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"I remember my brother-in-law going for a short sea trip once, for the benefit of his health. He took a return berth from London to Liverpool; and when he got to Liverpool, the only thing he was anxious about was to sell that return ticket. It was offered round the town at a tremendous reduction, so I am told; and was eventually sold for eighteen pence to a bilious-looking youth who had just been advised by his medical men to go to the sea-side and take exercise…He himself – my brother-in-law - came back by train." (Jerome K.J. Three men in a boat (to say nothing of the dog) 1889, pp.10-11)

The model of equilibrium price dispersion examines the demand for cars through the optics of the demand for mileage where the asymmetry of information is produced by the odometer fraud. Theoretically, fraudsters can destroy the market as it is described by the "theorem of lemons". But the market self-deactivation does not take place. The purchase of a car with regard to the demand for mileage represents a form of home production where driving like gardening and pets' care provide a direct utility but is also something one can purchase on the market. At the margin nobody buys but everybody gets taxi. The increase in taxi price per mile raises the demand for good cars of taxi drivers and it makes rational for potential buyers to pay for taxi drivers expertize fee in order to choose a good car. The demand for good cars is restored at the new price level.

The pessimistic scenario, however, doesn't take place because good cars stay attractive. The equilibrium price of a mile establishes the direct relationship between marginal savings on purchase and the time horizon of the consumption-leisure choice. Great discounts provide potential buyers the additional information about short life cycle of vehicles like unexpected low price for beefsteak tells about its short shelf life. The equilibrium price of a mile describes also the trade-off between the purchase price and the costs of ownership. The marginal approach does not rely on the endowment effect. The choice between a good car and a bad car discovers the willingness to take care of good cars where the after-the-purchase costs of ownership per mile become greater than for a bad car. The willingness to take care of the big-ticket quality items reinforces the willingness to pay of potential buyers, and sellers of good cars do not quit the market.

***Keywords**: theorem of lemons, equilibrium price dispersion, optimal consumption-leisure choce, willingness to take care of big-ticket items*

***JEL Classification:** D11, D83.*

1.Introduction

Almost fifty years passed after George Akerlof published his famous paper "The Market for lemons: Quality Uncertainty and the Market Mechanism". The theoretical model of the used cars gave birth to the new wave of economic thought. Today we can speak of the economics of "lemons" that covers different fields – from pharmaceuticals to education – where the asymmetry of information significantly changes human behavior (Katz 2007, Cooper 2007). Moreover, five years after the article the wave of regulatory "lemon" laws started with the Magnuson-Moss Warranty Act. And in 2001 George Akerlof received the Nobel Memorial Prize for his research on asymmetric information.

However, the issue of "lemons" and their competition with "peaches", high-quality products, was well known at least from the medieval ages when it was supervised by professional corporations and unions, where the strict regulation of membership solved successfully the problem of the asymmetry of information. The real novelty of the article was the presentation of the market mechanism of self-deactivation with the withdrawal of good cars, called later "the theorem of lemons". George Akerlof illustrated that mechanism by the equilibrium price, which stayed below prices of good cars under bad cars' pricing schedule.

Nevertheless, in real life used-car markets haven't broken down and, as some authors pointed out, they could survive even without "lemon" legislation (Anderson 2001).

The model of the optimal consumption-leisure choice that uses the modified George Stigler's equation (Stigler 1961) of marginal values of search as the the constraint to the consumption-leisure utility function, discovers some interesting features that make the choice of "peaches" with regard to "lemons" more advantageous.

2. Quantity to be purchased

The analysis of the Cobb-Douglas utility function $U(Q,H)=Q^{-\partial L/\partial S}H^{-\partial H/\partial S}$ under the constraint of marginal values of search results in the following conclusions:

$$max\, U(Q,H)\ subject\ to\ w\frac{\partial L}{\partial S}=Q\frac{\partial P}{\partial S} \quad (1.1)$$

$$\Lambda = U(Q,H)+\lambda\left(w-\partial P/\partial S\frac{Q}{\partial L/\partial S}\right) \quad (1.2)$$

$$\frac{\partial U}{\partial Q}=\lambda\frac{\partial P/\partial S}{\partial L/\partial S} \quad (1.3)$$

$$\frac{\partial U}{\partial H}=-\lambda Q\frac{\partial P/\partial S}{(\partial L/\partial S)^2}\partial^2 L/\partial S\partial H=-\lambda\frac{w}{\partial L/\partial S}\partial^2 L/\partial S\partial H \quad (1.4)$$

where w is the wage rate; the values of L (labor), S (search), and H (leisure) represent the allocation of the time horizon T until the next purchase; the value $\partial P/\partial S<0$ measures marginal savings on price per unit under the search; and the value $\partial L/\partial S<0$, ***the propensity to search***, represents marginal costs of the search.[1]

Here the question of the quantity to be purchased is still open. If we come back the original example of the "peaches&lemons market" we can presuppose that potential buyers are searching not for a car – they are interesting in ***mileage***. How much miles a car has gone and how much it can go after the purchase? In addition, we can presuppose that used-car watchers compare the price with future mileage. Other words, ***they are buying future miles***. It can be the answer to our question – what we should take as the value of quantity Q under the consumption-leisure choice.

As the result, the choice between bad car and good car can be presented as following (Fig. 1):

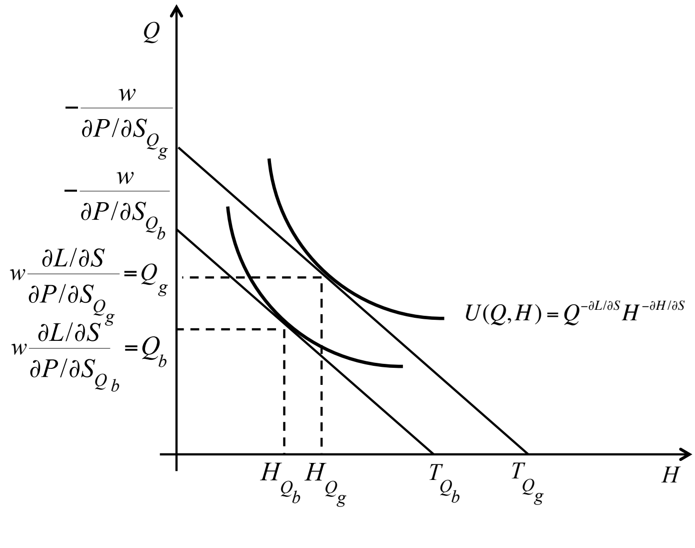

Fig. 1. Optimal choices for bad car and for good car.

Here we can see that the bad car offers less mileage Q_b than the good car Q_g. As a result, the purchase of another car in the case of the choice of the good car will come later, or $T_{Qg}>T_{Qb}$ even when the purchase of the good car presumes its more intensive use, sleep less but drive more, or $Q_g/H_g>Q_b/H_b$. What happens here with marginal savings? We can expect that, if the marginal efficiency of search is diminishing, or $\partial^2 P/\partial S^2>0$, the high price for the good car can be resulted in greater marginal benefit, or $|\partial P/\partial S|_g>|\partial P/\partial S|_b$. But it is not true. Indeed, when the trader proposes the important discount for the good

[1] The marginal utilities of consumption and leisure, presented in relative values, are equal to the classical $MU_Q=\lambda P$ and

car, he offers the discount on the QP value. In our example this discount or marginal savings are equal to the value $Q\partial P/\partial S$. And in the case of greater discount on a good car we have $|Q_g\partial P/\partial S_{Qg}|>|Q_b\partial P/\partial S_{Qb}|$.

But the demand for great mileage should cut the price per future mile. This is the law of demand. The price falls with the increase in quantity to be purchased. But this fall is inelastic, or $e_{P,Q}>-1$ because the seller should keep the positive cash inflow. If the price falls with the increase in mileage, marginal savings per future mile for the good car will be less than marginal savings per future mile for the bad car, or $|\partial P/\partial S|_{Qg}<|\partial P/\partial S|_{Qb}$. The consideration $e_{P,Q}>-1$ results in the assumption that marginal savings, here we can take an absolute value without the loss in the sense, follows the price, or $e_{|\partial P/\partial S|,Q}>-1$. This assumption results in the north-east shift of the budget constraint at Figure 1. Obviously, the good car promises the greater level of utility.[2]

And when the pocket is not tightly constrained, under perfect information the consumer certainly chooses the good car. However, when the information is not perfect, the choice is not obvious. The comparative static analysis of the choice between the good car and the bad car can discover this information gap. And we start the comparative static analysis with the presentation of the concept of the equilibrium price for one mile.

3.Equilibrium price of one mile.

The transformation of the budget constraint (Equation 1.1.) gives us the concept of the equilibrium price under price dispersion:

$$w\frac{\partial L}{\partial S} = -w\frac{L+S}{T} = Q\frac{\partial P}{\partial S} \quad (2.1)$$

$$w(L+S) = -QT\frac{\partial P}{\partial S} = QP_e \quad (2.2)$$

because

$$MRS(H\ for Q) = \frac{\partial U/\partial H}{\partial U/\partial Q} = -\frac{w}{\partial P/\partial S}\partial^2 L/\partial S\partial H \quad (2.3)$$

$$\partial^2 L/\partial S\partial H = \frac{\partial(\partial L/\partial S)}{\partial H} = \frac{\partial(-(L+S)/T}{\partial H} = \frac{\partial(H-T)/T}{\partial H} = \frac{1}{T} \quad (2.4)$$

$$MRS(H\ for Q) = -\frac{w}{\partial P/\partial S}\partial^2 L/\partial S\partial H = -\frac{w}{T\partial P/\partial S} = \frac{w}{P_e} \quad (2.5)$$

The previous analysis (Malakhov 2016) demonstrated the mechanism where the equilibrium price under price dispersion is equal to the lowest willingness to pay (*WTP*) of *shoppers*, consumers with zero search costs, and to the willingness to accept or to sell (*WTA*) of *searchers*, consumers with positive search costs The equilibrium price is equal to the purchase price only between shoppers. The willingness to pay wL_0 of searchers stays below the equilibrium price level. As a result, total expenses QP_p, i.e., the purchase price of a car, are less than equilibrium expenses QP_e for future mileage (Fig.2):

[2] For readers who have doubts in the idea of the quality-neutral mileage there might be some reasons to consider the trade-off between "quality of a mile" and the quantity elasticity of price discount $e_{P,Q}$. (S.M.)

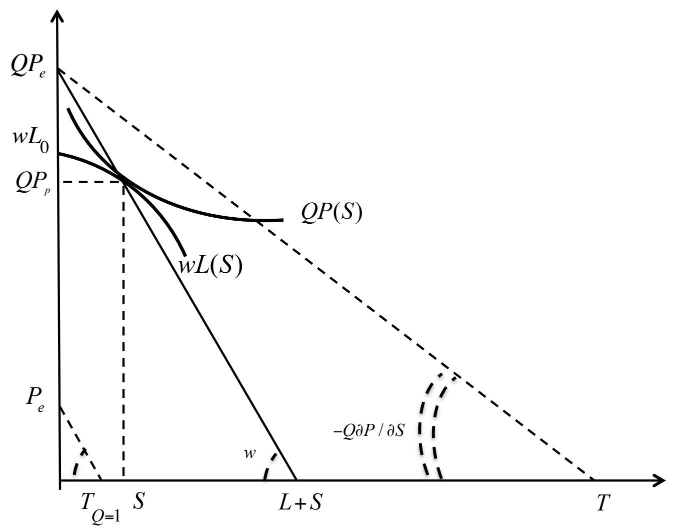

Fig.2. Equilibrium expenditures, willingness to pay for a car, purchase price, and equilibrium price of one mile.

However, while the concept of zero search costs of shoppers corresponds to the perfect equilibrium scenario, it looks unrealistic. The analysis of the equilibrium price dispersion and moral hazard (Malakhov 2016, 2017) demonstrated that when the search represents any activity that reduces purchase price and labor time, search costs under price dispersion are divided between search costs ***ex ante*** and search costs ***ex post***. The best example here is the home production where costs of preparing a meal represent *ex post* search costs. In the case of automobile market search costs $S_{ex\,post}$ represent costs of car maintenance after the purchase (wash, wax, oil, etc.). Buying a car, the consumer takes into account total costs of the ownership. As a result, the concept of shoppers with zero search costs really looks invalid. Nevertheless, shoppers really exist. If we speak about the purchase of mileage, there are consumers who are not washing cars; they are not paying for maintenance; moreover, they are not paying for gas and oil. These are taxi users. Thus, ***the equilibrium price per mile equals to price for a mile in the taxicab***.

A mile in rented car seems to be more adequate estimation of the zero-search costs-level because the option to buy or to rent a car really exists. However, there is another option – to rent a car or to get a taxicab. But if we take the price in taxi as the zero-search costs-level we should reconsider the purchase of a car as a form of home production because driving, which provides the final consumption of miles, becomes like preparing a meal. It means that under equilibrium price dispersion the costs $S_{ex\,post}$ summarize not only the cost of gasoline, maintenance, insurance, license and registration but also the cost of driving $S_{driving}$ itself.

Of course, driving can provide pleasure and sometimes it represents leisure itself. There are some dual activities like gardening and pets' care that can be classified as both leisure and home production because these activities provide direct utility but are also something one can purchase on the market. (Aguiar and Hurst 2007)

We see at Figure 1 that a consumer can optimize both choices – the purchase of a bad car and the purchase of a good car. But his individual $MRS\ (H\ for\ Q)=w/P_e=Q/(L+S)$ stays the same for both choices. It means that total time expenditures $(L+S)$ are unit elastic with respect to the mileage, or $e_{(L+S),Q}=1$. But it is not true for both leisure and the time horizon itself. The choice of a good car presumes its more intensive consumption, or $e_{H,Q}<1$. Respectively, we have $e_{T,Q}<1$. This consideration is very important. If we come back to the constraint itself (Eq.2.1), we can see that both unit elastic leisure and the time horizon, or $e_{H,Q}=1$ and $e_{T,Q}=1$ respectively, result in the constant ***propensity to search*** $\partial L/\partial S=-(L+S)/T$. But the constant propensity to search means that the key equation of the model (2.1) will be true for the choice of a good car only when marginal savings are unit elastic with respect to the mileage, or $e_{|\partial P/\partial S|,Q}=-1$. But this consideration is not reasonable. When $e_{(L+S),Q}=1$ under the constant $MRS\ (H\ for\ Q) = Q/(L+S)$, the value $e_{T,Q}<1$ gives us the increase in the absolute value of the propensity to search $|\partial L/\partial S|=|-(L+S)/T|$ with respect to the mileage. It means that the absolute value $|Q\partial P/\partial S|$ should rise. But it can take place only when $e_{|\partial P/\partial S|,Q}>-1$.

As a result, the choice between two optimums, presented at Figure 1, gets the following complete presentation of the equilibrium price dispersion (Fig.3):

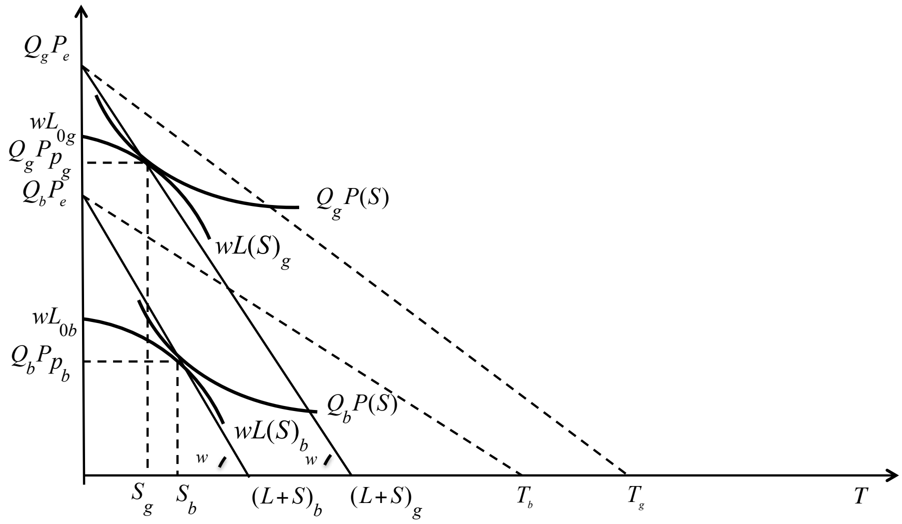

Fig.3. Optimal expenditures for good car and for bad car

Here we have the equilibrium expenditures Q_gP_e for a good car and Q_bP_e for a bad car, the corresponding purchase prices Q_gP_{Pg} and Q_bP_{Pb}, and different time horizons. When both purchases have one equilibrium price per mile P_e it means that the value ($-T\partial P/\partial S=P_e$) stays constant for both purchases, or $e_{|\partial P/\partial S|,T}= -1$. This consideration gives us the key tool for the analysis of the choice between the good car with expected great mileage and long time horizon and the bad car with limited expected mileage and short time horizon:

$$\frac{w(L+S)_g}{Q_g} = \frac{w(L+S)_b}{Q_b} = P_e \quad (3.1)$$

$$\frac{w(L+S)_g}{w(L+S)_b} = \frac{Q_g}{Q_b} \quad (3.2)$$

The idea of equilibrium expenditures of zero-search-costs' shoppers partly explains why markets do not disappear under the invasion of bad cars. Indeed, the gap between equilibrium expenditures and purchase price looks enormous but it cannot surprise us because we know about the gap in *WTP-WTA* estimations. And this gap is not empty. The market fills it not only by services of personal drivers hired with the purchase of a new car and but also by high-quality cars. It means that the gap between the equilibrium price level and the "lemons"' price level is open for a price that corresponds to the following reasoning:

$$QP_{lemon} < QP_{peach} < QP_{equilibrium} \quad (4)$$

Just here we get the answer to the question why markets do not disappear under "lemons"' invasion. Moreover, the greater gap, i.e., the lower price for a "lemon", increases entrepreneurial opportunities to fill it. However, this consideration looks theoretical and it is not enough to explain the stable demand for good cars. So, we will try to reinforce this argument by some practical reasons. But before we do it, we should come back to the original concept of the asymmetry of information now armed by the understanding of the equilibrium price dispersion.

4.Choice under odometer fraud

When we come back to the reasoning of the "theorem of lemons" we should start with very simple consideration – in this paper the concept of the equilibrium price per mile tells nothing about engines, transmissions, and air-conditioners. It works only with one tool – the odometer. Here, the asymmetry of information can be created by the fraud of busting miles. A potential buyer can be worry about incorrect number of traveled miles. Of course, he can inspect the car's conditions – to look inside the car and to find worn steering wheel and seats or to invite friends to make a detailed expertize. But this expertize has its limits. Usually, consumers calculate neither marginal values not utility itself. The process of search goes under the simple 'it's enough ' rule – "***it's enough to search***" for $S_{ex\ ante}$ search costs and "***it's enough to take care***" for $S_{ex\ post}$ search costs. A consumer makes an explicit satisficing decision that becomes implicitly optimal (Malakhov 2014, 2016). A friendly inspection might not be enough to verify the true mileage and the consumer should pay for the independent expertize. But the independent expertize has its costs. And if the consumer is not ready to pay for the expertize he could really buy a "lemon".

Let's look at the "theorem of lemons" with the optics of the equilibrium price. Under the equilibrium price dispersion the "theorem of lemons" is confined to a simple question – whether offers of good cars stays above the willingness to pay of potential buyers or not.

If there is a probability ***f*** of odometer fraud the consumer moderates his expectations about mileage and he recalculates all offers of future miles. The fair purchase price seems to him too high and expected maintenance costs with all wears-and-tears might be also very high. And the potential buyer reduces his willingness to pay. The market starts to fail. As we can see, the problems comes to very simple reasoning – the probability of odometer fraud, i.e., to the starting point of the "theorem of lemons". If fraudsters sell "lemons" at the price of good cars, the invasion of "lemons" take place and it will increase the probability ***f***. The market becomes totally marginal. If one "fair" fraudster successfully cuts 100.000 on the clock to 50.000 miles, another "unfair" fraudster take the "lemon" with 150.000 miles on the clock and cut to the same 50.000 mileage. If the odometer fraud dominates the market, the willingness to pay of potential buyers will be less than the price for a good car and owners of good cars quit the market. And "fair" fraudsters follow them. "***For it is quite possible to have the bad driving out the not-so-bad driving out the medium driving out the not-so-good driving out the good in such a sequence of events that no market exists at all***" (Akerlof 1970, p. 490). Nobody buys and nobody sells.

But the total mistrust works as the negative externality. And this externality really cuts the supply of miles. However, the decrease in supply should increase the equilibrium price. In our case this is the price per mile in taxicab. At the margin nobody buys but everybody gets taxi. But the increase in taxi price per mile should raise the demand for good cars… of taxi drivers. Moreover, it makes reasonable for potential buyers of good cars to pay expertise costs for taxi drivers. This expertise fee works like insurance. Thus, the demand for good cars is restored, now at the new price level.

Fortunately, "lemons" in general as well as odometer fraud in particular do not dominate the market. By definition, it is limited by supply of bad cars. Of course, today the odometer fraud is widespread, even when current legislation in many countries criminalizes this practice, like in United States where in 1986 the Truth in Mileage Act reinforced the Federal Odometer Act of 1972. At that time, it was easy to rollback the analog odometer devices. But modern digital odometers are also can be simply rewind. A fraudster can buy a plug-in or to come to some IT company, which reduces the mileage to whatever the customer wants. However, when the absolute figures of odometer fraud look extremely high, relative ratios are still more modest. While the total economic damage of the odometer fraud in Europe is estimated between EUR 5,6 and 9,6 billion, the share of tampered vehicles stays within 5-12% range in national sales (CECF-EU 2018).[3]

If we come back to the original paper, we see that George Akerlof takes the price as the quality-dependent variable. To sell successfully the "lemon" with 150.000 miles on the clock, the fraudster halves the mileage and offers the car at 75.000 miles with a price discount. It means that the price dispersion with regard to expected mileage appears. We can presuppose that the probability of odometer fraud is increasing with the decline of expected mileage. When we expect to drive only 30.000 miles in a bad car our unexpected costs will be higher with regard to unexpected costs of 100.000 miles' offer. But our expected costs should be exponential with regard to the expected mileage. It means, that at some expected mileage there is a minimum of total – expected and unexpected – costs. Evidently, this optimal mileage of used cars for sale stays far from the price of the new car and it can explain "***the large price difference between new cars and those which have just left the showroom***" (Akerlof, 1970, p.489).[4]

We should not forget that the search starts only when marginal costs of the search are less its marginal benefit. The probability of the fraud $f<1$ makes the search unreasonable and the owner of good

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[3] The share of odometer fraud rises to 30-50% in cross-border sales but it is explained by odometer fraud practice in Germany where "foreign consumers cross the Rhine to find the car of their dreams" and where "fraudsters are not worried" because "only the successful modification of the odometer can be considered as a fraud offence, punishable by a year imprisonment or a fine, compared to 2 years of imprisonment and 37,000 Euros under French law". (ibid, p.2).

[4] Almost new car for sale might hide some problems with engine and transmission but these problems can be presented again in the analysis like the fraud with limited mileage, short time horizon, and unexpected maintenance costs (S.M).

car should significantly cut the purchase price, i.e., the value *wL* from the point of view of a potential buyer, in order to sell it:

$$\left| -w\frac{L+S/f}{fT} \right| >> \left| fQ\frac{\partial P}{\partial S} \right| \quad (5)$$

However, this is the end of the story, which starts with unfair sales, followed by registration of odometer frauds, collection and distribution of information for potential buyers. The "theorem of lemons" needs all these feedbacks to be proved. But there is a shorter way to optimize the choice of a potential buyer.

A fraudster tries to sell a bad car for the price of a good car but he is ready to make price discounts that an owner of a good car cannot offer. If the fraudster makes an important discount $|\partial P/\partial S|$ the buyer can get great marginal savings on purchase. And when the value $|\partial P/\partial S|$ rises, it restores the equation of marginal values of search, now at the level below the equilibrium price. Here the trade-off between the purchase price *wL* and the price discount $|\partial P/\partial S|$ takes place. But it means that the "fair" fraudster needs the price level of good cars and the relative willingness to pay of potential buyers to make a discount. If there are no good cars there is nothing to compare. Moreover, the probability of appearance of "unfair" fraudsters with greater price discount rises. Other words, fraudsters should limit themselves the supply of bad cars. It means that ***offers of good cars do not quit the market and stay within the scope of the search of potential buyers***.

But under price dispersion the choice of cheap car is not evident. Facing an important price discount, the potential buyer gets the direct information about the vehicle. Here he doesn't need statistics on frauds.

Let's suppose that a potential buyer finds in Internet two offers of the same model at different prices. Of course, the low price is more attractive and it can exhibit only the wish of a seller to get rid of a car as soon as possible. However, the potential buyer can be bad-informed but he is not naïve. The unexpected low price means that the potential buyer gets for the same amount of *ex ante* search the greater discount with regard to his willingness to pay. But this unexpected discount can tell about the short lifecycle. Potential buyers do not calculate marginal values but they know that unexpected discount for beefsteak means its short shelf life (Malakhov 2014). Other words, price discounts increase the probability of odometer fraud. Here the rule of the equilibrium price works. It gives us the unit elasticity of marginal savings with regard to the time horizon, or $e_{|\partial P/\partial S|,T} = -1$. The greater absolute value of marginal savings per expected mile $|\partial P/\partial S|$ results in the shorter time horizon T because the equilibrium price P_e always is equal to the $(-T\partial P/\partial S)$ value. Sellers of "lemons" know that low price looks suspicious and they do not make great discount at initial offers. But this consideration simply states again the fact of gambling on the market of good cars with some probability to buy/to sell a "lemon". Indeed, the odometer fraud exists because the demand for good cars is stable.

5.Psychology vs. technology

If we look through the voluminous literature on automobile markets, we can find many psychological essays that challenge the model of "economic man". However, the simple mathematics of the optimal consumption-leisure choice under price dispersion makes the marginal approach more credible. The utility maximization problem constrained by marginal values of search can explain psychological phenomena more accurately than the classical income constraint.

Once that reliability was presented with regard to the paradox of little pre-purchase search for big-ticket items. While this paradox is related to the purchases of cars it is useful to re-present it here. In 1994 Grewal and Marmorstein wrote:

"Previous studies have consistently found that most consumers undertake relatively little pre-purchase search for durable goods and do even less price-comparison shopping…(when) prices of the more expensive products tend to exhibit the greatest variation across stores. Given the aforementioned evidence regarding the price variation of big-ticket items, it appears that many consumers engage in considerably less price search than is predicted by the economics-of-information theory."

Indeed, in 1979 Kapteyn et al. had demonstrated that purchase decisions concerned durables had been satisficing rather than maximizing (Kapteyn et al. 1979). R.Thaler (1987) documented that anomaly in the following manner:

"One application of marginal analysis is optimal search. Search for the lowest price should continue until the expected marginal gain equals the value of the search costs. This is likely to be violated if the context of the search influences the perception of the value of the savings. In Thaler (1980), I argued that individuals were

more likely to spend 20 minutes to save $5 on the purchase of a clock radio than to save the same amount on the purchase of a $500 television."
We can check the results of that experiment in order to show that there was no anomaly and that case did not conflict with the marginal approach.
Suppose an individual who is ready to give up 10 hours of leisure to get (i.e., to work and to search for) a big-ticket item Q_{bti} and only 2 hours of leisure to get a cheap item Q_{ci}. We can substitute the marginal $\partial P/\partial S$ value by the $\Delta P/\Delta S$ value, which is much easier for our individual to plan and to compare with the value of the wage rate w. If we take the value ΔP as the constant for both items and, when $S_0=0$; $\Delta S=S$, we have:

$$\frac{\partial P}{\partial S}=\frac{\Delta P}{\Delta S}=w\frac{\partial L}{\partial S}=w\frac{H-T}{T}=-w\frac{L+S}{T};$$
$$\Delta P=-w\frac{L_{bti}+S_{bti}}{T}\Delta S_{bti}=-w\frac{L_{ci}+S_{ci}}{T}\Delta S_{ci};\quad (6)$$
$$\Delta P=-w\frac{10}{T}\Delta S_{bti}=-w\frac{2}{T}\Delta S_{ci};$$
$$5\Delta S_{bti}=\Delta S_{ci}$$

When the individual finally makes these both purchases, he realizes that he has spent five times more on the search for the cheap item than on the search for the big-ticket item." (Malakhov 2014)

We can see here how the "***it's enough to search***" rule works. The gambling with odometer fraud also discovers some interesting psychological mechanisms that can be described by the marginal approach. For example, the ***fatal choice of a "lemon" by aggressive driver*** who likes bargaining stays close to the phenomenon of little pre-purchase search for big-ticket items.

We know from the game theory that the more risk-averse an individual is, the higher the pay-off of his opponent. We can transform this consideration into the question – who gets low price with great price discount?

Let's suppose that two buyers have the same need in mileage, but the low-risk individual expects to cover it in a long time horizon T_l, while the high-risk aggressive driver buys the same mileage for a shorter time horizon T_g. Indeed, there are two different intensities of consumption with the same total costs' value $w(L+S)$ but with different propensities to search:

$$\left|w\frac{L+S}{T_l}\right|=Q\left|\frac{\partial P}{\partial S}\right|_l \quad (7.1)$$
$$\left|w\frac{L+S}{T_g}\right|=Q\left|\frac{\partial P}{\partial S}\right|_g \quad (7.2)$$
$$T_l>T_g;|\partial P/\partial S|_g>|\partial P/\partial S|_l$$
$$w(L+S)=QP_e=QT_l\,|\partial P/\partial S|_l=QT_g\,|\partial P/\partial S|_g \quad (7.3)$$

Both buyers can optimize their purchases of the same mileage but high-risk aggressive driver needs more price discount $|\partial P/\partial S|_g$ for the shorter time horizon T_g. But, bargaining for a low price, he automatically increases the probability to buy a "lemon" with false odometer.

There is another more important psychological phenomenon, which takes place not only with the purchase of a new car but also with the purchase of a good used car. When a customer buys a used car he might be worry about future wears-and-tears with that purchase. But sometimes ***he is ready*** for unforeseen costs of maintenance or even of repair because he looks for a car of his dreams. Here we meet some ***willingness to take care of a big-ticket and/or new item***.

In 2004 R.Meyer asked 87 business students to evaluate two scenarios of cleaning the large stain on $1500 couch – to invite a professional furniture restorer for $195 or to clean the couch themselves with a mix of commercial cleansers for $30. In the case where the couch was brand-new, 62% of students preferred the expensive repair and 38% preferred the less-expensive option. But when the couch was described as being five years old, only 44% opted for the expensive repair. (Meyer 2004).

The information on car maintenance is enormously voluminous and there are many factors – brand, age, insurance – that vary over the statistical data. If we choose there the average age of vehicle fleet, which is taken as one of ***key external drivers*** for car wash and detailing services industry, we can find that «*consumers are more likely to get new vehicles professionally washed and detailed, preferring to keep their new high-value purchases in perfect condition. When the average age of the vehicle fleet declines, the composition of vehicles on the road trends towards newer cars, meaning more consumers can be expected to use the industry's services*.» (Whytcross 2015, p.5).

There are many psychological explanations of the readiness to take care of good or/and new purchases. Some of these explanations, like the endowment effect, come close to economics. But, as we can see, this phenomenon can be illustrated by the simple marginal approach. Buyers of good cars are still "economic men".

If we come back to the Equation 3.2, keeping in mind that price discount as well as price itself is quantity inelastic, or $e_{P,Q}>-1$ and $e_{|\partial P/\partial S|,Q}>-1$, we can get the visual illustration of the willingness to take care of good car. Let's take the situation when a consumer finds a good car and a bad car in the same place, i.e., when the search costs *ex ante* are equal:

$$\frac{w(L_g+S_g)}{Q_g}=\frac{w(L_g+S_{exante}+S_{g\,expost})}{Q_g}=P_e=\frac{w(L_b+S_b)}{Q_b}=\frac{w(L_b+S_{exante}+S_{b\,expost})}{Q_b}$$

$$\frac{wL_g}{Q_g}=P_{Pg}<P_{Pb}=\frac{wL_b}{Q_b};\frac{wS_{exante}}{Q_g}<\frac{wS_{exante}}{Q_b}\Rightarrow\frac{wS_{g\,expost}}{Q_g}>>\frac{wS_{b\,expost}}{Q_b} \quad (8)$$

or when the purchase price per mile for bad car, i.e., with short expected mileage, is higher than for the good car, the *ex post* search cost per mile are higher for the car with great expected mileage.

Of course, the long time horizon needs great care; at least, it needs greater maintenance costs. But here we get not only totals costs of care during the product lifecycle but costs per unit of its use where the long time horizon displays more intensive care with regard to the short time horizon.[5]

This consideration looks as the paradox from the point of view of technology. If maintenance costs are increasing exponentially with the age of the vehicle, the mean or average value wS/Q should be greater for the bad car with limited expected mileage. Even if we disregard the paradox of little pre-purchase search for big-ticket items and take the value of the search *ex ante* proportional to the expected mileage, or $wS_{ex\ ante}/Q=const$, we shall get greater *ex post* search costs per mile for a good car. The only way to explain important search costs per mile is to suppose that with the decreasing efficiency of search per mile the inverse relationship results in the increase of search costs per mile $S_{ex\ ante}$ before the purchase. But we can hardly explain the increase in search costs per mile by the intensive search *ex ante* because the time of search itself looks considerably less than the total time horizon with its all *ex post* search costs $S_{ex\ post}$.

We can also see that costs of driving itself are irrelevant here because with the same manner of driving the consumer has the same value $wS_{driving}/Q=const$ for both options.

The willingness to take care of new purchases seems to be universal psychological phenomenon. We can find it in housing, in clothing, etc. And this psychological phenomenon works because there is the unique equilibrium price under price dispersion. We see that under the long life cycle this care is not only important but it is also ***more intensive at the beginning of the use of the big-ticket item***.

The equilibrium price with the set of Equations 3 follows the car during its lifecycle. While the time horizon is decreasing with the use of the car, the purchase price of potential buyers, i.e., their labor costs per mile are rising and search cost per mile are declining.

If the owner of the good car decides in few years to sell it before the end of time horizon and if he sells it at the equilibrium price level, it will be the sale of bad car with short time horizon and lower *ex post* search costs per mile in spite of the technological increase in maintenance costs. It means that there are some *ex post* search costs, decreasing with the age of a vehicle, that stay over standard maintenance costs. This after-the-purchase care can take different forms. There could not be only cleaning and washing but also the expensive oil. And the insurance might be more expensive too.

[5] Here readers who have considered the trade-off between "quality of a mile" and the quantity elasticity of price discount $e_{P,Q}$.. and have found that the "quality of a mile" and quantity elasticity of price discount are inversely related, they can see how almost inelastic price discount decreases *ex post* search costs per mile (S.M.)

If our considerations are true and if the willingness to take care of a vehicle after the purchase exists, it should raise the attractiveness of good cars. At least, it should support the willingness to pay for them.

6.Conclusion

The illustration of the demand for good cars, presented in this paper, is based on the general price-quality relationship. But here this relationship is given with the optics of relative value of price discount, which is attached to the value of the time horizon by the rule of the equilibrium price per mile. Trying to pay attention to this rule, the present article significantly simplifies the analysis of the problem. The paper disregards some important features like advertising, insurance, market segmentation, institutions, substitutes like rail and air travels, etc. On the other hand, the article also limits the presentation of the original model by the “common model” of behavior and it overlooks the “leisure model” of behavior (Malakhov 2015, 2018) when the purchase of more horse power and excessive mileage decreases the utility and its level can be restored when consumers go to upper price niche, in our case, to the segment of prestigious cars, where they should overpay in order to increase the utility level under Veblen effect. Contrarily, the intuitive fear that purchase of prestigious car can decrease the utility produces the counter Veblen effect (Lea et al. 1987) and consumers can limit their dreams by robust choices. The purpose of this paper is the presentation of the price mechanism, relative to the time of search and care, which underlies all above-mentioned features of global car market.

6.References

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