better idea of the minimum price they can venture to reject in each store if they want to buy cheap but do not want to risk having to canvass too many sellers. As both sides get more informed - unless a new disturbance changes the facts (making the knowledge collected so far obsolete and forcing all to start over collecting new knowledge) - the market gradually starts to resemble one of the standard types of market (say, monopolistic competition) in terms of the market structure, the structure of prices, etc.

The subject of inquiry in the rest of this thesis will be buyer’s behaviour mentioned in the previous paragraph, i.e. the way buyers „try to get more informed about the supply (by looking at what prices are charged in various stores) so that they have a better idea of the minimum price they can venture to reject in each store if they want to buy cheap but do not wnat to risk having to canvass too many sellers“. It is a topic of interest both in itself and as a simplified picture of what goes on in the minds of buyers in the informationally richer cases which arise when buyers search for a low price (of a good with a non-disappearing price dispersion) in long-established standard consumer goods markets.

II. CONSUMER GOODS MARKETS IN CZECHOSLOVAKIA BEFORE AND AFTER PRICE LIBERALIZATION

To have a better idea of how to deal with the subject of inquiry in this thesis if the investigation is to be empirically relevant and, at the same time, to be able to see clearly in which ways and areas the reality will be simplified in later chapters of this thesis, let me briefly describe the factors that seem likely to have determined the price-libralization-related behaviour of the consumer goods markets participants before and after prices were freed on January 1st, 1991, and what were the consequences of this behaviour. I will start with influences on the behaviour of the supply side, then move to the demand side behaviour, and after that, I will briefly describe the actual development in the markets shortly before and after the liberalization.

II.1 Some Probable Factors behind the Supply Side After-liberalization Behaviour

Among the influences on the supply side behaviour were the following several important measures which the government (and in the case of the last measure, the State Bank) decided during 1990 to introduce at the same moment as the price liberalization, i.e., on January 1st, 1990:

- decreasing the number of different rates of a so-called turnover tax (corresponding to VAT) from about 1,400 to four,
- eliminating a large part of the many state subventions to enterprises (all of them at that time still owned by the state)
- switching to world prices in the trade with other member countries of Comecon,
- introducing a 20% surcharge on imports, increasing the discount interest rate from 6% to 24%.

The average impact of the first measure on the prices sellers would like to charge is not clear, while the other four measures led for a given level of production or retail activity undoubtedly to an increase in total costs and a decrease in total revenues. The intention to make these steps was announced by the authorities several months before January 1st, 1991.

Costs of many enterprises were further increased in consequence of the several devaluations of the Czech crown which the State Bank made during 1990: between the end of

1989 and the end of 1990, the price of one US dollar in terms of the Czech crown almost exactly doubled (Statistické přehledy 7/93). In spite of the fact that none of the devaluations was officially announced in advance, there were strong devaluationary expectations throughout the year, returning again soon after each devaluation (and enterprises' behaviour guided by these expectations was each time actually a big source of the pressure on the crown that resulted in its next devaluation).

Another increase in costs was expected to come after the price liberalization, since this liberalization was generally expected to bring an instant upward jump in the price level (more on these expectations below). As was mentioned in the previous chapter, some of the new, higher prices were already embodied in the contracts covering the first weeks or months of 1991 and signed before the end of 1990.

All but one of the influences listed so far clearly suggest that most members of the supply side had reasons to react to the price liberalization by increasing the price of what they were offering. We should, of course, add the possibility that prices would be increased also out of what might be called a speculative or strategic reason - simply to capitalize, even if for just a few days or weeks, on the expected short-run confusion on the part of buyers about what is a reasonable new price of the good in question or what is the price most suppliers charge.

A different kind of influence on the behaviour of the supply side was the fact that the production of most consumer goods had for a long time been highly oligopolized or even monopolized by state enterprises, as had the retail industry. Although first stores run by private entrepreneurs occured in 1990, at the time of the price liebralization in January 1991 they formed only a weak competition to state-owned retail chains: in January 1991 the share of private retailers on the total retail sales in the Czech Repulic was only 7% (Statistický bulletin ČSÚ 2/92). In other words, competition which would cause the however high initially charged prices to fall quickly to their approximately competitive levels was in many of the consumer goods markets almost absent, which implies that - apart from legal constraints described below - there was a very weak pressure on the sellers in these markets to charge lower than oligopolistic/monopolistic prices.

II.2 Some Probable Factors behind the Demand Side After-liberalization Behaviour

As far as the demand side is concerned, there seem to have been three important influences on its behaviour. The first was a result of the shortage-surplus phenomenon mentioned in the previoius chapter. The long-lasting discrepancies between the amounts supplied and the amounts demanded in many of the Czechoslovak consumer goods markets were due to the disequilibrium price structure determined by the state, to wrong quantitative decisions made by the state planning authorities and to the enterprises often not meeting these plans. The amount demanded had for many years been larger than the amount supplied in the case of many types, sizes, models, colours, etc. (or even of whole categories) of such commodities as flats, building materials, furniture, colour TV sets, freezers, refrigerators combined with freezers, washing mashines, cars, spare parts, clothing, sport- and other footwear, cotton underwear, kitchen-ranges, sewing mashines, video equipment, personal computers, hi-fi systems, watches, toys, parlour games and so on. In 1988 the situation started to worsen also for commodities in the areas of hygiene, cosmetics and health care products. On the other hand, warehouses, store windows and store racks were replete with other types, sizes, models, colours, that were produced or imported in too high numbers or, in other words, were too old-fashioned, of too bad quality or too unattractive in some other way for the Czechoslovak demand to buy it out, given the commodities' centrally determined prices, even thoug the buyers held in their hands the money they could not but would have liked to spend on the scarce commodities. Since only some consumers[1] were able to buy the scarce commodities via one of the several rationing systems that had developed (queues, bribing insiders in a given market who could help get the commodity needed, taking advantage of being a relative or a friend of such an insider, insiders in two different markets helping each other, etc.), forced savings had gradually accrued. Svejnar (1990) describes the situation clearly: „According to official Czechoslovak statistics, in the period 1979-1989 households savings and cash held by households increased by 55% while retail prices increased by 22% only. (Western estimate of the actual increase of retail prices for the same period is 44%). [...] In the time of economic stagnation this means that the velocity of money decreased or that people are not able to spend a part of their income. [...] This growth of a monetary overhang could result in a massive inflationary pressure as soon as households start to fear an adverse future macroeconomic development (especially inflation)." (p. 13). Picture II.1 tries to capture - assuming away many important details - the essence of the situation.

[1] In this thesis primarily consumer goods markets are involved and so „buyer" will in the rest of the thesis mean the same as „consumer".

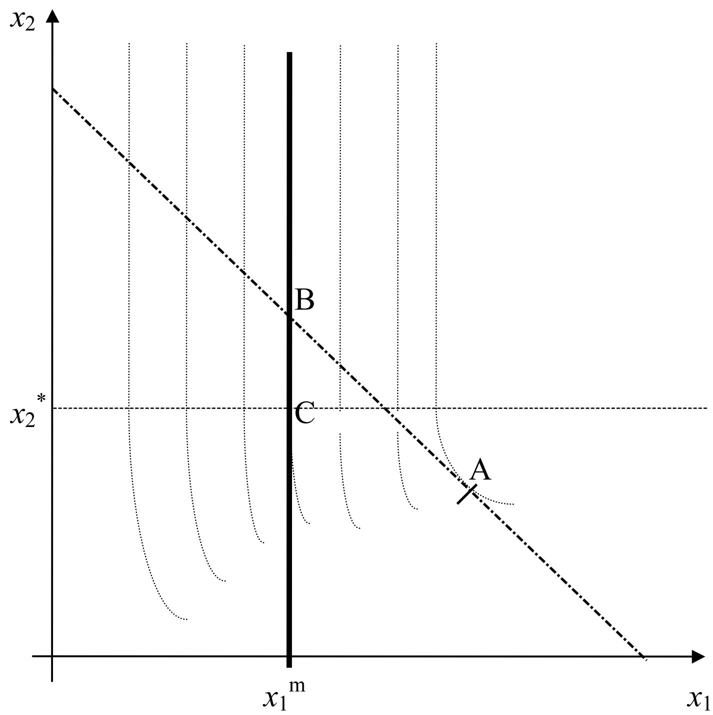
Picture II.1.: Equilibrium of a consumer who would normally choose point A but cannot buy more than x_1^m of the good x_+ so that she would choose point B if it wasn't for the unusual shape of her preferences which - stemming from the fact that she does not want to buy more than x_2^* of the good x_2 - forces her to choose point C and save the unspent part of her income.

the upper limit on the quantity of good x_1 obtainable in the market

budget constraint

indifference curves of a typical consumer

the quantity of good x_2 beyond which its marginal utility for the consumer is non-positive



The extent of forced savings was, however, moderated very much in the second half of 1990 when the consumers' decisions were dominated by their expectations of considerable inflation to occur in 1991. There are various statistical data that indicate this: Household demand deposits in Czechoslovakia reached their highest volume in August 1990 and from September 1990 they started to decrease, between September and December 1990 going down by 10% or by over CZK 10 bil. (SBČS (1991)). (Time deposits remained, however, roughly at the same level.) Non-food goods physical retail turnover in the Czech Republic was in 1990 higher by 5.7% compared to that in 1989 (Statistický bulletin ČSÚ 2/91);[2] for some goods like bed linen, carpets, furniture, refrigerators, and tools, this figure was more than 10% (and the demand for these goods was not satiated).

Newspapers at that time wrote: „In expectation of inflation, people attack savings banks and make every effort to spend their savings as long as they have some value. [...] droves of people in the Czech Lands search for any useful goods for which they could spend saved money.“ (MFS 27.11.1990, 4.12.1990) An investment-like nature of these increaed purchases is documented by the fact that physical retail turnover in the Czech Republic in the areas of foodstuffs and catering was, on the contrary, *lower* by 3.6% and 6.3%, respectively, in 1990 than in 1989 (Statistický bulletin ČSÚ 2/91).[3] Another indication of an effort to prepare best for the 1991 inflation is the fact that from October to December 1990, the volume of total foreign currency deposits in Czechoslovakia increased more than twice. All these data suggest that at least a part of accrued forced savings was eliminated and thus the after-liberalization ability of consumers to easily accept higher prices was moderated. How much of what used to be forced savings consumers still had on January 1st, 1991, is therefore an open question.

The second factor that seems to have shaped buyers' behaviour in an important way is how they felt at that time about the liberalization. In the „socialist“ era, the way prices used to be raised usually was that many prices were raised together at one point in time by a few percent. These rises in prices for a given category of commodities used to take place in a few years' intervals. The one-time increase in prices expected to come after the price liberalization was therefore not a completely new phenomenon for Czechoslovak consumers. What *was* new was the size of the increase, the fact that the increase occured in so many commodity categories, and the ensuing diversity of prices charged for the same commodity in different stores. Since it was not clear how the public would react to threefold shock, the government had been careful to make it clear during 1990 that the liberalization was a cornerstone of the transition programme, that it would have important curative effects on the markets, that its potentially painful consequences were a part of the unavoidable cost of the whole transition and that the painful consequences were going to be offset to some extent by increases in wages. This campaign had been carried out over most of the year 1990, with the result that

[2] But other influences besides inflationary expectations are behind this result too, such as a flood of buyers from Germany and Austria.

feelings of many Czechoslovak citizens towards the price liberalization had probably improved from unfriendly and suspecting to resigned, which probably strengthened their tolerance towards higher prices occuring after the liberalization.

Finally, the third factor that is likely to have co-determined buyers' behaviour after the liberalization is what they thought would happen after it - i.e., their expectations, and particularly their expectations concerning the movement of prices. Only as buyers were gradually learning about the new prices in the first days and weeks of 1991, they could start replacing their expectations with actual knowledge and thus creating a truer idea about the market as it looked at that time. Well, what sources could buyers use to form their expectations of the development that would occur after the liberalization?

A qualitative cue for forming expectations was the existence of legal instruments that the government could use to prevent freed prices from jumping too high. In November 1990 the Czechoslovak parliament passed the Law on Prices (and in December 1990 a decree further specifying the meaning of this law) which established four different ways of regulating prices. Whether, when and how any ofthese ways would actually be used and for which goods, was up to the Ministries of Finance[4] who were to do so by issuing „Price Rulings". The government had during 1990 often repeated that it would certainly make use of these instruments for some time after January 1st, 1991. In other words, the initial price liberalization on January 1st, 1991, was (publicly known to be) planned not to be absolute, namely, that besides the many prices that would be freed completely, many other prices would be allowed to change to a given extent but not entirely freely and prices of some goods would stay fully regulated. This may have created a belief in buyers that the price jump in January 1991 would not be as high after all - not as high as it would be without regulation. This belief was to remain this general and vague until as late as January 9, 1991, because it was on that date only that the very first Price ruling based on the Law on Prices occured (details will be given below).

But buyers had also direct quantitative cues for forming their expectations: predictions (of price level movements in 1991) by various politicians and experts. Most predictions agreed that the overall effect of the price liberalization would be first a sharp increase in the

[3] But again, other influences played a role here - primarily the elevation of prices of foodstuffs in the middle of 1990.

[4] Czechoslovakia was at that time actually a „federation" of the Czech Republic and the Slovak Republic, each of whom had its own Ministry of Finance. There was also the federal Ministry of Finance.

price level immediately during the first days of January 1991 and then a two-digit inflation for the year 1991 as a whole. Specific values occuring in the predictions, however, varied quite substantially. Skimming through several 1990 issues of three major Czechoslovak newspapers and not distinguishing between what was said by politicians in power, opposition politicians, or experts, I found these examples of published (i.e., available to buyers) predictions of the January 1991 price jump (in %): 5-10, 30, 35-40, and these predictions of the 1991 CPI increase or of some other measure of inflation during 1991 as a whole (in %): 15-30, up to 30, 25-30, 30-40, up to 50, 30, 50, 15-20, 20.

II.3 Actual Development

Anticipating sellers' attempts to charge very high prices as soon as price setting is freed, the Czechoslovak government intended to issue at the very end of 1990 the Price Ruling no. 1/91 which would have served to inform all subjects in the economy about what legal limits would exist from January 1st, 1991, on the increases in prices of what goods. Protracted political fights over the division of powers between the federal Ministry of Finance, the Ministry of Finance of the Czech Republic and the Ministry of Finance of the Slovak Republic made the creation and publication of that crucial Price Ruling 1/91 impossible before the end of 1990. A „working" version (version unsigned by the Ministers and thus legally void) was published on January 2nd, 1991. It listed (1) several commodities whose maximum prices were stated directly, (2) several groups of commodities whose prices were allowed to reflect only „economically justified costs and an adequate profit", and (3) several groups of commodities whose sellers had to announce to the Ministry of Finance one month in advance their intention to increase prices if the intended increase (or the sum of gradual increases) was to be higher than that stated in the Ruling for the given commodity.

The valid version (almost identical to the working one) was published as late as January 9, 1991. Unti this date, therefore, sellers could freely charge whatever prices they liked (many did not notice or understand, however, the words „working version" in the heading of the version from January 2). Some sellers did not comply with the Price Ruling 1/91 for various reasons even after January 9: of 537 stores inspected by the consumer protection authorities during the first two weeks of 1991 in the Czech Republic, 37 stores (almost 7 percent) were found to charge prices that were higher than the maximum prices stated in or implied by the

Price ruling 1/91 (MFD 15.1.1991); the list of sellers in the Czech Republic fined for violating the Price Ruling that was valid at the time of inspection during the first quarter of 1991[5] has 42 items (Cenový věstník částka 30-31/91). The government has not made much effort to enforce observing the Price Rulings orto familiarize buyers with the Price Rulings' parts devoted to consumer goods prices. All this indicates that the strength of the legal background of the price liberalization was to some extent wasted.

Somewhat surprisingly, not all sellers started to charge higher prices right from january 2nd, 1991 (January 1st was a state holiday). While decreasing the price from its level as it had been at the end of 1990 was rare, a wide-spread policy was to increase the price only after stocks from 1990 would be sold. For more storable goods, this approach caused a noticeable time lag in the initial price jump. We can see this, for instance, on the differences in the development of foodstuffs prices and non-food goods prices duringthe first months of 1991 in the Czech Reublic as stated in Table II.1.

Table II.1.: CPI and estimated physical turnover from January 1991 to March 1991

Category	**Variable**	**January 1991**	**February 1991**	**March 1991**
Total	CPI in the middle of the month[a]	125.8	134.6	140.9
	Est. index of phys. turnover for the month[b]	72.8 (70)[c]	64.1 (75)[c]	58.7
Foodstuffs	CPI in the middle of the month[a]	131.4	132.6	129.7
	Est. index of phys. turnover for the month[b]	65.6 (66)[c]	61.2 (76)[c]	64.0
Non-food goods	CPI in the middle of the month[a]	123.3	140.0	156.0
	Est. index of phys. turnover for the month[b]	73.6	74.6	48.8

Notes: [a]CPI in the Czech Republic, for CPI in mid December 1990 = 100

[b]Ratio of turnover in the month in 1991 of enterprises in the Czech Republic with more than 100 employees and stating „internal trade" as their prevailing activity, and turnover in the month in 1990 of so-called main trade systems in the Czech Republic (the method of measuring the turnover data changed from 1990 to 1991), and further divided by CPI in the middle of the month in 1991 in the Czech Republic, CPI in the middle of the month in 1990 =

[5] Together there were four Price Rulings issued during this time period: no. 1/91 issued on January 9th, no. 2/91 issued on January 30th, no. 3/91 issued on February 21st, and no. 4/91 issued on March 28th.

100; for foodstuffs and non-food goods, only enterprises directed by the Ministry of Industry and Trade of the Czech Republic are included

[c]Numbers in brackets are the corresponding figures as estimated by the Czech Statistical Office (Statistický bulletin 4/91); I was unable to find these estimates for the remaining five cells and that is why I had to get the estimates by calculating them (the calculation is described in note b); unfortunately, the two official estimates for February differ quite sizable from those I arrived at

Source: ČSÚ (Czech Statistical Office) and my calculation

From the table we can see that foodstuffs prices increased between mid December 1990 and mid January 1991 by about 8 percent points *more* than non-food goods prices, while during the next 30 days, the relation between the rates of increase switched - between mid January and mid February, foodstuffs prices increased by 0.9 percent (132.6/131.4 - 1 ≅ 0.9) and that is more than 12 percent points *less* than the increase in non-food goods prices, which was over 13 percent (140/123.3 - 1 ≅ 13.5). Then until May 1991 foodstuffs prices were actually decreasing, while non-food prices kept rising (though at a decreasing rate).

Another often-cited reason for increasing the prices later than the very first day of sale in 1991 was that many a store belonging to a chain received pricing instructions from the chain management too late (often later than january 2nd).

Another phenomenon moderated (though probably to a limited extent) the growth of prices in the first weeks of January 1991. This time, primarily foodstuffs prices were concerned. Right at the beginning, chain store enterprises decided to openly exploit the opportunity to capitalize on their nearly monopolistic position in the consumer goods markets as well as on the confusion that followed the liberalization and on the inelasticity of the demand for foodstuffs (difficulty for consumers of postponing their purchases of foodstuffs), by charging prices that in many cases included an enormous retail margin. Quite a few individuals and foodstuffs producers alike came swiftly with the idea (or followed the suggestion in this sense made by government officials a few days after the liberalization) to make profits by setting up impromptu selling places as soon as possible and by selling in this way primarily those sorts of foodstuffs for which the prices charged by the chain stores were farthest upwards from levels bringing to the seller at least a reasonable margin (this applied especially to milk, dairy products, meat and bread). Due to the need to start the sale as soon as possible, selling places usually took the form of primitive stands placed in the squares and streets, or the goods were sold directly from the trucks in which they were brought from the producing plant. A long queue formed by each such stand or truck soon after it turned up. This street sale was not, however, a full-value substitute to the traditional store sale - mainly because at most of these stands or trucks one could buy only a single specific brand and type of the good. To purchase, for instance, some butter, milk, bread, and beef, all at the low „street prices“, one had to go through four queues. Simply said, prices were higher in stores, time costs and energy costs were higher in the streets.

Table II.2.: CPI from January 1991 to March 1991 for individual categories of foodstuffs and non-food goods[a]

Category	Jan 91	Feb 91	Mar 91
Total	125.8	134.6	140.9
Foodstuffs	131.4	132.6	129.7
Meat and meat products	132.9	130.0	123.0
Dairy products	154.9	151.8	140.0
Eggs and egg products	134.6	134.7	134.4
Fats	134.8	124.2	113.1
Flour and pasta products	142.9	144.8	145.7
Sugar and confectionery	140.0	153.5	153.9
Potatoes and potato products	132.4	152.0	162.1
Non-alcoholic beverages	130.7	138.6	138.4
Alcoholic beverages	128.6	128.0	127.6
Other foodstuffs	118.8	132.8	136.8
Non-food goods	123.0	140.0	156.0
Textile goods	116.5	132.5	154.9
Footwear and leather goods	112.1	138.2	164.0
Household durables (excl. radio and TV sets)	119.6	144.7	166.7
Kitchen utensils, pumps, tools, etc.	109.8	131.8	163.9
Entertainment (radio and TV sets, musical instruments, etc.)	137.1	155.6	156.6
Articles of culture (periodicals, books, records, jewellry, etc.)	159.5	166.0	173.5
Health care goods, toiletries, paints, etc.	125.3	159.0	199.5
Tobacco products, smoker's utensils	149.9	153.1	151.2
Vehicles (incl. fuel, oil, tyres, spare parts, etc.), sports, etc.	108.8	116.6	117.6
Building materials	168.1	222.4	151.4
Fuels	102.7	105.1	109.6

Notes: [a]CPI in the Czech Republic in the middle of the month in 1991, for CPI in mid December 1990 = 100

Source: Statistické přehledy 6/91

Let's now turn attention to the development of sales and prices in the first weeks and months of 1991. An overall picture is provided by Table II.1., while Table II.2 shows the development of prices in the first three months of 1991 specifically for selected subcategories of foodstuffs and non-food goods. The data in Table II.1. confirm anticipations of an initial price jump in January 1991 - the monthly weighted increase in all prices was about 27 percent in January, while in February and March it was much lower. The negative reaction of demand is indicated by the sharp fall in turnover levels for all three months included in the table. The turnover data apply, however, to larger retail enterprises (employing at least 100 people) only, they do not cover the retail activity of small sellers whose numbers weregrowing rapidly in the period under study, and so the actual total volume of sales in consumer goods markets was probably somewhat higher than the table states. Even so, the Czech Statistical Office estimated that total physical turnover for the first quarter of 1991 in the Czech Republic was about one third lower than that for the same period of the previous year (Statistický bulletin ČSÚ 5/91).

Within the general development described above, the most controversial category were certainly dairy products for which - as Table II.2. shows - the initial price jump was higher than it was for any other foodstuffs category and higher than it was for most other categories as well (outdone only by the categories „articles of culture“ and „building materils“). Among dairy products, full-fat milk was the only good with a determined maximum price. Many sellers did not hesitate to charge this maximum price (CZK 6.30) from the very first moment; some were selling even half-fat milk at this price. Most others increased prices of full-fat milk and other sorts of milk less but still considerably.

Thus, for instance, the average price of half-fat milk and butter in Czechoslovakia rose from CZK 3.60 and CZK 67.20, respectively, in mid October 1990 to CZK 5.14 and CZK 84.82 in mid January (increase 43 and 26 percent, respectively) (Statistická ročenka 1991). Average price data are not available for December 1990 but it is almost certain that most of the increase in average prices occured during January 1991 because CPI in this area of foodstuffs was in the fourth quarter of 1990 only 3.3% higher than it was in the third quarter of 1990 (Statistický bulletin 5/91). Naturally, the consequence of these price jumps was a sharp fall in sales: the newspapers wrote about shops that were unable to sell more than two thirds or even half the volume of milk and other dairy products that they used to sell out easily before they increased the prices. Consequently, given that many stores reduced substantially their orders of these products from dairies, which then had to store much of their production (soon running out of storing place) or reduce in a considerable extent their orders from the producers of raw milk. Unable to face such a resistance on the part of the coinsumers for more than a few days, already after the first week of sale at the new prices some sellers were reported to decrease prices somewhat. And Table II.2. shows that they kept on doing so for the next two months - CPI of dairy products was decreasing from its initial high level throughout the first quarter of 1991.

III. RELEVANT APPROACHES AND RULES IDENTIFIED SO FAR

For analysing much of the research relevant to studying consumer search for a low price, it is useful to assume that the search has the following general structure: a searcher inspects n_1 options, paying in some way for inspecting each option, judges whether among options seen there is an option which she thinks she can accept (e.g., a sufficiently low price), and if there is none, she pays to see further n_2 options and makes an analogical judgement, while if there is such an option, she accepts it (e.g., buys at the price) and the search ends. In this way, the searcher inspects n_1 options, then n_2 options, then n_3 options and so on, until she decides at one moment that she wants to accept one of the options that are availabler for accepting at that moment (of course, it can easily happen that she does so right after inspecting the first n_1 options). Here, to „inspect“ can mean to visit a store, to call the store by phone, to write to it, etc.[6]

We are usually dealing with one of two special cases of the general structure described above: one of these two special cases, sometimes called „fixed sample size search“ (or „fixed stopping“), corresponds to $n_i = 0$ for $i = 2, 3, ...$, while the other special case, sometimes called „sequential search“, (or „optional stopping“), corresponds to $n_i = 1$ for $i = 1, 2, ...$ Which case we are dealing with may be implied by the nature of the situation (e.g., one can choose to send letters asking for a price list to several stores at a time).

Various aspects of the situation in which the search behaviour occurs play an important role in various approaches, many aspects being important to more than one approach. Below there are listed some of the more important aspects together with examples of what I will call „realizations“ of these aspects; each combination of these realizations will be called „setting“.

[6] A rather different understanding of the term „search“ is used in the literature on „local search“ (Wall (1993)): this understanding assumes (1) that in each period the decision maker chooses an option without making any informative inspections, (2) that the set of options has inner structure which makes it sensible to say that the decision maker follows a certain direction as she proceeds from the option chosen in one period to that chosen in the next period, (3) that with each her decison about which option to choose in the next period, the decision maker takes advantage of that structure by trying to follow the direction which - given what the options chosen so far looked like - seems most attractive in terms of the extent to which the options chosen meet the decision maker’s objective, and (4) that once the decision maker finds an option which fulfils her objective at least in the extent defined by the „aspiration level“ determined by her, she chooses it and keeps doing so in the following periods as long as this option meets the condition mentioned. Several authors have viewed search from yet other perspectives (e.g., Radner (1975), Radner & Rothschild (1975)).

All the realizations listed are taken from the existing literature and for realizations which are not very easy to encounter, I give references to some of the texts where they occur.

(1) Nature of each option + searcher's objective:

(1a) a single number + pick such an option that its value after the total of search costs is deducted from it is maximized

(1b) a vector of parameters (e.g., a vector of prices of a given vector of goods), one of them being variable across options + pick such an option and suggest such a vector of positive constants (e.g., amounts of the goods) that (a) the sum of the total of search costs and of the scalar product of the option chosen and of the suggested vector (e.g., total costs of buying the goods in the suggested amounts) is not higher than a given constant, and (b) that a given scalar function of the suggested vector is maximized (Manning and Morgan (1982))

(1c) a vector of parameters (e.g., a vector of prices of a given vector of goods of each of which we want to buy exactly one unit), all of them being variable across options + pick one or more options and form a new vector which has the same number of components (e.g., prices of the given vector of goods) as the options and whose *i*-th component is the *i*-th component of one of the options chosen so that the sum of the total of search costs and of all the components of the new vector (e.g., total costs of buying the goods in the suggested amounts) is minimized (Burdett and Malueg (1981), Carlson and McAfee (1984))

(1d) a vector of parameters, all of them being variable across options + pick such an option that the sum of its components after the total search costs are deducted from it is maximized (Grether and Wilde (1984))

(2) Probability that it will be possible to inspect a given option:

(2a) one

(2b) less than one (Gronau (1971), Salop (1973), Chalkley (1984))

(3) Time discounting:

(3a) absent

(3b) present (Gronau (1971), Kohn and Shavell (1974), Talmain (1992))

(4) The value of an aggregate measure of amounts of various resources the searcher has to give up and of amounts of various sufferings she has to undergo to inspect a given option, or briefly **search cost** (realization (4c) relevant for options in the form of vectors of numbers only):

(4a) zero (Brickman (1972), Shapira and Venezia (1981)

(4b) positive and same for all options

(4c) positive and same for all options for a given component but different for different components of each option (Grether and Wilde (1984))

(4d) positive and different for different options (Weitzman (1979), Kogut (1990), Harrison and Morgan (1990))

(5) **Type of probability distribution of options**, or briefly **type of option distribution** (relevant for options in the form of (vectors of) single numbers only):

one typology:

(5a) continuous

(5b) discrete (Rothschild (1974), Ölander (1975), Talmain (1992))

another typology:

(5a') normal (Hey (1982), Moon and Martin (1992, 1996), Martin and Moon (1992))

(5b') uniform (Telser (1973), Kogut (1990), Sonnemans (1996))

(5c') triangular (Telser (1973))

(5d') general

(6) Option distribution in time or for various options (relevant for options in the form of (vectors of) single numbers only):

(6a) same at all times and for all options

(6b) its mean changing monotonically in time and same for all options

(6c) different for different options (Salop (1973), Weitzman (1979))

(7) Initial general information on options (realizations (7a) and (7b) relevant for options in the form of (vectors of) single numbers only):

(7a) complete (i.e., functional shape and values of all parameters)

- operationalized in various ways, e.g.:[7] functional shape and values of all parameters (Moon and Martin (1990)), [8] relative frequency of options in any chosen interval (Hey (1987, 1993)), frequency chart (Ölander (1975))

(7b) in the form of a subjective prior distribution (Rothschild (1974), Hey (1981), Rosenfield and Shapiro (1981), Morgan (1985), Talmain (1992))

(7c) shape of and values of only selected parameters of the option distribution (Shapira and Venezia (1981))

(7d) range (Ölander (1975), Urbany (1975))

[7] Hey (1987) raises the question of how to describe the option distribution to people so that they can be described as knowing the distribution completely.

(7e) number of different possible options (Ölander (1975), Urbany (1986))

(7f) *r* options inspected in advance but not available for choosing (Rapoport and Tversky (1966), Martin and Moon (1992))

(7g) none (Ölander (1975), Hey (1982), Moon and Martin (1990), Butler and Loomes (1997))

(8) Learning about option distribution from options inspected (relevant when option distribution is not known completely at the beginning of the search):

(8a) Bayesian (Rothschild (1974), Talmain (1992))

(8b) having the following property: the higher the number discovered by inspecting an option, the more the searcher's subjective idea of the option distribution changes in favour of high numbers (Morgan (1985))

(9) Information sources used:

(9a) inspected options only

(9b) all that are usually available

- categorized in various ways, e.g.: friends - salespeople - prices - advertisements - family members - other (Claxton, Fry and Portis (1973)), store inspection - media - opinion leaders (Beatty and Smith (1987))

(10) Recall (relevant for sequential search only):

(10a) full

(10b) partial (Landsberger and Peleg (1977))

(10c) none

(11) Total number of options that it is possible to inspect:

(11a) finite

(11b) infinite

(12) Highest possible value of the sum of an aggregate measure of amounts of various resources the searcher has given up and amounts of various sufferings she has undergone (a) while searching and (b) while subsequently exercising the option chosen:

(12a) finite (Hey (1982), Manning and Morgan (1982), Carlson and Gieseke (1983), Urbany (1986), Butler and Loomes (1987))

(12b) infinite

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[8] If the searcher does not possess knowledge of statistics, however, such information is meaningless.

In what follows, contributions will be grouped by general approach and method typical for a given discipline - even if the specific source discussed appeared in a journal related to a different discipline.

III.1. Economics

In economics, the situation this thesis focuses on is usually labeled „price search“ or „consumer search“ (for a survey see, e.g., Wilde (1987), McMillan and Rothschild (1994)). In most respects, it is analyzed similarly to what is called „job search“ (for a survey see, e.g., Mortensen (1986)) where the searcher looks for a job offering a high salary. The main formal difference is that price search serves to decrease the amount to pay, while job search serves to increase the amount to receive. In all these cases, options have the form of single numbers or vectors of numbers and will be called „quotes“.

We will find several rather different approaches to studying price search, which all can be considered to exist within economics (and all are applied or applicable also to job search). They can be categorized broadly as three approaches: theory building, simulation, observation. The essence of all three approaches will be described below. While theory building and simulation bring usually new knowledge about a given rule in a given situation, observation says usually something about people, the way they actually think. Since only observation is directly interested in what I am interested here, that is, in the price-search rules people actually use, it is the only approach of the three whose findings will later be briefly overviewed.

III.1.1. Theory Building

This approach, among economists by far the most popular of the three, proceeds by first specifying the particular setting in which the price search is assumed to occur, and then by deriving (at least some properties of) the „optimum search rule“ - the way the searcher is to decide when to stop the search if she is to maximize the expected value of her objective function - appropriate to the assumed setting.

This deductive method of studying search in general (be it price search or other kinds of search) belongs in fact more into the realm of mathematics than empirical science, as is documented by the fact that quite some of the findings that economists dealing with search build on and develop, were originally published by mathematicians and statisticians in books and journals oriented on mathematics, statistics and operations research (such as Ash and Jones (1964), Breiman (1964), Gilbert and Mosteller (1966), DeGroot (1970), Chow, Robbins and Siegmund (1971)). Probably the first model of this kind is contained in the appendix of the article in which Simon (1955) suggested search as a wide-spread way of decision making and has become legendary as the text introducing into social sciences the more general notion of bounded rationality. It was Stigler (1961, 1962) and McCall (1965), however, who were succesful in bringing search into the attention of economists.

Many articles on price search have occured since then, deriving results related to optimum price-search rules appropriate to many various settings. To mention just one example, Manning and Morgan (1982) state optimum fixed sample size search rule (and how it reflects changes in several task parameters) for the following setting: (1) Nature of each quote + searcher's objective: (1b) a vector of prices of a given vector of goods, one of them being variable across quotes + pick such a quote and suggest such amounts of the goods that (a) the sum of the total of search costs and of the costs of buying the goods in the suggested amounts is not higher than a given constant, and (b) that a given scalar function of the suggested vector is maximized. (2) Probability that it will be possible to inspect a given quote: (2a) one. (3) Time-discounting: (3a) absent. (4) Search cost: (4b) same for all quotes. (5) Type of quote distribution: (5a) continuous; (5d') general. (6) Quote distribution in time or for various quotes: (6a) same at all times and for all quotes. (7) Initial general information on quotes: (7a) complete (i.e., functional shape and values of all parameters). (9) Information sources used: (9a) only inspected quotes. (11) Total number of quotes that it is possible to inspect: (11b) infinite. (12) Highest possible value of the sum of an aggregate measure of amounts of various resources the searcher has given up and amounts of various sufferings she has undergone (a) while searching and (b) while subsequently exercising the option chosen: (12a) finite.

III.1.2. Simulation

The usual aim of this approach is to help map properties of a given search rule - i.e., find out what results we can expect to obtain if we use that rule - in a given situation, with various parameters of the rule and/or of the task taking on various values from predetermined intervals, and/or for various settings. Obviously, this approach is taken primarily in cases where it is impossible or very difficult to map the rule's properties analytically. The rule can come from empirical observation (Hey (1982), Moon and Martin (1990), Martin and Moon

(1992)) or it can be suggested by the researcher's imagination (Telser (1973), Moon and Martin (1990)).

Usually, a computer is programmed to do the following for each of the combinations of concrete parameter values considered and/or for each setting considered: (1) generate thousands of sets of quotes according to the concrete version of the quote distribution defined by the parameter values chosen and aspects chosen, (2) simulate searching in each of these sets according to the concrete version of the rule defined by the parameter values chosen, and (3) report the average (over all the sets of quotes) of a search characteristic of interest (Hey (1982)). This average is then often compared to what is used as a „standard“, such as the average of the corresponding characteristic of search conducted either according to the rule that is optimal for the given situation with complete information (Moon and Martin (1990), Martin and Moon (1992)) or according to the simplest rule possible, namely, the rule „take the very first quote inspected“ (Telser (1973)).

Of course, the computer can be programmed to perform various follow-up procedures, such as identifying those values of the parameters of the rule for which using the rule leads to results that are closest to those we get using the best rule we can imagine for the given task - that is, the rule that is optimal for the task with complete information (Moon and Martin (1990), Martin and Moon (1992)).[9]

III.1.3. Observation

This approach seeks mainly to find out what rules people actually use in various tasks of the price-search type, or at least what properties these rules have.[10] Quite a few methods have been used within this approach; other methods which have been used for studying job search could easily be used, too. The following are some of the methods of studying price or job search behaviour (the first two methods require that the researcher has identified in advance a „candidate“ rule - candidate for the rule actually used by searchers):

(a) Comparative statics: (i) observe the behaviour of searchers in two situations which differ in the value of exactly one parameter or in the realization of exactly one aspect of the

[9] Two other, rather different uses of computer are mentioned in subsection 1.3.

[10] An example of the latter is studying the extent to which empirically observed search results are in accord with the results that would be obtained in the same task, using the rule that is optimal for the task with complete information (Hey (1987)). Another example is an attempt to estimate real-life returns to search in terms of lower prices paid (for cars), resulting from searching one more hour (Ratchford and Srinivasan (1993)).

setting,[11] (ii) from a candidate rule, derive predictions on the differences in search behaviour in the two situations, and (iii) see the extent to which the candidate rule's predictions are fulfilled by the data obtained in step (i) (Butler and Loomes (1997)). ANOVA, a version of the above procedure with differences in the values of more than parameter or in the realization of more than one aspect of the setting, has been used, too (Urbany (1986)).

(b) Fitting data with a rule: find the values of a given vector of parameters of a candidate rule for which the behaviour implied by this candidate rule corresponds best to a given set of empirically observed searh results. To find these parameter values, computer simulation has been used (Moon and Martin (1990), Martin and Moon (1992)).

(c) Statistical „explanation": suggest variables that seem to codetermine the probability that a searcher stops at a given moment of the search and estimate the parameters of an expression which combines these variables; analyse the estimated values in an effort to discover potential regularities or contours of a rule. Examples of specific statistical techniques used in this way are probit analysis (Hey (1993)) and duration analysis (Kogut (1990)).

(4) Delegated search: ask the („original") searcher to spell out the rule that a search agent (such as a computer) is to use for searching on the original searcher's behalf, if the payoff that the original searcher receives after the search is terminated depends on the outcome of the search (Sonnemans (1996)).

(5) Think-aloud protocols: encourage the searcher to think aloud as she searches, record her words and analyse them in an effort to discover potential regularities or even contours of a rule (Hey (1982), Moon and Martin (1990), Martin and Moon (1992)).

(6) Written reports: after search, ask the searcher to put downin detail how she was reasoning during her search and analyse this report in an effort to discover potential regularities or even contours of a rule (Moon and Martin (1996)).

(7) Electronic information board: programme a computer to simulate search environment in such a way that (i) at each moment of the search, the searcher can reveal each piece of information that the experimenter intends to be obtainable (e.g., quotes, the total of search costs spent so far, etc.) only by clicking with the mouse on the appropriate region of the screen, and that (ii) the computer records when the searcher revealed in this way what information; analyse this record in an effort to discover potential regularities or even contours of a rule (Sonnemans (1998)).

[11] Unless the options inspected are the single thing that distinguishes the two situations, they have to be exactly the same in the two situations.

III.2. Psychology

In psychology, the situation this thesis focuses on is one of several related topics usually gathered under the umbrella label of „optional stopping“. Given the fact that probably no more than two or three dozens of papers have ever been published on optional stopping in psychological journals, the topic can safely be considered to lie on the very edge of psychologist's attention (which is where most other statistical or decision-oriented human thinking lies).

Moreover, only some of these papers deal with human behaviour in tasks that have the general structure sketched at the beginning of this chapter. We could label this structure as „direct-search structure“ to distinguish it from a related but different „indirect-search structure“ - that is the structure that the other optional stopping papers deal with. The difference lies in the relation between the source of information for a given decision and the options among which the decision is then to be made: in direct search, the information that is needed for a given decision is provided directly by (inspecting) the options among which the decision is then to be made, while in indirect search, the information source and the options are separate entities, i.e., the information that is needed for a given decision is provided by (inspecting) mere cues and the subsequent decision is made among options which may have nothing in common with the cues except the (statistical, causal, etc.) relation that makes the inspection of at least some of the cues helpful for deciding among the options.

All direct-search optional studies (e.g., Rapoport and Tversky (1966, 1970), Kahan, Rapoport and Jones (1967), Brickman (1972), Corbin, Olson and Abbondanza (1975), Shapira and Venezia (1981)) try to answer the same kind of question: to what extent does empirical evidence support the optimum search rules (identified in mathematics, statistics, operations research and economics, as was touched upon in section 1.1.) for a given setting? In most of the settings used, several aspects have the same relizations - (1) Nature of each option + searcher's (assumed) objective: (1a) a single number + pick such an option that its value after the total of the search costs is deducted from it is maximized. (2) Probability that it will be possible to inspect a given quote: (2a) one. (3) Time discounting and (8) Learning about option distribution from options inspected: the realizations were determined implicitly and individually by the subjects and were not ascertained in any way by the experimenters. (9) Information sources used: (9a) inspected options only. As for realizations of the remaining aspects, the settings considered in different studies differed. Given the fact that these studies did not attempt to identify rules actually used by searchers, the findings of this stream of psychology are not important for studying the subject of inquiry in this thesis.

Let's briefly overview some other fields of psychology which seem related to studying the subject of inquiry in this thesis:

(1) Indirect-search behaviour: This literature is similarly scarce as that on direct-search, but even so, it can be further divided according to the specific kind of indirect-search task it is concerned with, such as:

- (tasks inspired by Wald (1945, 1947)) each cue is a single-value sample from an unknown distribution; the decision is to choose among several given binomial distributions the distribution from which the cues come (Becker (1958), Pruitt (1961), Fried and Peterson (1969)) or to state whether the mean of the source population is positive or negative (Irwin, Smith and Mayfield (1956), Irwin and Smith (1957));

- (estimator-type task) each cue is an estimator of a certain unknown value; the decision is to choose (from a real line) a number that estimates correctly this value (Connolly and Gilani (1982), Connolly and Serre (1984), Connolly and Wholey (1988));

- (component-type task) all cues are zero-mean values which - if inspected all - would add up to a certain unknown zero-mean value; the decision is to choose (from the real ine) a number that estimates correctly this value (Connolly and Thorn (1987), Connolly and Wholey (1988));

- (cell task) each cue is a statement on whether the cell the subject points to, one of 16 cells in a 4x4 table, is the cell that was drawn in advance by the experimenter, each cell having a probability 1/16 of being drawn (Edwards and Slovic (1965)).

(2) Judgmental forecasting (for a review, see Goodwin and Wright (1993)): This stream of research has been interested in how people forecast time series and related problems. A basic step is to measure the extent to which human forecasts based on a known sequence of values of the time series match the actual subsequent development of the time series under various conditions, such as various functional types of the source formula from which the time series is generated, various values of parameters in the formula, various modes of presenting the known part of the time series (graph, table), various lengths of this part of the time series, with/without real-life context, etc. A number of researchers have focused on the conditions under which forecasters discover and assess correctly the trend (Wagenaar and Sagaria (1975), Timmers and Wagenaar (1977), Wagenaar and Timmers (1978), Mosteller et al. (1981),

Eggleton (1982), Lawrence and Makridakis (1989), Andreassen and Kraus (1990)), periodicity (Harvey, Bolger and McClelland (1994)), and serial correlation (Lawrence and O'Connor (1992)) of the time series they forecast. Also, several more or less formal rules have been suggested which try to express the way people form their forecasts (Jones (1979), Andreassen (1990), Bolger and Harvey (1993)).

Actually, very similar topics have been studied also by economists (Ferber (1953), Visco (1984), Levy and Spivak (1988), Hey (1994)) who - instead of „judgmental forecasting" prefer the heading „expectation formation" probably to emphasize a focus on specific kinds of time series (primarily price level development). Occasionally, similar issues have been studied also by consumer researchers (Jacobson and Obermiller (1990)).

Findings coming under both the label „judgmental forecasting" and „expectation formation" could be useful for the subject of inquiry of this thesis in modelling the way searchers arrive (if - within their search rules - they need to do so) at a prediction of the value of the next option to be inspected, given the values of the options inspected so far.

(3) Generalizing: Quattrone and Jones (1980), Jepson, Krantz and Nisbett (1983) and Nisbett et al. (1983) are among the very few studies focused on the way people generalize, i.e., form their idea of what the population looks like, given what the sample that is available to them looks like. The populations and properties about which the generalizations in these studies were made from small samples range from an unknown kind of bird being blue and nesting in a eucalyptus tree and members of an unknown tribe being brown and obese, to students of the subject's own vs. a different university preferring rock or classical music. This research as well as the closely related research on probability/frequency estimation (Estes (1972, 1976), Hasher and Zacks (1979), Whitlow and Estes (1979), Howell and Kerkar (1982)) could indicate the ways searchers deduce what the whole otpion distribution looks like from the several options they have inspected so far during the search.

(4) Ability-related tasks: Some parallels can be found also between the research on low-price search tasks and the (in psychology tather more popular) research on ability-related tasks (Morgan and Buskist (1987), Lant (1992)) in which people often first determine the level of success they will try to achieve, given their abilities (as known to them from previous trials or similar tasks), overall displeasure of various levels of effort and various levels of success. For instance, the aspiration level in ability-related tasks plays a role similar to that played by the highest acceptable price in the low-price search tasks: if it is not achieved in the appropriate sense, an unpleasant situation arises (feeling of failure and suffering the costs of another trial

in the former type of tasks,[12] doing without the benefits of having done the decision to be made after the search and suffering the costs of inspecting another option in the latter type of tasks). In other respects, however, the analogy is less perfect (e.g., in ability-related tasks, the subject can usually choose the level of effort to be „paid“, while in low-price search tasks, the search cost is usually given in advance).

III.3. Consumer Research

„Consumer research“ is a label used here to refer to the already large amount of literature (most of it usually considered to belong to „marketing science“) which seeks to describe and understand the thinking and behaviour of today's real-life consumers as captured by various sorts of primarily survey data. Consumer researchers have not succeeded yet in finding a general framework (something like a Kuhnian paradigm) within which they would conduct their studies and thus consumer research remains highly disintegrated and heterogeneous in terms of methods as well as topics - the researchers in it have been using many different approaches, taking up as their starting points various theories from both psychology and economics, and answering various kinds of questions about various aspects of consumer behaviour.

In spite of this disintegration there can be found a stream in the consumer search literature which deals with consumer behaviour more or less related to search for a low price (for an early review, see Newman (1977); among more recent articles, Beatty and Smith (1987) are closest to a review). In most of the articles that from this stream the (assumed) setting is in some aspects the same: (1) Nature of each option + searcher's objective: (1a) a single number + pick such an option that its value after the total of search costs is deducted from it is maximized. Search cost: (4b) positive and same for all options. (9) Information sources used: (9b) all that are usually available. (11) Total number of options that it is possible to inspect: (11a) finite. (12) Highest possible value of the sum of an aggregate measure of amounts of various resources the searcher has given up and amounts of various sufferings she has undergone (a) while searching and (b) while subsequently exercising the option chosen:

[12] Of course, these costs are necessary to be suffered only if the overall task is to keep on trying in the ability-related task until a result considered at the given moment to be a success is achieved.

(12a) finite. The realizations of the remaining aspects of the situation were usually determined implicitly and individually and were either not ascertained in any way by the researchers or were different for different individuals whose search behaviour was studied (this applies mainly to the aspect no. 7, Initial general information on options).

Unfortunately, in each of these articles there is something that makes the findings in that article not directly usable for the study of the subject of inquiry in this thesis - in some of the articles it is the particular kind of data used, the assumptions made when building a model to be estimated, etc. Thus, just a brief overview of this part of the consumer research literature should suffice.

There are many sources from which a consumer can get informationon the good she wants to buy. The extent of search conducted by the consumer can therefore be defined either as the intensity of using one of these sources or as a weighted average of the intensities of using all the sources. Hauser et al. (1993) concentrate on how consumers allocate a given time budget among several information sources. Quite a few consumer researchers have studied the relation of the extent of search conducted by the consumer - defined in one of the two ways defined above - and either generally search correlates, i.e., variables whose values change systematically with the extent of search conducted by the consumer, or more specifically search determinants, i.e., variables which are considered likely to determine causally the extent of search conducted by the consumer (Udell (1966), Claxton, Fry and Portis (1974), Westbrook and Fornell (1979), Kiel and Layton (1981), Duncan and Olshavsky (1982), Punj and Staelin (1983), Beatty and Smith (1987), Urbany, Dickson and Wilkie (1989), Srinivasan and Ratchford (1991), Putsis and Srinivasan (1994)).

Carlson and Gieseke (1983) and Punj and Staelin (1983) try to estimate how much the price that is paid after search is terminated depends on the extent of that search.

One could consider as highly relevant those studies of consumer purchase decisions which make use of the notion of a „reference price“ (Kalwani et al. (1990)) to which the consumer compares the actual tag price to find out whether they are in a relation that suggests the good is worth buying. The reference price in this research has the same role thatt the highest acceptable price has in the low-price search literature. The problem which eliminates the relevance of the reference/expected price research is that the data this research uses do not cover *all* (both non-purchase and purchase) decisions of the consumer concerning the purchase of the given good. Apart from this crucial difference in the completeness of data, i.e., in terms of methods used, this research is very close to the method under letter (c) (statistical „explanation“) of observational approach in economics (section 1.3.).

Somewhere on the border of psychology and consumer research lies the study by Behrend (1966) who studies various aspects of the relation of consumers to prices, such as factors that influence the extent to which consumers learn what the prices look like, factors that determine whether consumers judge a stated price of a given good high or low, and the impact of inflation. Surveys of a similar nature were conducted also by Katona (1975).

III.4. Rules Identified So Far

Given that this thesis focuses on the buyer search for a low price, all rules mentioned in this section as well as those described and discussed later on in this thesis will be stated as they would sound in this buyer search context even if they were published in a different context.

If we disregard differences in the setting (degree of knowledge, degree of recall etc.) and differences in the origin of the rule (derived mathematically, suggested by the imagination of the researcher, derived from empirical data etc.), we will see that many rules have already occurred in the literature.

The rules mentioned in this section will be classified using a cutoff value framework in which the decision to stop or to go on searching is based on a comparison of the current value of a variable (for whose values the relation "is higher than" is defined) with that variable´s value that is considered at the moment by the buyer limiting in the sense that it seems to her to draw a good demarcation line between (1) the set of that variable´s values of which any, if observed at the moment during the search, indicates that it is a good moment to stop the search and choose the lowest price available at the moment, and (2) the set of all other values of that variable. I will call the variable whose values the buyer is watching "the indicator" and its current limiting value "the indicator´s current cutoff value". The current cutoff value as the buyer identifies it can be viewed as a variable distinct from the "the indicator" to whose value its value is compared and so it is actually up to us to choose within this pair of variables the one we will call "the indicator", leaving the label "the indicator´s current cutoff value" to the other one. Here I try to choose as the indicator that of the two corresponding variables whose role in the buyer´s motivation seems to me more obvious. Rules may - and many published rules actually do - use more than one indicator, but if they do, they must specify how exactly the momentary higher/lower relations of individual indicators to their current cutoff values are to be combined to arrive at the decision to stop or to go on searching.

First, there are rules which use a single indicator. This indicator can be the currently observed price, as in all optimum search rules with the "reservation-price" property (discussed, e.g., by Rothschild (1974)), in the rules described by Holt (1970), Hey (1982) (rules B and D), Moon and Martin (1990) (rules L, N), Martin and Moon (1992) (rule Q), Ratchford and Srinivasan (1993), and in the rules suggested (suggestion, of course, does by no means imply actual use) by subjects 8 and 24 to be used for them by the computer in Sonnemans (1997). Levinthal and March (1981) model adaptive aspirations in a way which can be (and at the end of Butler and Loomes (1997) it actually is) viewed as a search rule with the currently observed price as the only indicator.

But there are also other possible candidates for the single indicator. One is the lowest of the prices seen so far (full recall assumed), occuring, e.g., in rule M in Moon and Martin (1990). Another example of a single indicator is the difference between (1) the value which the buyer´s utility will take on if the search is terminated at the moment and the good is bought at the lowest price available and (2) the value it will take on if the good is not bought at the moment (Putsis and Srinivasan (1994)). Yet another possible single indicator is the difference between (1) the amount of resources allocated by the buyer to searching for a low price and buying the good subsequently, and (2) the actual current sum of the amount of resources that the search has consumed up to the moment and the lowest price seen so far (full recall assumed) (Butler and Loomes (1997)). In all "fixed-sample size" rules the single indicator is the number of prices seen so far during the search (e.g., the rule in Manning and Morgan (1982), rule G in Moon and Martin (1990)). In rules J in Moon and Martin (1990) and P in Martin and Moon (1992) the single indicator is the total search costs accrued during the search up to the moment.

Among rules with two indicators there is, for example, the "satisficing model" of Ölander (1975); one its possible generalization (Ölander used a rather specific rule corresponding to the rather specific experimental design he used) would use the currently observed price and the cost of the next search step as indicators, and assert that the searcher should go on only if the former indicator falls above its current cutoff value and the latter indicator falls below its current cutoff value (unfortunately, in this case - unlike the other rules in this overview - the way the two cutoff values are to be computed is not specified in the article). In rules K and K* in Moon and Martin (1990) the two indicators are the currently observed price and the number of prices seen so far and the search is terminated as soon as either the first indicator falls below its current cutoff value or the second indicator falls above its current cutoff value. Other examples of rules with two indicators are rules C and E in Hey (1982) (in both these rules the two indicators are the last price observed and the last but one) and rules suggested by subjects 12, 14, 16 and several others in Sonnemans (1996) (among the two indicators there are, e.g., the currently observed price, the lowest price encountered so far, the current sum of the amount of resources that the search has consumed up to the moment and of the lowest price seen so far). Sonnemans also reports some subjects suggesting rules with three, four and even five indicators.

Besides these pure cases, there are various hybrid rules in which the set of indicators used or the way their current cutoff values are computed change as the search goes on - examples include rule F in Moon and Martin (1990) and rules S and T in Martin and Moon (1990). For instance, in rule F of Moon and Martin (1990) the indicator at the second price inspected is the absolute value of the difference between this price and the first price, while at the third price, the indicator is the number of prices seen so far (its cutoff value being 3 in any circumstances - i.e., the rule dictates to search at most three times whatever happens during the search).

IV. HYPOTHESIS

The specific way I want to study the search conducted by buyers in the first days after price liberalization is to see to which extent the data I have collected support the hypothesis that these buyers search for a low price according to one of several rules. The question thus arises as to which of the many rules mentioned in the previous chapter should be chosen for this test.

Naturally, I want to choose for such a test those rules that seem most likely to be confirmed. A strong indication that a given rule - after it is adapted to the particular situation and setting I study - is likely to be confirmed, is that the rule has been identified on the basis of empirical data (rather than on the basis of optimization or the researcher's imagination). This consideration leads me to focus on empirically identified rules. But there are still too many of them to test them all. I will therefore introduce a pair of additional arbitrary criteria whose imposition will lead to leaving many empirically identified rules aside:

Criterion 1: All available information is used which it seems „reasonable" to use in the situation under study (i.e., the one that arises in a market in the first days after price liberalization) in the sense that ignoring any part of this information may for some parameter values make the search extremely inefficient.

Criterion 2: Existence of a heuristic behind the rule, where „heuristic" means a very general principle (usable possibly in many other settings and situations besides the present one) which may be very simple but makes some sense and can be used to explain and justify the rule (but does not have to resemble any optimal rule in any way whatsoever).

The foregoing paragraphs imply the structure of the rest of this chapter: Section IV.1 takes a closer look at the rules that have so far been identified empirically. Section IV.2 - after introducing several simplifying assumptions on the buyer's motivation and on the whole situation in which she searches - applies Criterion 1 to the market in the first days after price liberalization, i.e., it discusses what information available to her it seems reasonable for the buyer to use if she searches in that market. Section IV.3 applies Criterion 2 to the empirically identified rules listed in Section IV.1 by stating three different heuristics that I was able to extract from the empirically identified rules. Finally, Section IV.4 puts together the results of Section IV.2 and Section IV.3 - it suggests for each of the three heuristics one rule which can be obtained by requiring that a given heuristic uses all information that it seems reasonable to use when searching in a market in the first days after price liberalization. The three rules I will thus obtain are the rules that will form the hypothesis to be tested.

IV.1. Empirically Identified Rules

As the survey in Chapter III suggests, many researchers have been interested in actual search behaviour. While most of them restrict their attention to testing the empirical validity of theoretically derived rules or to studying separately various properties of search behaviour, I have been able to find just a handful of studies that have so far been devoted to empirical identification of search rules proper. All these studies focus on no or little information settings; this is quite understandable as soon as we realize that the less information the buyers have, the fewer possibilities there are of which parts of this information to use and in what way to combine them and therefore the easier it is to model the way buyers reason when searching.

The first pioneer in the field of empirical identification of search rules was Hey (1982). He observed search behaviour in an experiment in the following setting: 1) Nature of each option + buyer's (assumed) objective: a single number + fulfill the experimenter's request to strive to pick such an option that its value after the total search costs are deducted from it is maximized. 2) Probability that it will be possible to inspect a given option: 2a) one. 3) Time-discounting: the realization was determined implicitly and individually by the buyers and was not ascertained in any way by the experimenters. 4) Search cost: 4b) same for all options. 5) Type of distribution of options: 5a) continuous (with options being stated with two decimal places only), 5a') normal. 6) Distribution of options in time or for various options: 6a) same for all. 7) Initial general information on options: 7g) none. 8) Learning about option distribution from options inspected: the realization was determined implicitly and individually by the buyers and was not ascertained in any way by the experimenters. 9) Information sources used: 9a) inspected options only. 10) Recall: full. 11) Total number of quotes that it is possible to inspect: 11b) infinite. 12) Highest possible value of the sum of an aggregate measure of amounts of various resources the buyer has given up and amounts of various sufferings she has undergone (1) while searching and (2) while subsequently exercising the option chosen: 12a) finite. The whole experiment was described to the subjects in the low price search context (given the maximization formulation of aspect 1, options should be viewed as negative) and so the rules were already in the original form stated in the low price search context. On the basis of his evidence, Hey (1982) identified four rules which he labeled with letters from B to E (p_i is the price observed in the i-th store;[13] t is the current period; c is the (constant) cost of inspecting each quote; in all rules to be described in this section and later, it will be implicitly understood that the buyer inspects enough prices to make the rule usable and that once she terminates the search, she chooses the lowest of the prices available at the moment):

Rule B („one bounce“ rule): Go on if $p_t < p_{t\text{-}1}$.

Rule C („two bounce“ rule): Go on if $p_t < p_{t\text{-}2}$ and $p_{t\text{-}1} < p_{t\text{-}2}$.

Rule D („modified one bounce“ rule): Go on if $p_t < p_{t\text{-}1} - c$.

Rule E („modified two bounce“ rule): Go on if $p_t < p_{t\text{-}2} - 2c$ or $p_{t\text{-}1} < p_{t\text{-}2} - c$.

Moon and Martin (1990) used the same setting as Hey (1982) except two aspects: aspect 1 (nature of each option + buyer's (assumed) objective) for which they used the realization 1a by paying their subjects money and by doing so according to a scheme which induced the subjects to really aim at picking such a price that its value (less than zero) after the total search costs are deducted from it is maximized (Hey (1982) just asked the subjects to do so) and aspect 12 (highest possible value of the sum of an aggregate measure of amounts of various resources the buyer has given up and amounts of various sufferings she has undergone (1) while searching and (2) while subsequently exercising the option chosen) for which they chose the realization 12b) infinite.[14] On the basis of their evidence, Moon and Martin (1990) suggested four rules which they labeled (compatibly with Hey's notation) with letters F, G, H and J:

Rule F („two plus one“ rule): Go on if $|p_1 - p_2| > 2c$ but do not inspect more than three prices.

Rule G („three searches“ rule): Inspect three prices.

Rule H („three searches modified bounce“ rule): Inspect p_3 if $c \leq 0.1 min\{p_1, p_2\}$. After inspecting p_3, go on if $p_2 \leq p_1 - c$ and $p_t \leq p_{t\text{-}1} - c$.

Rule J („total search cost“ rule): Go on if $tc < 0.075p_t$.

The third paper in which rules were identified empirically was published by Butler and Loomes (1997) who used the same setting as Hey (1982) except aspect 1 for which they used the realization 1a - they prepared for each subject at the beginning of the experiment an

[13] The notation will be introduced gradually as needed and the meaning of each symbol that is introduced will remain the same for the rest of the thesis.

[14] It thus seems that Moon and Martin did not impose any limit on how much the subjects could search.

amount of money and after the buyer terminated the search, they deducted from this amount the price chosen and the total search cost that accrued during the search and they paid to the subject the sum that remained (so that the buyer can be assumed to be motivated to maximize the sum of the total search cost and the price paid - both taken with the minus sign). Also, instead of the prices being drawn randomly from a given distribution, Butler and Loomes designed in advance specific sequences of prices so that the testing of predictions made on the basis of the rule they suggested was clear-cut. Their evidence supports their conjecture that buyers use the following rule (d_0 is a price that the buyer had considered acceptable before she started to search; M_t is the average of prices the buyer has seen so far during the search; $0 \leq w_t \leq 1$ is a weight which grows in time):

Go on if $p_t > c + (1 - w_t)d_0 + w_tM_t$.

Martin and Moon (1992) left the extreme assumption (contained in the realization 7g) of no initial information about the prices and moved to the case of some (though little) information - they changed the setting from the one they used in Moon and Martin (1990) in that the buyers now knew - for free and before they started their search - two prices which, however, were not available as options to choose from (the authors call these prices „guide prices“). On the basis of their evidence, Moon and Martin identified five new rules. Their continued use of the simple one-capital-letter notation is a bit misleading as it conceals the important change in the setting.[15] The five rules are ($g \leq G$ are the two prices known in advance; m_t is the average of $\{g, G, p_1, ..., p_t\}$):

Rule P („total search cost II“ rule): Go on if $tc \leq 0.075(g + G)/2$.

Rule Q („modified guide price“ rule): Go on if $p_t > g + c$.

Rule R („total expenditure, minimum guide price“ rule): Go on if both $p_t > g - tc$ and $tc < 0.1(g + G)/2$.

Rule S („staggered target“ rule): Go on if both $tc \leq 0.25(g + G)/2$ and p_t is higher than the target that corresponds to the momentary level of tc according to the following table:

[15] The development up to now seems to suggest that the number of rules that buyers appear to use in various settings (and maybe even for various values of relevant parameters) may grow further and it may soon become unavoidable to establish a systematic way of labeling them (unlike compounds in chemistry, for instance).

Table IV.1.: Momentary levels of *tc* and targets which correspond to these levels in rule S

Level of tc	Target
$tc \leq 0.05(g + G)/2$	$g + c - (G - g)/2$
$0.05(g + G)/2 < tc \leq 0.10(g + G)/2$	$g + c$
$0.10(g + G)/2 < tc \leq 0.15(g + G)/2$	$g + c + (G - g)/2$
$0.15(g + G)/2 < tc \leq 0.20(g + G)/2$	$G + c$
$0.20(g + G)/2 < tc \leq 0.25(g + G)/2$	$G + c + (G - g)/2$

Rule T („locate a bargain“ rule): Go on if the condition that corresponds to the momentary level of *tc* according to the following table is met:

Table IV.2.: Momentary levels of *tc* and targets which correspond to these levels in rule T

Level of tc	Condition
$tc \leq 0.1m_t$	$p_t > 0.9m_t$
$tc > 0.1m_t$	$min\{p_1, ..., p_t\} > m_t + c$

Given that the adaptive aspirations model (Levinthal and March (1981)) can be viewed as a search rule, the fact that the model stems from empirical observations of the bounded-rational organizational decision-making school (Simon (1948), Cyert and March (1963)) implies that the rule can be considered indirectly empirically identified. It can be stated for example in this form (d_t is the price the buyer considers acceptable after inspecting the t-th price; k_t is the value of a coefficient of adaptation at the moment of inspecting the t-th price): Go on if $min\{p_1, ..., p_t\} > d_t$,where $d_i = d_{i-1} + k_t(p_i - d_{i-1})$, $0 \leq k \leq 1$.

IV.2. Information that It Is Reasonable to Use

First, in order to make the subject of inquiry of this thesis tractable and to focus on the search aspect of the buyer behaviour, I have to make several more or less grossly simplifying assumptions regarding the situation in which the search takes place (of course and as with any model, the reality has an infinite number of characteristics on which simplifying assumptions will have to be made; only those assumptions that I consider most important can be mentioned, the others will be made implicitly):

1) The buyer will be assumed to perceive a need of a constant intensity to get exactly one unit of a single good so that she does not have to determine which goods and how much of each of them to buy and under what conditions to leave the market without buying the good.

2) The buyer will be assumed to expect the overall price distribution in the market not to change to any considerable degree between the beginning and the end of her present search.[16] (Of course, this expectation on the part of the buyer could be viewed as a piece of information which the buyer has about the price distribution besides the more quantitative kinds of information such as prices seen so far during the search).

3) Each of the stores inspected will be assumed to offer exactly the same single brand of the good and thus exactly one price can be observed in each store; „inspecting a price“ then corresponds to and can be used interchangeably with „inspecting a store“.

4) Apart from the price observed to be charged in a given store for one unit of the good, the first or any other inspection of any of the stores will be assumed to have about the same characteristics for the buyer as the first or any other inspection of any other store.

5) Each of the prices that the buyer has seen during her present search will be assumed to remain the same and available for her to return to the store where she saw the price and buy the good at that price if she chooses to do so at any moment later during the search. I make this assumption of full recall (rather than no or partial recall) primarily to preserve continuity with previous research - full recall is the case with which most studies of actual search rules have worked.

6) The buyer will be assumed to know at the beginning of her search all facts describing the situation in which she searches except the price distribution and the concrete prices she is going to encounter during her search. The facts which describe the situation and which the buyer is aware of include, among other things,

a) what I will call „the old price“, that is, the price that all stores had charged for one unit of the good until the moment of price liberalization,

[16] Otherwise the buyer would have to be prepared to solve the formidable task of forming an idea not only about the price distribution but also about its rate of change in time.

b) what I will call „the prediction“, that is, a rough average of various experts' predictions concerning the jump in the overall price level that would follow right after the price liberalization,

c) what I have already labeled „the search cost“, that is, the value of an aggregate measure of amounts of various resources that the buyer has to give up and amounts of various sufferings she has to undergo to inspect any particular store. Assumption 4 stated above implies that the search cost is the same for all stores.

Let me now turn to the information that it is reasonable to use in the sense that ignoring some part of it might lead to very bad performance of the search. When making at the end of each search step the decision whether to go on searching or to terminate the search, the buyer would certainly be reasonable to compare (1) benefits-related influences and (2) costs-related influences she faces at the moment, that is, she would be reasonable to compare in some way - even if unconsciously or in a very simple way - (1) the prices that she thinks the market offers and (2) the costs of inspecting various stores in an effort to locate a price that is relatively low among the prices she considers available. Obviously, ignoring what the prices in the market may look like and determining the length of search solely on the basis of the costs of search may lead the buyer to search far too little or far too much relative to what prices actually are available in the market, and the same applies to ignoring the costs and focusing only on the prices that the market seems to offer.

When (re-)forming at each moment of the search her idea of the prices that the market offers, the buyer would certainly be reasonable to take into account **all prices seen so far during the present search** - the prices she has so far observed during the present search are the only direct and thus the most valuable piece of information on what the whole price distribution (or its informal expression the buyer works with in her mind) actually looks like.

Parts a and b of Assumption 6, stemming from the circumstances of the actual Czechoslovak price liberalization as described in Chapter II, offer two other sources of information which the buyer could use when she (re-)forms her idea on what the prices in the market may look like - namely, **the old price** and **the prediction**. But this time the information is indirect only and thus it is a matter of personal opinion whether it is reasonable to use these as supporting sources. For example, during the first several search steps the buyer may believe (or „punish“ high-price sellers by behaving as if she believed) that not all sellers have been so bold as to have increased the price from the old level by as much as the first sellers inspected may happen to have done - in which case it does make sense if the buyer does not forget the old price and includes it (perhaps with a decreasing weight) in her price-related judgments together with the actual particular prices seen, while a different buyer may view such a thinking idealistic and may think that the best thing was to forget about the old price completely at the moment of price liberalization. Also, many buyers would probably reflect the old price - unconsciously and with differing weights - simply out of habit and mental inertia, being adapted to the old price for months or even years. Similarly, some people may rely on the predictions of experts very much and prefer to estimate the average price in the market according to this prediction instead of on the basis of the prices seen so far, while others may not even know very much about experts' predictions or may distrust them. Generally speaking, for different buyers, to use these two sources of information may be reasonable to a different extent (including no extent at all).

As to the search cost of a given search step, it is an aggregate of several variables. All but one are **the opportunity costs of search** implied by the several budget constraints that every buyer faces and within which she must conduct the present search and together with it all other her activities. Thus, the time constraint (each day has no more than 24 hours) corresponds to the time cost of the given seach step and the concrete value of this cost depends on how much time the search step in question takes; the financial constraint (all assets of the buyer have a finite market value) corresponds to the money cost of the given search step and the concrete value of this cost depends on how much money (phone calls, fuel in the car, train tickets, etc.) the search step in question takes; the physical energy constraint (after a limited amount of physical effort the buyer loses her ability to move and to do anything else) corresponds to the physical energy cost of the given search step and the concrete value of this cost depends on how much physical energy (walking, running, carrying a bag, talking, etc.) the search step in question takes; and so on.

There is, however, a source of search cost which is of a quite different nature and that is what I will call **the patience cost of search**: it is the suffering that the buyer has to undergo when she is to do without the good for the time period from now until one more store is inspected (in case the buyer considers going on with the search) or until the store is visited which the buyer considers returning to. This cost may be viewed as the expected value of the „time integral" over that time period of the momentary intensities of the buyer's need to have the good (several ways of measuring the overall experience of a particular feeling over a period of time are considered by Kahneman (1994)).

There is no reason to distinguish among the various types of search cost as to how reasonable it is for the buyer to take them into consideration - neglecting any of them may lead to a huge gap between what the search takes and what it brings. But there is a question to which the reasonable answer is much less clear: at a given point during the search, the search costs of exactly which search steps - out of those that have been done and those that may be done if the search goes on - should enter the buyer's contemplation whether to keep on searching or to stop? What is sure is that the cost of the very next search step should be considered because if its value is very extreme relative to what prices the buyer thinks are available in the market, she can make an easy decision. But apart from this, there seems to me to be no persuading general intuitive argument for either excluding or including the other search steps' costs. When specifying the rules to be tested, I will prefer simplicity by including in the rules the next search step only (or the average of all search steps, because these two values will - for a constant search cost - be equal).

Obviously, the reason I introduce Assumptions 3 and 4 above is to make sure that the individual opportunity costs of inspecting each price are the same for all stores inspected (even those inspected for the second, third, ... time) and thus for all search steps the buyer may make, while the constant intensity in Assumption 1 is assumed because it implies that the patience cost is the same for each search step, so that taken together, these assumptions imply that the search cost is the same for all search steps the buyer may make.

To sum up, I have identified the following reasonable-to-use subsets of the set of all the data available to the buyer at a given moment during the search:

(1) all prices seen so far,

(2) the cost of the next search step,

and the following subsets which it may be reasonable to use under some circumstances or in the opinion of some buyers:

(3) the old price,

(4) the prediction.

IV.3. Three Search Heuristics

I have been able to find a heuristic, that is, a very general principle (usable in many different settings and situations besides the present one) which may be very simple but makes some sense and can be used to explain and justify the rule, behind only some of the empirically identified rules collected in Section IV.1. And from these heuristic-based rules, I have been able to extract the following three different heuristics. Each heuristic determines „the cutoff price“: the highest price the buyer considers at the moment to be acceptable, i.e., the price which $p_{mt} = min\{p_1 + c, p_2 + c, ..., p_{i-1} + c, p_t\}$ must not exceed if she is to agree to buy the good at p_{mt},.

Adaptation Heuristic (detectable behind the model of adaptive aspirations in Levinthal and March (1981) and behind the rule suggested at the end of Butler and Loomes (1997)): After observing p_t, the buyer adapts her idea of a just acceptable price from its previous value d_{t-1} to d_t that seems to her appropriate in view of the newly observed quote. That is, she sets d_t either equal to d_{t-1}, or equal to p_t, or somewhere in between these two extremes.

Bargain Heuristic (detectable behind rules K, K* in Moon and Martin (1990) and behind the first part of rule T in Martin and Moon (1992)): After observing p_t, the buyer considers all data which she considers relevant and which are available to her at the moment and she decides how much below[17] the average of the prices being offered in the market - whose value she must somehow estimate - a price must lie if she is to consider it and any lower price a bargain that is sufficiently attractive to be accepted and paid for the good.

Improvement Heuristic (detectable behind the rule described in part iii.1 of Butler and Loomes (1997) as well as behind the second part of rule T in Moon and Martin (1990)): After observing p_t, the buyer considers the improvement likely to be brought by the next search step. She considers p_{t+1} - whose value she must somehow predict - worth inspecting only if it is going to be so much below p_t that the resulting decrease in the price to be paid for the good from p_{mt} to p_{mt+1} (which must equal p_{t+1}) will be large enough to cover $c_{t,t+1}$. In other words, if the buyer is to decide to inspect p_{t+1}, her prediction of p_{t+1} must be so low as to imply that the sum of the total search costs and the price eventually paid for the good is predicted to improve (i.e., decrease) after inspecting p_{t+1}.

This improvement heuristic resembles in its structure the full-knowledge optimal search model (as described briefly, e.g., in Hey (1982)) which also compares p_t with the sum of (1) the cost of the inspection of p_{t+1} and (2) an expression partially related to the expected value of p_{t+1}. But the present heuristic is a simplification of this optimal rule in that it takes into

[17] If the buyer´s estimate of the average of the prices available in the market *is* contaminated with the (relatively low) old price so that the estimate is lower than the lowest of the prices inspected so far during the present search, then the bargaining heuristic with its cutoff value always *below* (or at most equal to) this estimate is not able to express the buyer´s willingness to accept a very high or even any price she observes in the very first store in markets where the search costs are very high.

account neither the possibility of further search beyond p_{t+1} nor the possibility of recall (surely exercised if p_{t+1} is found to be higher than p_{mt} increased by the cost of re-inspecting the store in which p_{mt} was encountered).

IV.4. Hypothesis

The three rules that appear below and whose correspondence to data will be tested are derived from the three heuristics just spelled out by trying to „fill" each heuristic with the information that was in Section IV.2. suggested as reasonable to be used in the particular situation of the first days after price liberalization (also, the heuristics were adapted to the present setting by assuming $c_{jk} = c$ for all j, k). The heuristics are quite general and there are many ways of exactly how they can be filled with this information, i.e., exactly how this information can be used in each heuristic. Some uses are more in line with the logic of a given heuristic, some are less so. I will try to suggest for each heuristic such a use of the information that seems to me to be among those most in line with the logic of the heuristic. Therefore, my choice of the particular way the information is used in each heuristic is not the only one possible. For all three heuristics, I did not find a strong argument for taking into account the cost of search steps other than the next one.

Adaptation Rule: Go on if $p_{mt} > d_{t-1} + \{1 - (c_{min}/c)^{\delta}\}(p_t - d_{t-1})$,

where $\delta > 0$,

$c_{min} \leq c$,

$d_0 = \{1 - \phi\}p_0 + \phi(1 + \pi/100)p_0$,

$0 \leq \phi \leq 1$.

In accord with what was said in Section IV.2 about the possibility (but not necessity) of buyers taking into account the prediction, I assume that the prediction plays a role (with a weight which may actually be zero). In particular, the initial idea of an acceptable price is assumed to be equal to a weighted average of (1) the old price p_0 as the price to which the buyer had become completely adapted in the times before the price liberalization and a (2) the price that we obtain when the prediction π (whose format is, e.g., „20%") is applied to the old price.

c_{min} is the lowest possible value of c. Its role is just supporting - it helps to form the ratio c_{min}/c whose value (1) is a decreasing function of c and (2) falls into the interval [0, 1] far all $c \geq c_{min}$, so that the value of $1 - (c_{min}/c)^{\delta}$ is (1) an increasing function of c and (2) in the interval

[0, 1] for any $\delta > 0$, as is required if the adaptation is always to be stronger for higher c and if it is to lead to d_t falling into the interval $[p_t, d_{t-1}]$. Obviously, if we change $c_{\min}$, the value of δ changes appropriately and for each observation differently:

$(c'_{\min}/c)^{\delta'} = (c_{\min}/c)^{\delta}$ holds for $\delta' = \delta[\ln(c_{\min}/c)]/\ln(c'_{\min}/c)$.

This specification therefore makes the estimates I will obtain meaningful only in situations were the condition $c_{\min} \leq c$ is met so that the ratio $c_{\min}/c$ does not exceed 1 in any observation and a there is no need to introduce a lower $c_{\min}$ (which would make the estimates of the parameter values in the rule useless).

Bargain Rule: Go on if $p_{mt} > \{1 - [(c_{\min}/c)(V_t/V_{\max})]^{\alpha}\}E_t$,

where $\alpha > 0$,

$V_{\max} \geq Vt = \Sigma_1^{\,t}\,(p_t - E_t)2/t$,

$E_t = \{1 - [t/(t+1)]^{\beta}\}p_0 + [t/(t+1)]^{\beta}\{\{1 - [t/(t+1)]^{\gamma}\}(1 + \pi/100)p_0 + [t/(t+1)]^{\gamma}M_t\}$,

$\beta \geq 0$,

$\gamma \geq 0$.

I assume that the distance that a bargain in the buyer's view lies below her idea of the average price in the market is the larger, (1) the larger is the buyer's idea V_t of the spread of the prices in the market (because with this spread getting larger, the likelihood increases that a very low price will be found), and (2) the smaller is the cost c of search (because with this cost rising, waiting to encounter a given bargain gets more expensive).

V_t is assumed to be equal to the variance of all the prices the buyer has seen so far during the search but not about their proper average but about E_t which is what the buyer thinks the price distribution mean is equal to.

$V_{\max}$ is equal to a constant which estimates the upper boundary of the values that V_t is likely to take on in given circumstances.

Both $c_{\min}$ and $V_{\max}$ are introduced just make sure that the value of the expression $(c_{\min}/c)(V_t/V_{\max})$ is (1) a decreasing function of c and increasing function of V_t and (2) in the interval [0, 1] for any $c \geq c_{\min}$ and $0 \leq V_t \leq V_{\max}$, so that (for $\alpha > 0$) the coefficient by which E_t is multiplied stays between 0 and 1 and increases with increasing c and decreasing V_t. The limits of the value of the cutoff price suggested by the rule for extreme values of c and V_t are shown in Table IV.3.:

Table IV.3.: Limits of the cutoff price suggested by the Bargain rule for extreme values of c and V_t

If c approaches	and Vt approaches	then $(c_{min}/c)(V_t/V_{max})$ approaches	and the cutoff price approaches
c_{min}	0	0	E_t
c_{min}	V_{max}	1	0
infinity	0	0	E_t
infinity	V_{max}	0	E_t

Obviously, a similar unpleasant effect exists here as for the Adaptation rule: the value of α depends on how we choose the value of the ratio c_{min}/V_{max} and so the estimates of the parameter values Iwill obtain will be usable only in situations in which the value of the expression $(c_{min}/c)(V_t/V_{max})$ is not higher than 1 so that we do not have to introduce a higher V_{max} or a lower c_{min}.

Again in accord with Section IV.2. the prediction and the old price are assumed to enter (both with a weight which may actually be zero) the buyer's thinking, but this time they take part in the estimation of the average of prices available in the market. In particular, the estimate E_t of the average of prices available in the market is assumed to be calculated as a weighted average of the old price p_0 and a weighted average of (1) the price that we obtain when the prediction p is applied to the old price, and (2) the average M_t of prices seen so far during the search. The weights of both the old price and the prediction are assumed to decrease in time - in other words, as the search proceeds the old price and the prediction are assumed to lose their impact on the buyer's idea of what the prices in the market may look like and this idea is more and more based just on the prices actually observed during the search. From the way I define the weights it follows that $\beta = 1$ would imply that p_0 is treated as having the same importance as any of the prices $p1, ..., pt$ actually observed during the present search, $\beta < 1$ would imply that the buyer is conservative in that she gives in her reasoning for some reason special importance to p_0 in comparison with $p_1, ..., p_t$, and $\beta > 1$ would imply the contrary - that the buyer suspects p_0 to be less useful for the purposes of estimation of the average price in the market than prices $p_1, ..., p_t$.

Improvement Rule: Go on if $p_{mt} > E_t + c$.

I assume that the way the buyer predicts the value of p_{t+1} is identical with the way she estimates the average price in the market, i.e., that she predicts p_{t+1} to be equal to E_t.

Given that the Bargain rule leads never to accepting a price higher than E_t while the Improvement rule leads never to rejecting a price equal to or lower than E_t, the Improvement rule can never be more demanding as to the price to be accepted than the Bargain rule.

V. EXPERIMENT

There are several kinds of empirical data with which I could test the hypothesis. Given that the real price liberalization on the territory of the Czech Republic took place some seven years ago (at that time it was Czechoslovakia), questionnaires asking people to recall what they did then would produce data of little reliability. Nor do the official statistics covering that period of time contain the kind of data that I need. In view of the funds available to me, to conduct some kind of a field experiment would be far too expensive. The only remaining option was therefore to conduct a laboratory-type experiment. In this chapter the experiment will be described, while the following chapter will describe and analyze the results obtained from the experiment.

V.1. Experimental Design

The experiment simulated the task that buyers face when they want to buy a good at a low price in a market for this good in which they do not know the current prices but they know „the old price", i.e., the price that used to be charged until today in all stores throughout the market, and they also know „the prediction", i.e., experts' prediction of how much higher the average price in the whole economy is likely to be after the price liberalization compared to what it was before that.

Each subject was to go through two „runs": in the first run, she[18] was to look sequentially at prices charged in various stores for one unit of a good and buy the good in one of the stores she has „visited" in this way; in the second run, the subject was to go through an analogical process with another good. The prices she would observe in either run in the stores were described to her as prices charged after price liberalization before which all stores had charged the same known price for one unit of a given good. The subject could visit up to eight different stores in the first run and up to eight stores (with no relation to the stores in the first run) in the second run. Within each run, the subject could return at any moment to any of the stores already visited, and visit in this way any store any number of times.

Whenever the subject entered a store, she had to pay a „travel fee" regardless of whether it was a store that the subject had already visited and whether she was going to buy the good in the store. This arrangement tries to capture the fact that when buyers look for a low price in a full-recall situation, they can return to a store they visited previously but they still have to travel there even though they have already been there at least once and even though they will buy the good there. In the relevant literature, suffering the search cost (here paying the travel fee) when the buyer „only“ returns to an already visited store is rather unusual. The travel fee varied both among subjects and between the two runs for each subject.

The subject paid all expenses that she had made in the first run (i.e., all travel fees incurred and the price at which the first good was finally bought) from an imaginary bank account which the experimenters told her they had set up for her. The same way of payment was used in the second run for which a new account was set up separately from the first account. The initial endowments deposited by the experimenters to the two accounts varied among subjects and between the two runs for each subject.

Before each of the two runs, the subject was informed about the following (all four figures varied among subjects and between the two runs for each subject):

1) the old price,

2) the prediction,

3) the initial endowment,

4) the travel fee.

To prevent subjects from making an obviously erroneous purchase once they decided to buy the good (and thus to save the theoretical analysis of the results from having to explain such a mistake), the subjects knew that the experimenter would not allow the subject to buy the good in a store in which it would be more costly to buy it than in another store already visited by the subject (if the subject was going to do this mistake at all): that is, when the subject announced that she wants to buy the good, she was forced to buy it in the last store visited, unless the sum of (1) the price charged in one of the stores visited so far and of (2) the travel fee, was lower than the price charged in the last store visited - in that case the subject was forced to return to that store (and thus pay one more travel fee) and buy the good there.

After the subject finished the second run, the sums that remained on the account for the first run and on the account for the second run were added to the turn-up fee of CZK 40 and the result rounded up to the nearest crown was the subject’s total earnings from the experiment. In this way, the subject (if she tried to maximize her earnings from the experiment) was motivated to search so as to minimize the amount of money deducted - as a result of her actions - from the initial sums deposited to the two accounts. Each subject’s total earnings from the experiment were paid to her immediately after she finished the second run.

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[18] For the sake of brevity, I will write as if all subjects were women.

The figures described to the subjects as experts' predictions of the jump in the price level due to the price liberalization were chosen (see Table V.1.) to resemble actual predictions published towards the end of 1990 in the Czechoslovak press (see the end of Section II.2.).

The prices were generated from normal distributions with their left tails truncated at the level of the corresponding old prices in the sense that whenever a price was generated at or below the level of the old price it was replaced by a newly generated price. The means and standard deviations of these normal distributions varied among subjects and between the two runs for each subject (see Table V.1.). The mean and the standard deviation in one of the two runs for each subject were selected so that the prices she would observe in the stores resembled the prices of 1kg of fresh butter reported in the newspapers to be actually observed in the first days after price liberalization in Czechoslovakia at the beginning of 1991. For this run, the old price was selected similarly to resemble the average price of 1kg of fresh butter in October 1990 which was CZK 67.20 (Statistická ročenka 94).

The means and standard deviations of the distributions generating the prices to be observed in the stores in the other of the two runs for each subject were selected analogically but this time so that the resulting prices resembled January 1991 prices of 250g of fresh butter. Also, the old price was selected to resemble the October 1990 average price of 250g of fresh butter (one fourth of the price of 1kg of fresh butter, or CZK 16.80).

The old price and the prices to be observed by each subject in the stores were thus in the former run which I will call the „high-price run" about four times higher than the old price and the prices to be observed in the latter run, the „low-price run". The subject was not informed about this underlying relation between the two runs she went through.

When choosing the ranges of values of the travel fee and of the initial endowments (see Table V.1.), I was led by the belief that values from about these particular ranges were most likely to induce the subjects to visit on average some three, four or five stores in each run which I considered to be a realistic estimate of the actual average number of stores people would visit when looking for cheap butter in January 1991 in Czechoslovakia. This also explaines why I expected the eight stores for each run to be a more than sufficient number for most subjects.

All values and the order of the two runs were determined before the subjects started signing up and so independently of any characteristics the subjects happened to have.

Table V.1.: Input data for each subject

first run	code	μ	σ	π	p_0	N	c	code	μ	σ	π	p_0	N	c
high price	M1S	21.1	3	20	16.0	55	1.50	M1T	88.1	12	20	66.5	120	2.00
low price	M2S	21.2	3	25	16.1	55	1.25	M2T	88.2	12	25	66.6	120	1.75
high price	M3S	21.3	3	30	16.2	55	1.00	M3T	88.3	12	30	66.7	120	1.50
low price	M4S	21.4	3	35	16.3	55	0.75	M4T	88.4	12	35	66.8	120	1.25
high price	M5S	21.5	3	40	16.4	55	0.50	M5T	88.5	12	40	66.9	120	1.00
low price	M6S	21.6	3	45	16.5	55	0.25	M6T	88.6	12	45	67.0	120	0.75
high price	M7S	21.7	3	50	16.6	60	1.50	M7T	88.7	12	50	67.1	120	2.00
low price	M8S	21.8	3	20	16.7	60	1.25	M8T	88.8	12	20	67.2	125	1.75
low price	M9S	21.9	3	25	16.8	60	1.00	M9T	88.9	12	25	66.5	125	1.50
high price	M10S	22.0	3	30	16.0	60	0.75	M10T	89.0	12	30	66.6	125	1.25
high price	M11S	22.1	3	35	16.1	60	0.50	M11T	89.1	12	35	66.7	125	1.00
low price	M12S	22.2	3	40	16.2	60	0.25	M12T	89.2	12	40	66.8	125	0.75
low price	R1S	23.1	3	20	16.5	60	1.00	R1T	90.1	12	20	67.1	125	1.50
low price	R2S	23.2	3	25	16.6	60	0.75	R2T	90.2	12	25	67.2	125	1.25
low price	R3S	23.3	3	30	16.7	60	0.50	R3T	90.3	12	30	66.5	125	1.00
low price	R4S	23.4	3	35	16.8	60	0.25	R4T	90.4	12	35	66.6	125	0.75
low price	R5S	23.5	3	40	16.0	60	1.50	R5T	90.5	12	40	66.7	125	2.00
low price	R6S	23.6	3	45	16.1	60	1.25	R6T	90.6	12	45	66.8	125	1.75
high price	R7S	23.7	3	50	16.2	60	1.00	R7T	90.7	12	50	66.9	125	1.50
high price	R8S	23.8	3	20	16.3	60	0.75	R8T	90.8	12	20	67.0	130	1.25
high price	R9S	23.9	3	25	16.4	60	0.50	R9T	90.9	12	25	67.1	130	1.00
high price	R10S	24.0	3	30	16.5	60	0.25	R10T	91.0	12	30	67.2	130	0.75
high price	R11S	24.1	3	35	16.6	65	1.50	R11T	91.1	12	35	66.5	130	2.00
high price	R12S	24.2	3	40	16.7	65	1.25	R12T	91.2	12	40	66.6	130	1.75

Notes: Subjects are coded M1, M2, ..., M11, M12, R1, R2, ..., R12

Runs are coded: S...low price run, T...high price run

μ, σ ... mean and standard deviation of the distribution from which prices were generated

c ... travel fee N ... initial endowment

p_0 ... old price π ... prediction

V.2. Subjects

24 subjects (coded M1, M2, ..., M12, R1, R2, ..., R12) participated in the experiment, of which 11 were women. One subject (code M10) was a member of the staff of the Faculty of Social Sciences of Charles University, the other subjects were students of the Faculty. All the subjects were recruited in the same way: they read posters which were posted at several places in the main building of the Faculty inviting the readers to take part in an economic experiment. The posters asked those interested in participating to sign up by entering their name into a participant sheet kept by the secretary of the Institute of Economic Studies at the Faculty. 28 persons signed up - thus, one seventh of those who had signed up did not then turn up in the experiment. The poster announced that each actual participant in the experiment would earn a constant turn-up fee of 40 Kc plus his/her earnings from the experiment and that it would take about eight minutes of their time to participate in the experiment. All subjects appeared to take the experiment seriously.

V.3. Apparatus

The subject faced a pair of separate tables on each of which there was a series of eight paper cards. On one side of each card there was a price printed on it, while the other side of the card was blank. The cards were laid the blank side up so that to see the price printed on the card, the card had to be turned overleaf. At each table the subject was told that each of the eight cards lying on the table had a number printed on it that represented a price of the good to be bought as charged in one of eight randomly selected stores after price liberalization. For each subject, one of the two tables was the „low-price table“, the other table was the „high-price table“.

On each of the two tables there was also a sheet of paper with the information described in the previous section under numbers 1 to 4 printed on it so that the subject could read it. All this information pertained to the eight prices printed on the cards lying on the same table.

The experimental room was divided into two halves, in each of which there was one pair of tables as just described so that two subjects could take the experiment at the same time. The distance between the two pairs of tables proved sufficient to prevent two subjects taking the experiment at the same time from distracting each other or interfering with each other in any other way.

V.4. Procedure

Upon signing up, each potential participant obtained a copy of instructions. These instructions contained all information the subject needed to know except the specific values with which she would then actually work. Their translation into English appears at the end of this thesis.

The participant sheet was arranged so that each potential participant chose the time at which her participation in the experiment should start. At most two subjects could choose each of the times offered. On the day of the experiment, the subjects were let in the experimental room roughly according to this time-table but always so that there were no more than two subjects in the room.

At each table the experimenter repeated for the subject the basic information printed on the sheet placed on the table. Then the subject was told how to go through the run: she was to turn around the first card from the left on that table, look at the price, then turn the card into the original position, and either announce that she was terminating the search at that point or move on to the second card from the left which she was to turn around, look at the price, then turn the card into the original position, and either announce that she was terminating the search at that point, or announce that she was going to return to the first price from the left, or move on to the third card, where there were the same three possibilities (terminate, return to one of the cards already inspected, go on to the next card), and so on.

V.5. Setting

The setting which I chose for the experiment is thus characterized by these aspects and their realizations:

1) Nature of each option + buyer's (assumed) objective: 1a) a single number + pick such an option that its value after the total search costs are deducted from it is maximized. 2) Probability that it will be possible to inspect a given option: 2a) one. 3 - Time-discounting: the realization was determined implicitly and individually by the subjects and was not ascertained in any way by the experimenters. 4) Search cost: 4b) same for all options (eventual choice of a previously inspected option *is* considered as an inspection and the search cost must be paid). 5) Type of distribution of options: 5 a) continuous (with options being stated with two decimal places only), 5a') normal. 6) Distribution of options in time or for various options: 6a) same for all. 7) Initial general information on options: 7 - a new realization: the single previously available option (old price) and experts's prediction of the mean of the option

distribution. 8) Learning about option distribution from options inspected: the realization was determined implicitly and individually by the buyers and was not ascertained in any way by the experimenters. 9) Information sources used: 9a) inspected options only. 10) Recall: full. 11) Total number of quotes that it is possible to inspect: 11a) finite. 12) Highest possible value of the sum of an aggregate measure of amounts of various resources the buyer has given up and amounts of various sufferings she has undergone (1) while searching and (2) while subsequently exercising the option chosen: 12b) infinite.

VI. RESULTS

VI.1. General Statistics

The subjects earned on average CZK 75.90 in the experiment itself (i.e., apart from the turn-up fee of CZK 40). The standard deviation of these earnings was CZK 9.80. The earnings (after rounding) ranged from CZK 94 (subject M1) to CZK 133 (subject R11).

The total number of stores visited at least once and thus the total number of observations that will be analysed below was 128. If a subject returned to a previously visited store, it was always to buy the good there (i.e., it was never just to refresh her memory). With 48 runs this means that the average number of stores visited per run was about 2.7.

In 15 runs which I will call „single-price searches“ just one store was visited (see Table VI.1.), in two runs all eight stores were visited.

Table VI.1.: Single-price searches

		subject											
	run	M1	M2	M4	M5	M7	M8	M9	M10	R3	R4	R7	R11
observ. no.	low pr.	1	3*	14*	18*		44*	46*	50	77*			
	high pr.	2*			19	43*	45				85	100*	121*

Note: A star marks the first of the two runs the subject went through.

The numbers of observations classified according to the value of y_i, according to whether the observation is a single-price search (SPS), and according to whether the observation comes from a low price run or a high price runs, are shown in Table VI.2.:

Table VI.2.: Numbers of observations classified according to the value of y_i, according to whether the observation is an SPS, and according to the type of run the observation comes from

	$y_i = 1$	$y_i = 0$	total
low price runs	40	SPS´s: 8 other: 16 24	SPS´s: 8 other: 56 64
high price runs	40	SPS´s: 7 other: 17 24	SPS´s: 7 other: 57 64
total	80	SPS´s: 15 other: 33 48	SPS´s: 15 other: 113 128

VI.2. Method of Testing the Hypothesis

One way to test the hypothesis would be to derive as many ceteris-paribus-style qualitative predictions from the three rules as possible (of the form „If p_0 increases, ceteris paribus, then the average length of search decreases“), choose input data for the experiment suitably so that pairs of „conditions“ arise, each pair corresponding to one prediction, and then one could see which rule´s prediction is confirmed by the data. But this method does not allow the estimation of the values of the parameters appearing in the rules.

Therefore, to see to which extent the data correspond to the three rules which form the hypothesis, I will choose a different route - first try to fit the data with the rules, that is, I will try to find those concrete values of the various parameters appearing in each of the three rules for which the rules correspond best to the data, and then, once I obtain these estimates of the parameters, I can assess the extent to which the resulting concrete versions of the rules correspond to the data.

„The data“ are represented here by observations on what the subjects did. Each observation pertains to a certain subject and a certain price she has just observed. The observation describes - in the form of a binary variable y - the subject´s decision to either accept the price that it is best to accept at the moment - let´s describe this case by $y = 0$ - or to go on - let´s describe this case by $y = 1$. The observation contains also a record of the concrete values which various variables had when the subject made the decision she made.

When we pick an observation and plug these concrete values of the variables into a rule, the rule tells us either that the subject should stop at that particular point (that is, the rule suggests $y = 0$) or that the subject should go on (the rule suggests $y = 1$). To „fit the data with a rule“ means to find such values for the parameters in the rule that when we take all observations together, the rule gets in its suggestions as to the value of y for individual observations „as close as possible“ to the actual values of y in the observations. How is the „closeness“ to be measured?

For some observations it may easily happen that the rule suggests $y = 0$ while in reality $y = 1$ or vice versa. That would imply that the subject certainly was not using the rule. We can avoid this strict falsification of the rule by assuming that the subject uses the rule but makes mistakes which have a certain variance and are on average zero (so that on average she does what the rule tells her to do) but in individual cases the cutoff price she arrives at may be different from the one the rule suggests and that may cause her to accept a price the rule does not suggest to accept or vice versa. Now if in given circumstances the rule suggests, for example, $y = 0$ while in fact $y = 1$ (i.e., the subject goes on), we may conclude that the subject does use the rule but has just made a mistake large enough to explain the inconsistency between what the rule suggests and what she actually does. The probability that the subject would make at least such a big mistake in that particular case is the higher the less the cutoff price which the rule suggests exceeds the price that the subject is in fact rejecting. Similarly, the probability that the subject would make at least such a big mistake as to accept ($y = 0$) a price which the rule suggest not to accept ($y = 1$) is the higher the less the price that the subject is in fact accepting exceeds the cutoff price suggested by the rule. On the other hand, the probability that the subject accepts a price lower than the price the rule suggests to accept is the higher the more the latter price exceeds the former and similarly for the case where the subject rejects a price higher than the price the rule suggests to accept. The closeness over all observations (both those where the subject did do what the rule told her and those where she did not) of the rule´s suggestions (for a given set of values of the rule´s parameters) and the actual decisions can then be measured as the probability - or „likelihood“ - of obtaining the particular set of observations given the particular values of the rule´s parameters and given the variance of the subject´s mistakes. If the observations describe mutually independent events, then this probability is equal to the product of the probabilities (over all observations) that the subject - while using the rule and making the mistakes - arrived in each observation at a cutoff price leading him to do what she did in that observation.

To be able to calculate this likelihood (as a function of the values of the parameters in the rule and of the variance of the subject´s mistakes), a particular probability distribution function has to be chosen for the subject´s mistakes. I will assume that the subject´s mistakes can approximately be described by the normal distribution function. When this assumption is added to the above binary dependent variable maximum-likelihood method of estimating the parameter values, the result is what is known as probit analysis.

As will be seen, the fact that the rules are nonlinear in the parameters to be estimated implies that the assumption that the subject´s mistakes have unit variance, an assumption that is usual in „linear" probit analysis, will not be acceptable here - the variance will simply have to be estimated together with the rules´s parameters.

To express the above reasoning more formally and thus more succintly, some notation is needed. i is the index of the observation (so that if all observations I obtained in the experiment are meant, then $i = 1, 2, ..., 128$). F_σ is the distribution function of the mistake $e_i \sim N(0, \sigma)$ which the subject makes relative to the suggestion of the rule in observation i. The cutoff (i.e., highest acceptable) price suggested by a given rule for observation i and for a given set of values of the rule´ s parameters β is $d_i(\beta)$ or briefly d_i.

The subject stops if $d_i + e_i \geq p_{mi}$, that is, if $e_i \geq p_{mi} - d_i$, so that the probability that the subject stops in the i-th observation is

$\Pr\{y_i = 0\} = \Pr\{e_i \geq p_{mi} - d_i\} = 1 - F_\sigma(p_{mi} - d_i)$,

while the probability that the subject goes on in the i-th observation is

$\Pr\{y_i = 1\} = \Pr\{e_i < p_{mi} - d_i\} = F_\sigma(p_{mi} - d_i)$.

From that it follows that the likelihood as defined above is

$L(\beta, \sigma) = \Pi\ [F_\sigma(p_{mi} - d_i)]^y[1 - F_\sigma(p_{mi} - d_i)]^{1-y}$,

where the multiplication is done over all i.

My aim is to find for each of the three rules which form the hypothesis the maximum (logarithm of) likelihood - or ML - estimates, that is, those values (β_{ML}, σ_{ML}) of the parameters (β, σ) that maximize $L(\beta, \sigma)$.

It should be noted that the present probit analysis is not of the standard „linear" type. In the linear probit analysis it is assumed that $\Pr\{y_i = 1\} = \Pr\{e_i < h_i\}$, where h_i is a scalar product of a vector of i-th values of several „explanatory" or „independent" variables deemed important for the determination of the value of y (one of them being always 1 to form the constant term) and of a vector of coefficients to be estimated. In that case we are able to obtain from the estimation not the estimates of the coefficients appearing in h_i but these estimates divided by σ, the true variance of the subject´s mistakes so that (unless we know in advance the value of σ) we can freely choose what σ we will calculate the estimates with; usually, for the sake of simplicity, it is assumed $\sigma = 1$. In the present case, however, σ will have to be estimated together with the parameters that appear in the rules, because in the present non-linear case it is not true that doubling an assumed value of σ will lead to estimates of the parameters which would be simply twice the values of the estimated values for the originally assumed value of σ.

The possibility of finding estimates of the parameter values and the reasonableness of these estimates are one piece of information on which the assessment of the hypothesis can be based. Once I obtain these estimates which I will label (β_{ML}, σ_{ML}) even though they are numerical and thus they only approximate true ML estimates, I can study the worth of the model, i. e., the quality of the estimates and of the overall fit of individual rules and in that way obtain another piece of information for the assessment of the hypothesis. In the case of probit, the quality of the estimates and of the fit can be done in a number of ways (Amemiya (1981)) none of which can unfortunately be considered superior and decisive. I will discuss only some of these ways.

First, it is usual to report estimated variances (or standard deviations) of individual parameter estimates. This information allows us to test whether any given parameter´s estimated value is significantly different from what we may suspect the actual value of the parameter is equal to, and the information also gives us an idea of how precise the estimates are and what are their confidence intervals. Under rather general conditions the ML estimates (β_{ML}, σ_{ML}) of the actual values (β_*, σ_*) are consistent and asymptotically normal with the asymptotic variance-covariance matrix

$$- \{E[\partial^2 \ln L(\beta_*, \sigma_*) / (\partial(\beta_*, \sigma_*)\partial(\beta_*, \sigma_*)')]\}^{-1}.$$

This matrix can be estimated by evaluating it at (β_{ML}, σ_{ML}). In the case of a *standard* (i.e., not limited dependent variable) nonlinear ML estimation as well as in the case of *linear* probit, the calculation of the estimate of the asymptotic variance-covariance matrix is not very difficult and the formulas can be found in Judge et al. (1985) and Amemiya (1981), respectively. In the present case of *nonlinear probit*, however, the calculation of expected values of the estimates of the elements of the Hessian matrix of the logarithm of L, that is, the calculation of expected values of the elements of the matrix

$\partial^2 \ln L(\boldsymbol{\beta}_{ML}, \sigma_{ML}) / (\partial(\boldsymbol{\beta}_{ML}, \sigma_{ML})\partial(\boldsymbol{\beta}_{ML}, \sigma_{ML})')$

would be very complex and would go beyond the scope of this thesis. Since I have not come across final formulas for this case in the statistical literature, I will have to omit this issue and do without the estimates of the variance of the estimates of parameter values.

Second, to assess the worth of a statistical model estimated by the maximum likelihood method, that is, to assess the ability of the model to explain the observed behaviour of the dependent variable, a popular test is the likelihood ratio test. This test is based on the finding that if k of the paramaters in the model are known to have specific values $\beta_{01}, ..., \beta_{0k}$ then the statistic $2[L(\boldsymbol{\beta}_{ML}, \sigma_{ML}) - L_0]$ is asymptotically distributed as χ^2_k, where L_0 is the maximum value which $L(\boldsymbol{\beta}, \sigma)$ can take on for the data at hand and for the k parameters having the values $\beta_{01}, ..., \beta_{0k}$. Comparison of the value of $2[L(\boldsymbol{\beta}_{ML}, \sigma_{ML}) - L_0]$ with the tabulated value of χ^2_k for a selected significance level α tells us whether $L(\boldsymbol{\beta}_{ML}, \sigma_{ML})$ exceeds L_0 by enough to allow us to conclude that the values of the k parameters are with probability $(1 - \alpha)$ different from the values $\beta_{01}, ..., \beta_{0k}$. If this test is employed in order to assess the worth of a model (in the present context, each of the three rules in the hypothesis is a model), k is equal to the total number p of parameters in the model (note that σ is not a parameter of the model) and their „specific values" $\beta_{01}, ..., \beta_{0p}$ or $\boldsymbol{\beta}_0$ assumed in H_0 are chosen so that if they were really true, the model would help us explain the behaviour of the dependent variable as little as its structure would allow. Ideally, $\boldsymbol{\beta}_0$ should be chosen so that the model does not explain the behaviour of the dependent variable at all; for instance, in linear probit models, we simply hypothesize that the actual coefficients are equal to zero so that the model brings no information whatsoever on the probability of $y_i = 0$ or $y_i = 1$. Unfortunately, the structure of each of the three rules in my hypothesis makes it impossible to find a vector of parameter values which would make the rule in question so perfectly silent. In other words, no vector $\boldsymbol{\beta}$ of parameter values in any of the three rules can be found such that for a given rule $d_i(\boldsymbol{\beta}) = p_{mi}$ for all i. The way I will try to get as close as possible to this ideal will be to estimate - via least squares - the rule's parameter values $\boldsymbol{\beta}_{0,LS}$ in the nonlinear regression equation $p_{mi} = d_i(\boldsymbol{\beta}) + \varepsilon_i$. I will then find the „real" L_0 as the maximum (over σ) of $L(\boldsymbol{\beta}_{0,LS}, \sigma)$. Already at this point it can be noted that the real L_0, i.e., the maximum value of $L(\boldsymbol{\beta}_{0,LS}, \sigma)$, will never be lower than the „ideal" value of L_0 (i.e., value of L_0 we would obtain if we somehow managed to force d_i

to equal p_{mi} for all i) which is 0.5^n, where n is the number of observations. The reason is that the ideal L_0 can always be attained by setting $\sigma = \infty$. Therefore, the real L_0 will be larger than the ideal L_0 in those cases in which there is at least one $\sigma < \infty$ for which $L(\beta_{0,LS}, \sigma)$ will be larger than the ideal L_0. And this is the disadvantage of this approach: the test compares the rule's performance in the task of interest not with a rule-independent benchmark, but with a benchmark that depends on the rule's performance in a different task so that we use different benchmarks for different rules. This variability of the benchmark weakens significantly the relevance of the likelihood ratio test outcomes reported below. More specifically, for the Improvement rule the real L_0 is equal to the ideal L_0 (which is, of course, the same for all three rules) so that for this rule the likelihood ratio test as set up here is as favourable as it can be. For the other two rules, their least-informative versions are not completely uninformative and so for each them the real L_0 is larger than the ideal L_0. Thus, for these two rules it is more difficult to pass the test than it is for the Improvement rule.

Third, to compare the goodness of fit of different rules I will look at two other often used summary measures. Namely, they are the percentage of wrong predictions the estimated model makes within the data set at hand and the sum of squared residuals weighted by estimated probabilities WSSR = $\Sigma_i \{y_i - F[p_{mi} - d_i(\beta_{ML})]\}^2/\{F[p_{mi} - d_i(\beta_{ML})]\{1 - F[p_{mi} - d_i(\beta_{ML})]\}\}$. Both these measures are lower for models with a better fit. Unfortunately, none of the two measures contains an adjustment for degrees of freedom and so both have to be used with caution in cases where the two rules being compared have different numbers of degrees of freedom.

Also, the obtained estimates of σ may serve as a supplementary indicator of the extent to which the rule with β_{ML} corresponds to the data - the higher this extent, the lower the spread (or σ) of the subject's mistakes that we need to invoke together with β_{ML} to make her behaviour maximally consistent with the rule.

VI.3. Dealing with the Discrete and Finite Nature of Numerical Estimation

The standard way of maximizing a function - through setting its first derivative equal to zero and its second derivative negative - is not applicable here due to the nonlinearity of $\partial L(\beta, \sigma) / \partial(\beta, \sigma)$. Therefore, numerical methods have to be used. The statistical software available to me offers, however, probit analysis for the linear case only (as mentioned in the previous section). Therefore, I developed a set of programs in pascal which allowed me to locate approximately the maximum (logarithm of) likelihood point in the parameter space. I developed also programs which performed some other calculations needed in this thesis.

Unfortunately, numerical methods have the disadvantage of being discrete and finite: for example, calculations have a finite precision, numbers lower than a finitely small limit must be considered zero, when looking for an extremum of a function over a subspace of the real space only a finite number of points in this subspace can be examined so that the search has a finite „density" which must be somehow selected, etc. I had to deal with such issues as well and I did so as follows:

For each σ, it had to be decided what would be (1) the lowest and the highest value of $p_{mi} - d_i$ beyond which the normal density would be assumed to be 0 and 1, respectively, and (2) the step of integration during the calculation of $F_\sigma (p_{mi} - d_i)$. The lowest real number the language could work with was about $10^{-39} \cong e^{-89}$ and therefore as the lowest value of $p_{mi} - d_i$, I chose $-\sigma\sqrt{172}$ and its opposite value as the highest value of $p_{mi} - d_i$. At these values of $p_{mi} - d_i$ the normal density is

$1 / [\sigma e^{86}(2\pi)^{0.5}] =$

(here π means the Ludolf´s constant, not the experts' prediction) so that if one were to go with the value of $p_{mi} - d_i$ still further away from zero, the normal densities would soon become indiscriminable from zero for the computer. The absolute value of the search step was, for a given σ, chosen such that 1000 such steps would cover roughly the whole interval $[-\sigma\sqrt{172}, \sigma\sqrt{172}]$.

As to the width ν of steps with which the estimates were looked for, I chose the following policy:

σ was estimated with the step $\nu = 0.1$ because this precision seems to me sufficiently informative about what the spread of the subjects´ mistakes may look like.

α was estimated with the step $\nu = 0.01$. I wanted to choose such a $\nu = 10^x$, where x is an appropriate whole number, that the value of the coefficient $1 - [(c_{min}/c)(V_t/V_{max})]^\alpha$ when evaluated at the approximate ML estimates I obtained does not change by more than 5%[19] in any observation when one adds to or subtracts from the estimate of α the step, i.e., that

$$\left| \{1 - [(c_{min}/c_i)(V_t/V_{maxi})]^{\alpha\pm\nu}\} - \{1 - [(c_{min}/c_i)(V_t/V_{maxi})]^{\alpha}\}\right| \leq 0.05, \text{ for all } i. \qquad (*)$$

[19] 5% is my guess of what is the least number of percent that people are usually able to discriminate.

The expression on the left hand side of (*) is an increasing function of ν (for $(c_{min}/c)(V_t/V_{max}) < 1$) and (*) therefore establishes an upper bound on what values can be chosen for ν. Naturally, the highest possible value of ν implied by the requirement (*) depends on the particular data occuring in the experiment. If one inserts into (*) the values 0.05 and 3600 that I used for c_{min} and V_{max} in the estimation and if one inserts into (*) the estimates β_{ML} and γ_{ML}, then computation of $(c_{min}/c_i)(V_t/V_{maxi})$ for each $i = 1, ..., 128$ shows that (*) is met for all i if in (*) we use $\nu = 0.01$ but it is not met for all i if we use $\nu = 0.1$.[20]

β was estimated with the step $\nu = 0.1$ and $\nu = 0.01$ when β_{ML} was about 2 (Improvement rule) and below 0.2 (Bargain rule), respectively. The two values of ν were arrived at by requiring that the value of the weight $[t/(t + 1)]^{\beta}$, t = 1, 2, ..., 8, when evaluated at β_{ML}, does not differ for any given t by more than 5% from its values when evaluated at β_{ML} increased or decreased by the step $\nu = 10^x$.

γ was estimated with the step $\nu = 0.01$. The mathematical role of γ in the Bargaining rule and in the Improvement rule is very similar to that of β and so the step was determined along similar lines as that for β.

δ was estimated with the step $\nu = 0.01$ which was arrived at by requiring that the value of the coefficient $[(c_{min}/c)]^{\delta}$, $c = 0.25, 0.50, ..., 2.00$, when evaluated at δ_{ML}, does not differ for any c by more than 5% from its values when evaluated at δ_{ML} increased or decreased by the step $\nu = 10^x$.

ϕ was estimated with the step of $\nu = 0.01$. In accord with the preceding lines, I chose the step $\nu = 10^x$ so that the value of the weight ϕ does not change by more than 5% - obviously, the highest number which is both lower than 5% or 0.05 and of the form 10^x, is 0.01.

VI.4. Estimates

In all (logarithm of) likelihood computations discussed in this thesis, the likelihood $L(\beta_{ML}, \sigma_{ML})$ turned out to have a single maximum and no minima with regard to every parameter estimated.

[20] In fact, with $\nu = 0.01$ the value of the right hand side of (*) is below 0.02 in all cases.

Estimates (β_{ML}, σ_{ML}) for each of the three rules for all 128 observations[21] obtained in the experiment together with the values of three summary measures are reported in Table VI.3:

Table VI.3.: ML estimates for all observations and three summary measures

rule	α_{ML}	β_{ML}	γ_{ML}	δ_{ML}	ϕ_{ML}	σ_{ML}	LR vs. critical $\chi^2_{0.99}$	WSSR	wrong pred.[a]
Adaptation	-	-	-	0.07	0.00	25.5	$3.1^b < \chi^2_2 = 9.2$	128.33	34.4% (44 obs.)
Bargain	0.32	0.02	0.06	-	-	5.2	$8.3^c < \chi^2_3 = 11.3$	*127.94*	*32.8% (42 obs.)*
Improvement	-	2.4	0.00	-	-	17.1	$13.9 > \chi^2_2 = 9.2$	128.52	35.9% (46 obs.)

Notes: [a]Rounded percentage of wrong predictions, 100% is 128 observations.

[b]Non-significant at the 0.90 level.

[c]Significant at the 0.95 level.

Italics is used to emphasize that WSSR and wrong predictions can be compared directly for Adaptation rule and Improvement rule only, because the Bargain rule has one parameter more than the other two rules.

What is probably most striking about these estimates is the high value of σ_{ML}, especially for the Adaptation rule and the Improvement rule. If σ_{ML} for the two rules are to be taken as correctly describing the average mistake the subjects make relative to what the rule they use suggests to do, then the values 25.5 and 17.1 are absurdly high (they even imply that it should happen quite often in the low price runs that $d_i + e_i \leq 0$). Apart from this, if we take into account the one-parameter advantage of the Bargain rule, WSSR and the wrong predictions give us little reason at this stage to pick one of the three rules as the one that corresponds to the data clearly better than the other two. For the Adaptation rule the fit is not even significantly better than the least-informative fit as described in Section VI.2. (where the advantage of the Improvement rule in terms of the LR test was, however, also emphasized).

[21] The fact that I begin by estimating the parameters of each of the three rules on *all* observations implies that I start the estimations with the implicit fourfold assumption that (1) all subjects think the same way, (2) they do so by using the same rule, (3) they plug into it the same specific parameter values and (4) and they do so in all situations. Later estimations will stem from *partial* relaxation of this assumption in several ways.

The easiest explanation of why the estimates of σ are so nonsensically high is that not all the decisions made by all the subjects in all the runs in the experiment are generated by the same underlying mechanism (a rule of any kind, a specific rule, a specific rule with specific parameter values) and that if one tries to capture all these decisions by a single vector of parameters values in a single rule, then large discrepancies arise in many observations between the price which the rule evaluated at the estimated values of the parameters suggests to accept/reject and the price the subject in fact rejects/accepts - and these discrepancies form the basis of σ_{ML}. In other words, the estimate of σ can be viewed as another measure of the goodness of fit. This explanation suggests that the estimates might be made more realistic and better-fitting if I divide the whole data-set according to some a priori plausible criterion and estimate the rules separately on those of the resulting data-subsets that I consider for some reason likely to be actually generated by one of the three rules.

One obvious way to go is to separate high price runs and low price runs because these two groups of observations are fairly likely to be based on two different values of σ. In other words, this separation is likely to eliminate any heteroscedasticity which might be in the observations due to the possibility that the subjects perform mental operations with higher prices in a different way than with lower prices. E.g., it is well-known to all retailers that the higher the total amount a customer pays in a store, the less she objects to adding into the cart at the end of the purchase one more item at a given price. Similarly, the subjects in the experiment may have been unconsciously more careful about exactly what price a given rule they use suggests to accept in the low price runs than in the high price runs.

ML estimates of the parameter values for low price runs and high price runs separately for the three rules are given in Tables VI.4. and VI.5.:

Table VI.4.: ML estimates for low price runs only and three summary measures

rule	α_{ML}	β_{ML}	γ_{ML}	δ_{ML}	ϕ_{ML}	σ_{ML}	LR vs. critical $\chi^2_{0.99}$	WSSR	wrong pred.[a]
Adaptation	-	-	-	0.21	0.00	8.3	$4.8^b < \chi^2_2 = 9.2$	64.64	35.9% (23 obs.)
Bargain	0.27	0.01	0.00	-	-	1.1	$6.5^b < \chi^2_3 = 11.3$	*60.32*	*29.7% (19 obs.)*
Improvement	-	1.7	0.00	-	-	4.8	$11.4 > \chi^2_2 = 9.2$	63.63	34.4% (22 obs.)

Notes: [a]Rounded percentage of wrong predictions, 100% is 64 observations.

[b]Significant at the 0.90 level.

Italics is used to emphasize that WSSR and wrong predictions can be compared directly for Adaptation rule and Improvement rule only, because the Bargain rule has one parameter more than the other two rules.

Table VI.5.: ML estimates for high price runs only and three summary measures

rule	α_{ML}	β_{ML}	γ_{ML}	δ_{ML}	ϕ_{ML}	σ_{ML}	LR vs. critical $\chi^2_{0.99}$	WSSR	wrong pred.[a]
Adaptation	-	-	-	0.06	0.00	32.9	$1.5^b < \chi^2_2 = 9.2$	63.73	34.4% (22 obs.)
Bargain	0.32	0.02	0.07	-	-	6.5	$6.5^c < \chi^2_3 = 11.3$	*63.34*	*32.8% (21 obs.)*
Improvement	-	2.6	0.00	-	-	22.6	$8.2^d < \chi^2_2 = 9.2$	63.63	35.9% (23 obs.)

Notes: [a]Rounded percentage of wrong predictions, 100% is 64 observations.

[b]Non-significant at the 0.90 level.

[c]Significant at the 0.90 level.

[d]Significant at the 0.95 level.

Italics is used to emphasize that WSSR and wrong predictions can be compared directly for Adaptation rule and Improvement rule only, because the Bargain rule has one parameter more than the other two rules.

The two tables suggest that the separation of the whole data set according to the level of prices in a given price run does not lead to any increase in the quality of fit as measured by the likelihood ratio test - in fact, except for the Adaptation rule in low price runs, the opposite is true. The absurdity of the values of σ_{ML} has been significantly weakened for the Bargain rule only. As regards WSSR and percentage of wrong predictions, however, this rule outperforms the other two only very weakly (given the one additional parameter it has) in low price runs and is actually probably worse (after a hypothetical degrees-of-freedom adjustment) in high price runs. It thus seems that the mere separation of the high price runs and low price runs does not lead to a sufficient improvement in fit and does not allow us to distinguish among the three rules clearly the best one.

While for the Adaptive rule and the Improvement rule the estimated parameter values differ quite a lot between the low price runs and high price runs, for the Bargain rule the corresponding estimates are rather close to each other (relative to the size of the estimate). This suggests the possibility that the values of the parameters for the Improvement rule do not in fact differ for high price runs and low price runs and that a joint estimation might suffice if it takes into account the heteroscedasticity by making the estimate of σ for high price runs a κ-multiple of the estimate of σ for low price runs and by estimating κ together with the other parmaters in the rule. This joint estimation brings results that are reported in Table VI.6.:

Table VI.6.: ML estimates for the Bargain rule with heteroscedasticity and three summary measures

				σ_{ML}				
α_{ML}	β_{ML}	γ_{ML}	κ_{ML}	low price runs	high price runs	LR vs. critical $\chi^2_{0.99}$	WSSR	wrong predictions[b]
0.28	0.02	0.00	8.7	1.2	10.44[a]	$18.6 > \chi^2_3 = 11.3$	123.51	31.2% (40 obs.)

Notes: [a]Obtained by multiplying the low price runs estimate of σ_{ML} by κ_{ML}, i.e., 1.2 x 8.7 = 10.44.

[c]Rounded percentage of wrong predictions, 100% is 128 observations.

[c]Significant at the 0.95 level.

In this case we obtain a very good LR test result. Not surprisingly, the value of WSSR is lower than that for the Bargain rule with just a single standard deviation, but the percentage of wrongly predicted observations has decreased only slightly. Also, the implied estimate 10.44 of the standard deviation of subjects' mistakes in high price runs is still awkwardly high, which is why it is hard to accept this estimation as giving even rough approximations to true values. Below a different estimation of the parameters of the Bargain rule will produce a much lower high-price runs' value of σ_{ML}.

The results obtained so far are far from reasonable and satisfactory. That means either that the data simply correspond to the rules very little or that some of the data might correspond to some of the rules much better but the remaining data which do not correspond to the rules at all spoil the estimation.[22] To follow the second, optimistic route, I want to exclude from the set of observations upon which the estimates are built those observations for which my suspicion is strongest that they are generated by a mechanism different from the

[22] Obviously, there is also the possibility of separating the low-price-run data subset and high-price-run data subset further (e.g., according to various characteristics of the subjects) so that for each of the three rules and for each of the two levels of prices we would get *several* sets of parameter estimates. This direction is mentioned also in the next chapter.

mechanism that generated the other decisions (and that is - I hope - identical to one of the rules in the hypothesis).

What observations are those for which there is a reason to cut them off? One could probably generate several different stories, each leading us to delete a different set of observations. According to the simplest story I can think of, the group of runs in which the decisions of the subjects seem particularly likely not to be arrived at by using any of the three rules in my hypothesis is the set of single-price searches, briefly SPS's. The subjects who stopped at the first price, once they learn the first price and thus how much money will go to them if they stop at that price, might reason in this very simple fashion: „Oh, that's a nice sum, I surely don't want to take the risk of losing a part of it by proceeding to the other prices, even if there is a chance that some of them would imply even a higher overall net gain.“ Such an approach views the „optional“ (i.e., after-first-price) part of each of the two runs as a risky adventure where the riskiness is not analyzed beyond the impression that the sum earned could be perhaps increased by going further but that this possibility cannot outweigh the possibility of decreasing that sum from the level at the very first price.

This explanation accounts fully for the behaviour of the three subjects (M1, M5 and M8) who stopped in both runs at the first price. Also the behaviour of the seven subjects who stopped in the first run at the first price but went beyond the first price in the second run is not hard to interpret simply and yet consistently with the above explanation - they made what they considered a nice sum in the first run and so they thought they could afford to have some fun (and maybe earn more?) by taking more risk in the second run. Tables VIII.1. - VIII.3. in chapter VIII show the rounded „contribution“ of each of the 128 observations to $L(\beta_{ML}, \sigma_{ML})$ for each of the three rules when their parameters were estimated with all observation (the case reported in Table VI.3 above). It is clear that SPS´s belong for all three rules among the observations with the lowest contribution and which therefore harm the overall fit measured by the likelihood (the product of these „contributions“) most - this lends some support to the conjecture that the thinking of the subjects in the SPS's was not „like“ that in the other runs. As for the subject R4 who saw several prices in the first run but stopped at the first price in the second run, Tables A.1. - A.3. show that this subject's SPS actually supports the Bargain rule and is very close to supporting the other two rules. In other words, from the point of view of the rules, this particular SPS was (nearly) a reasonable thing to do and so in this case there is no strong need for an alternative explanation. Thus, there is just one SPS that is left „without a story“ - that of M10.

If we exclude SPS´s, the ML estimates for all remaining observations (Table VI.7.) of σ are substantially lower compared to the original estimation with all observations (Table VI.3.) for all three rules, while changes in the estimates of the other parameters´ values are mostly small or even none:

Table VI.7.: ML estimates for all observations (SPS excluded) and three summary measures

rule	α_{ML}	β_{ML}	γ_{ML}	δ_{ML}	ϕ_{ML}	σ_{ML}	LR vs. critical $\chi^2_{0.99}$	WSSR	wrong pred.[a]
Adaptation	-	-	-	0.10	0.00	11.3	$13.4 > \chi^2_2 = 9.2$	110.38	30.1% (34 obs.)
Bargain	0.32	0.11	0.00	-	-	4.4	$24.1 > \chi^2_3 = 11.3$	*115.30*	*24.8% (28 obs.)*
Improvement	-	2.2	0.00	-	-	7.5	$34.7 > \chi^2_2 = 9.2$	116.06	27.4% (31 obs.)

Notes: [a]Rounded percentage of wrong predictions, 100% is 113 observations.

Italics is used to emphasize that WSSR and wrong predictions can be compared directly for Adaptation rule and Improvement rule only, because the Bargain rule has one parameter more than the other two rules.

Generally speaking, the exclusion of SPS´s noticeably improves the quality of fit according to all three measures (as compared to their values in Table VI.3.).

Comparing now the results within Table VI.7. for individual rules, we see that while the Adaptation rule has a bit more favourable WSSR score compared to that for the Improvement rule, the Improvement rule has a bit better predictive performance. If we realize that the hypothetical adjustment of the WSSR score of the Bargain rule for degrees of freedom would lead to a higher value of this score, the fact that the unadjusted value of this score of the rule is only slightly lower than this score for the Improvement rule and even *higher* than the WSSR score for the Adaptation rule should make us doubt the descriptive validity of the Bargain rule relative to the other two rules. On the other hand, this rule boasts the lowest estimate of σ. Again, none of the rules seems to fare significantly better or worse than the other two.

But the σ_{ML}´s remain very high, at least relative to the standard deviation of the distributions from which the prices in the low price runs were generated (just to remind the reader, this standard deviation was for all low price runs in the experiment uniformly set equal to 3). Again, we can try to estimate the parameters separately for high price runs and for low price runs and to eliminate in that way any heteroscedasticity which might be in the observations. ML estimates of the parameter values for low price runs and high price runs separately for the three rules are given in Tables VI.8. and VI.9.

Table VI.8.: ML estimates for low price runs only (SPS excluded) and three summary measures

rule	α_{ML}	β_{ML}	γ_{ML}	δ_{ML}	ϕ_{ML}	σ_{ML}	LR vs. critical $\chi^2_{0.99}$	WSSR	wrong pred.[a]
Adaptation	-	-	-	0.36	0.00	1.9	$16.9 > \chi^2_2 = 9.2$	38.82	25.0% (14 obs.)
Bargain	0.28	0.10	0.00	-	-	0.8	$21.3 > \chi^2_3 = 11.3$	*47.79*	*17.9% (10 obs.)*
Improvement	-	1.9	0.00	-	-	2.4	$24.4 > \chi^2_2 = 9.2$	44.96	28.6% (16 obs.)

Notes: [a]Rounded percentage of wrong predictions, 100% is 56 observations.

Italics is used to emphasize that WSSR and wrong predictions can be compared directly for Adaptation rule and Improvement rule only, because the Bargain rule has one parameter more than the other two rules.

Table VI.9.: ML estimates for high price runs only (SPS excluded) and three summary measures

rule	α_{ML}	β_{ML}	γ_{ML}	δ_{ML}	ϕ_{ML}	σ_{ML}	LR vs. critical $\chi^2_{0.99}$	WSSR	wrong pred.[a]
Adaptation	-	-	-	0.09	0.00	15.3	$6.8^{b} < \chi^2_2 = 9.2$	52.87	29.8% (17 obs.)
Bargain	0.33	0.17	0.00	-	-	5.7	$16.3 > \chi^2_3 = 11.3$	*54.69*	*24.6% (14 obs.)*
Improvement	-	2.2	0.00	-	-	10.1	$20.1 > \chi^2_2 = 9.2$	52.70	28.1% (16 obs.)

Notes: [a]Rounded percentage of wrong predictions, 100% is 57 observations.

[b]Significant at the 0.95 level.

Italics is used to emphasize that WSSR and wrong predictions can be compared directly for Adaptation rule and Improvement rule only, because the Bargain rule has one parameter more than the other two rules.

As could be expected, the values of σ_{ML} and of the three direct indicators of the goodness of fit have improved in Table VI.8. as compared to values in Table VI.4 (*all* low-price run observations) and in Table VI.9. as compared to Table VI.5. (*all* high-price run observations). The estimates of σ for low price runs are dramatically lower than in Table VI.7. for all three rules while for high price runs they are larger than in Table VI.7. again for all three rules. This divergent behaviour obviously indicates strong heteroscedasticity. The resulting estimates, however, are still much too large (especially for high price runs) in comparison both with the prices' spread and with subjective introspection (example: σ_{ML} = 15.3 for the Adaptation rule suggests that if a subject basically wants to reject a price higher than, say, CZK 90, with probability about 0.16 she will in fact accept anything below CZK 105 and with the same probability reject anything above CZK 75) and so especially the Adaptation rule and the Improvement rule seem to continue to fit the data rather imperfectly even after the separation of low price runs and high price runs.

In the high price runs results, the WSSR score of the Bargain rule is - even before adjusted for the degrees of freedom - higher than the scores for the other rules, again suggesting that, in comparison with the other two rules, the Bargain rule does not correspond to the data particularly well. The Improvement rule is slightly better than the Adaptation rule in terms of the number of wrong predictions. Also, the Adaptation rule has a bad likelihood ratio test outcome.

For low price runs, the Adaptation rule outperforms the Improvement rule with both comparative measures. Here too the Bargain rule is patently betrayed by its unadjusted WSSR score.

To sum, for both the low price runs and the high price runs the Bargain rule excels as to σ_{ML} and loses completely as to WSSR. The Adaptation rule seems to correspond to high price run data slightly less than the Improvement rule, while for the low price runs data are clearly matched better by the Adaptation rule.

While for the Bargain rule and even more for the Adaptive rule the estimated parameter values differ quite a lot between the low price runs and high price runs, for the Improvement rule the two estimates of γ are equally zero and the two estimates of β are rather close to each other (relative to the size of the estimate). This suggests the possibility that the values of the parameters for the Improvement rule do not in fact differ for high price runs and low price runs and that a joint estimation (SPS's excluded) might be fruitful if it takes into account the heteroscedasticity by making the estimate of σ for high price runs a κ-multiple of the estimate of σ for low price runs and estimating κ together with the other parmaters in the rule. This joint estimation brings results that are reported in Table VI.10.:

Table VI.10.: ML estimates for the Improvement rule (SPS excluded) with heteroscedasticity and three summary measures

			σ_{ML}				
			low price	high price			wrong
β_{ML}	γ_{ML}	κ_{ML}	runs	runs	LR vs. critical $\chi^2_{0.99}$	WSSR	predictions[b]
2.1	0.00	4.0	2.5	10.0[a]	$44.4 > \chi^2_2 = 9.1$	97.20	28.3% (32 obs.)

Notes: [a]Obtained by multiplying the low price runs estimate of σ_{ML} by κ_{ML}, i.e., 2.5 x 4.0 = 10.0.

[c]Rounded percentage of wrong predictions, 100% is 113 observations.

As could be expected, the estimates of σ are worse than in the case of separate estimation (Tables VI.8 and VI.9.). Also, it is understandable that WSSR is now lower than for the Improvement rule in Table VI.7. On the contrary, in comparison with the Improvement rule's figure in Table VI.7., the percentage of wrong predictions has increased - though by the least amount possible.

Let me close this chapter by stating the rules as they read with the parameter values reported in the last three tables.

Adaptation rule for low price runs: Go on if $p_{mt} > d_{t-1} + \{1 - (0.05/c)^{0.36}\}(p_t - d_{t-1})$, where $d_0 = p_0$.

Adaptation rule for high price runs: Go on if $p_{mt} > d_{t-1} + \{1 - (0.05/c)^{0.09}\}(p_t - d_{t-1})$, where $d_0 = p_0$.

Bargain rule for low price runs: Go on if $p_{mt} > \{1 - [(0.05/c)(V_t/3600)]^{0.28}\}E_t$,
where $E_t = \{1 - [t/(t + 1)]^{0.10}\}p_0 + [t/(t + 1)]^{0.10}M_t$.

Bargain rule for high price runs: Go on if $p_{mt} > \{1 - [(0.05/c)(V_t/3600)]^{0.33}\}E_t$,
where $E_t = \{1 - [t/(t + 1)]^{0.17}\}p_0 + [t/(t + 1)]^{0.17}M_t$.

Improvement rule for low price runs: Go on if $p_{mt} > \{1 - [t/(t + 1)]^{1.9}\}p_0 + [t/(t + 1)]^{1.9}M_t + c$.

Improvement rule for high price runs: Go on if $p_{mt} > \{1 - [t/(t + 1)]^{2.2}\}p_0 + [t/(t + 1)]^{2.2}M_t + c$.

Improvement rule for all runs: Go on if $p_{mt} > \{1 - [t/(t + 1)]^{2.1}\}p_0 + [t/(t + 1)]^{2.1}M_t + c$.

Tables VI.7. - VI.9 may help to get a better idea of how these rules work.

TableVI.11.: Values (in the form of rounded percentages) of the *t*-dependent weights appearing in the Bargain rule and in the Improvement rule

weight	*t* = 1	2	3	4	5	6	7	8
$1 - [t/(t+1)]^{0.02}$	1%	0%	0%	0%	0%	0%	0%	0%
$1 - [t/(t+1)]^{0.10}$	7%	4%	3%	2%	2%	2%	1%	1%
$1 - [t/(t+1)]^{0.17}$	11%	7%	5%	4%	3%	3%	2%	2%
$1 - [t/(t+1)]^{1.9}$	73%	54%	42%	35%	29%	25%	22%	20%
$1 - [t/(t+1)]^{2.1}$	77%	57%	45%	37%	32%	28%	24%	22%
$1 - [t/(t+1)]^{2.2}$	78%	59%	47%	39%	33%	29%	25%	23%

TableVI.12.: Values (in the form of rounded percentages) of the *c*-dependent coefficients appearing in the Adaptation rule

coefficient	*c* = 0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
$1 - (0.05/c)^{0.09}$	-[a]	-[a]	22%	24%	25%	26%	27%	28%
$1 - (0.05/c)^{0.36}$	44%	56%	62%	66%	69%	71%	-[a]	-[a]

Notes: [a]The value of *c* did not appear in the observations to which the coefficient applies.

TableVI.13.: Values (in the form of rounded percentages) of the *c*- and V_t-dependent coefficients appearing in the Bargain rule

coefficient	V_t	*c* = 0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
$1 - [(0.05/c)(V_t/3600)]^{0.28}$	0.16[b]	4%	3%	3%	3%	2%	2%	-[a]	-[a]
$1 - [(0.05/c)(V_t/3600)]^{0.28}$	2.83[c]	9%	7%	6%	6%	5%	5%	-[a]	-[a]
$1 - [(0.05/c)(V_t/3600)]^{0.28}$	12.99[d]	13%	11%	10%	9%	8%	8%	-[a]	-[a]
$1 - [(0.05/c)(V_t/3600)]^{0.33}$	6.52[b]	-[a]	-[a]	5%	5%	4%	4%	4%	4%
$1 - [(0.05/c)(V_t/3600)]^{0.33}$	82.85[c]	-[a]	-[a]	12%	11%	10%	9%	9%	9%
$1 - [(0.05/c)(V_t/3600)]^{0.33}$	208.32[d]	-[a]	-[a]	16%	15%	13%	13%	12%	12%

Notes: [a]The value of *c* did not appear in the observations to which the coefficient applies.

Three values of V_t were selected at which the coefficients' values are stated:

[b]The lowest value of V_t (among all observations to which the coefficient applies) when V_t is evaluated at the ML estimates' values.

[c]The average value of V_t (over all observations to which the coefficient applies) when V_t is evaluated at the ML estimates' values.

[d]The highest value of V_t (among all observations to which the coefficient applies) when V_t is evaluated at the ML estimates' values.

VII. DISCUSSION

The main task I chose in this thesis was fulfilled: several bounded-rational rules which have a fair chance of being used by buyers when they search for a low price in the market in the first days after price liberalization were tested against data from an experiment and the extent to which the data correspond to each of the three rules was assessed.

Fortunately, all three rules correspond to the data (after they were somewhat cleared) fairly well: likelihood ratio tests reveal in most cases quite a strong statistical significance in comparison with the rules' least-informative versions. Less fortunately, they correspond to the data in some cases about equally well and in other cases differently according to different measures so that it is hard to distinguish between them in terms of their relative strength of correspondence to the data. An exception to this ambiguity is perhaps estimation on the basis of low price runs only where the Adaptation rule seems to fit the data markedly better than the Improvement rule.

How could this indeterminateness be cured? A number of directions may be taken:

(1) To find other summary measures, preferably those which can take the number of degrees of freedom into account. For example, Akaike Information Criterion (AIC) is suggested in Amemiya (1981), but it would be necessary to verify that it can be used also in the present case of nonlinear probit. Also, statisticians might try to find a way in which the tabulated critical χ^2 values should be adjusted for cases in which the nonlinearity of the model whose parameters are to be estimated does not allow to identify a set of the parameters' values which would make the model completely useless for prediction of the behaviour of the variable whose behaviour the model is to explain. Until it is clear how this adjustment is to be done, the likelihood ratio test will remain a very unreliable indicator of the quality of fit.

(2) To estimate the variances of the estimates. Given the complexity of calculating the formulas for elements of the variance-covariance matrix of the estimates, an alternative route which I consider trying in the future is bootstrap.

(3) To choose a different specification for the rules - in other words, I should play with various other particular ways of filling the three heuristics with the information suggested as reasonable to be used. For example, the positions of the old price and the prediction in the buyer's reasoning could be switched or changed in some other way.

(4) To increase the number of observations is a step which helps in many problems with statistical indeterminateness.

(5) Once the number of observations increases to several hundreds, it should be possible and statistically meaningful to estimate the parameter values for variously segregated data - e.g., to estimate each rule on observations coming from those subjects whose behaviour seems particularly well capturable by that rule, or to distinguish between the subjects according to their characteristics such age, shopping experience, sex, etc.

(6) To obtain possibly more coherent data and certainly more real-life-relevant data by inviting members of the general public to participate in the experiment instead of students.

To eliminate thoughtless stopping at the first price seen, i.e., to get rid of SPS's (but what if precisely that is what some buyers content themselves with even when they have no idea about the price distribution?), I should decrease the amount to be gained by stopping at the first price as well as the show-up fee (which, however, means running the risk of few subjects turning up).

As to the estimated values of parameters, all three rules in all four cases treat the prediction π as useless (except the Bargain rule for all observations which gives the prediction a minuscule value) - i.e., both γ and ϕ are estimated to be zero. This would imply that people distrust economists' predictions and believe only what they see with their eyes. This seems to have been all the more likely in practice given the substantial variability of experts' forecasts described at the end of section II.2. The other estimates do not have this extreme character. It is up to the reader to judge for herself or himself whether the values in Tables VI.11. - VI.13. are or are not realistic and reasonable - in my opinion, all of the rows in the tables are reasonable individually, and most also in comparison with other rows; one could perhaps just ask whether it is realistic that the rate of adaptation in the Adaptation rule is about 1/4 for high price runs but about 2/3 for low price runs.

VIII. APPENDIX

VIII.1. English Translation of the Instructions for Participants in the Experiment

INSTRUCTIONS FOR THE PARTICIPANT

who has signed up in the sign up sheet under no. ...

The experiment will take place on December 9, 1997 from ... p.m. in the Hollar building of the Faculty of Social Sciences, 2nd floor, door no. 212 (the Hall)

You will participate in an experiment from the area of decision making of an individual. Your participation in it, which should take about 8 minutes, will enable you to earn a relatively interesting amount of money - given how much time it will take - that will be paid to you immediately on the spot. This amount will consist of the turn-up fee of CZK 40 and of the terminal balance of your „account“ (see below). How much this balance will be will depend on your decisions during the experiment. Please read the following instructions very carefully, make sure you understand everything, and if you have any questions, ask the experimentator on the spot before your participation in the experiment begins.

The experiment will have two parts:

First Part of the Experiment

Imagine you want to buy one unit of a certain commodity S. Until yesterday the price of each commodity in the consumption goods market in your economy had been determined by the government at a fixed level that all stores had had to comply with. The price of the commodity S in this system had until yesterday been x_S [the specific value will be revealed to you on the spot - all values that appear in the experiment (prices, fee, etc.) will be different for each participant from those that the other participants will face].

From today, however, a new governmental decree is in force which determines for each commodity the price that, starting from today, is the maximum allowed price, i.e., the actual retail price of a given commodity is not allowed to exceed the price stated in the decree for this commodity. The seller can charge whatever price she chooses to (of course, up to the price stated by the decree) regardless of when and at what price she has bought the commodity from her supplier. The maximum prices are for all commodities higher than the prices that had been compulsory up to yesterday and so - even though the decree does not prohibit selling goods at the old or even lower prices - in most stores an increase in the price can be expected. It is easily possible, however, that many stores will sell at the old (compulsory) price or at some other price lower than the maximum price (e.g., to fight with the competitors); on the other hand, in some stores it is possible that the commodity will be sold at a price higher than the maximum price stated in the decree (because the decree will not be inforced and the competition is weak).

The decree states that the maximum price for the commodity S that you will buy is CZK y_S [the specific value will be revealed to you on the spot].

At the beginning of this first part of the experiment the experimenter will set up an „account“ for you [the starting balance of this account will be revealed to you on the spot]. From this account you will cover all your expenses which you will decide to make in the first part of the experiment as well as in the second part of the experiment (described below). The balance of this account after you terminate your participation in both parts of the experiment will be paid to you (see below).

On the table you will see 8 white cards in a row. On the other side of each card there will be a number which you will be able to read after turning the card over. Eight numbers stated on these eight cards are eight prices which today, after the maximum prices have been determined, are charged by eight completely randomly selected stores. Thus, turning a card over is like visiting the corresponding store and finding out about the price that this store charges today for one unit of the commodity S. These eight stores were selected completely randomly including their order, so that any apparent regularity (e.g., increasing or decreasing) in the sequence of the first several prices on the cards is a result of pure chance - there is simply nothing systematic in the prices.

Your task will be to turn the cards over one by one as if you were visiting sequentially the corresponding stores. Whenever you turn a card over, a constant „travel fee“ of CZK z_S will be deducted from your account [the specific value will be shown to you on the spot]. Once you turn a card over and see the price written on it, you have to decide between two options: you can either (1) go on in the experiment, that is turn the next card over and see the price written on that card, or (2) buy the commodity at the moment.

If - at the turned-over card - you choose option (1), that is, to go on, you have to turn that card back with the price-side down and you continue by turning around the next card.

If on the contrary you choose option (2), that is, to buy the commodity at the moment, you can do so most naturally in one of two stores: either (a) in the store where you currently „are“, i.e, for the price written on the card which is currently turned price up - in that case this price will be deducted from your account and the first part of the experiment will be over for you, or (b) in that store among the stores you have already „visited“ in which you found the lowest price so far - in that case the travel fee will be deducted from your account, then the price of the commodity S that is charged in the store you returned to will be deucted from your account, and the first part of the experiment will be over for you. If after turning any card over you ask, the experimenter will tell you whether at that moment it is more profitable for you to choose the option (a), i.e., to buy in the store you „are in“, or the option (b), i.e., to pay the travel fee, return to that of the previously „visited“ stores which offers the lowest of the prices seen so far, and buy the commodity in that store for that price. The experimentator, however, cannot tell you the actual *value* of the lowest price seen so far and of the other prices.

The only three values that you will work with during the whole experiment are the old price of the commodity S which used to be compulsory, i.e. x_S, the newly determined maximum price of the cdommodity S, i.e. y_S, and also the value of the travel fee, i.e. z_S.

The speed with which you will proceed from card to card is entirely up to you - with just one exception: if you do not decide to buy the commodity within three minutes, the experimentator will stop you, deduct from your account half of the original sum „deposited“ to the account (so that your profit from the first part of the experiment can be considered in a certain sense zero) and you will proceed to the second part of the experiment. It is therefore in your interest to buy the commodity within three minutes

If, before buying the commodity, you turn the cards over so many times that you spend through travel fees half of the original sum deposited to your account, the experimentator will stop you and you will proceed to the second part of the experiment. Again, your profit from the first part of the experiment can be considered in a sense zero and it is therefore in your interest to avoid such a case.

You will not be allowed to make any written notes during the first part of the experiment just described nor during the second part of the experiment described below.

Second Part of the Experiment

The situation is the same as in the first part of the experiment, only a completely different commodity T will be involved and so you will work with completely different values.

Its price that had been compulsory until yesterday was x_T, its price that, beginning from today, is its maximum allowed price is y_T. The travel fee is this time z_T [the specific values of all three data will be revealed to you on the spot]. There is no relation between the prices of the commodity S and of the commodity T: the eight prices that you may see in the second part of the experiment comes from a completely different part of the consumer goods market and from different stores than the prices in the first part of the experiment, and so your experience with the prices in the first part of the experiment has no value in the second part of the experiment, it will not help you in any way.

In the second part of the experiment the three-minutes limit applies as well and overstepping it will also result in deducting (from your „account“) half of the initial sum „deposited“ to your „account“. The experiment ends also in the case that you will spend so much in travel fees that the balance of your account will be zero. It is therefore also this time in your interest to buy the commodity T within three minutes and not to allow that the balance of your account will become zero due to travel fees.

After the second part of the experiment is terminated, the final balance of your account will be paid to you in cash, as will be the turn-up fee of CZK 40.

The data obtained through this experiment will be used for research purposes. Please read carefully the declaration printed below which you will be asked to sign after the end of the experiment.

Good luck in your „shopping“!

DECLARATION OF A PARTICIPANT IN THE EXPERIMENT

1. I declare that I will not share any information on this experiment with other persons.

2. I confirm that I have received CZK ... for my participation in the experiment held on December 9, 1997, at the Faculty of Social Sciences, Charles University.

3. I consent that the data obtained on the basis of my participation in the experiment be used for research purposes (as long as my anonymity is maintained).

In Prague, December 9, 1997

....

signature

VIII.2. Addendum to the Instructions

Before each subject started her/his participation in the experiment, she/he was informed about the following changes in the instructions (after these changes the experimental set-up corresponds to the description in chapter V):

1. There will be one account from which all expenses of the subject in the first part of the experiment will be covered and a separate account from which her/his expenses in the second part of the experiment will be covered. After the second part of the experiment is terminated for the subject, her/his earnings will be the sum of the turn-up fee, of the balance of the first-part account and of the balance of the second-part account.

2. Instead of the maximum price determined by the government, she/he will be given an average of several experts' yesterday estimates of by how many percent the overall price level in the economy would jump up on the next day (i.e., today) as a result of the price liberalization.

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