# Willingness to take care of good cars: from the theorem of lemons to the Coase theorem

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Association Française des Sciences Économiques

2019

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# Willingness to take care of good cars: from the theorem of lemons to the Coase theorem.[1]

*The study of the marginal scenario of the theorem of lemons under the total failure of the market of used cars – nobody buys, but everybody gets taxi – shifts the analysis of the equilibrium down from the level of cars to the level of mileage, because the market of used cars stays under the pressure of options whether to buy or to lease and whether to rent a car or to get taxi. The buying of a car with regard to the demand for mileage represents the purchase of input for home production where driving like gardening and pets' care can provide a direct utility but is also something one can purchase on the market. The equilibrium price of a mile equalizes the willingness to pay of shoppers, consumers with zero search&maintenance costs, and the willingness to accept or to sell of searchers, consumers with positive search&maintenance costs. The practice to sell rights for queue jumping and illegal taxicab operations illustrate the arbitrage between shoppers' willingness to pay and searchers' willingness to accept.*

*The analysis of choice between a good high-mileage car and a bad aged low-mileage car goes beyond the traditional considerations on status purchases and describes the phenomenon of the consumers' willingness to take care of good cars. The willingness to take care increases after-the-purchase costs of ownership above the level of standard technological maintenance costs. As a result, after-the-purchase costs of ownership per mile for high-mileage cars become greater than for aged low-mileage cars. The willingness to take care of big-ticket items supports the demand and sellers of good cars do not quit the market. The willingness to take care redistributes used cars, i.e., assets for the home production of miles, for its more efficient use and cleans up the way to the Coase theorem.*

***Keywords***: *theorem of lemons, Coase theorem, equilibrium price dispersion, optimal consumption-leisure choce, willingness to take care, endowment effect*

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

## Introduction

Almost fifty years passed after George Akerlof published his famous paper "*The Market for lemons: Quality Uncertainty and the Market Mechanism*". Five years after the appearance of 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.

His verdict to markets under the asymmetry of information has become legendary:

"*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).

However, 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). It seems that real life has rejected the theorem of lemons. However, the model represents the brilliant illustration of

[1] The paper was presented at the 68th Congress of the Association Française des Sciences Économiques, Orléans, June 17-19, 2019.

Arrow's idea that "*a certain amount of lack of realism in the assumptions of a model is no argument against its value*" (Arrow 1963, p.944). Indeed, the theoretical model of the demand for used cars gave birth to the new trend in economic thought. Today we can speak about the "economics of lemons" that covers different applied fields – from education to pharmaceuticals – where the asymmetry of information significantly changes human behavior (Cooper 2007, Katz 2007).

The Akerlof model also has not yet exhausted its possibilities in microeconomics. The hypothetical question what happens with the market under the total asymmetry of information and mistrust goes beyond the field of the pure theoretical analysis and becomes crucial also for the applied economics.

The hypothetical marginal scenario of the total market failure discovers the limits to the "theorem of lemons". When the mistrust dominates the market, ***nobody buys cars***. And everybody ***takes taxi***. The price for taxi rises and it becomes reasonable for taxi drivers to buy good cars. Moreover, it also becomes rational for potential buyers of good cars to pay expertize costs for taxi drivers in order to choose a good car. Therefore, the demand for good cars is restored, now at the new price level.

However, when we take into account the price for a taxi not only at the hypothetical margin but also in everyday options - to buy or to lease a car and to rent a car or to get taxi – we should shift the focus of the analysis from the demand for cars to the ***demand for mileage***.[2]

Going down to the level of ***attributes*** (Lancaster 1966), we can say that under the basic assumptions of the Akerlof model consumers don't choose between a good car and a bad car. Their choice is concentrated on the ***expected mileage***. And they really meet there the prerequisites of the Akerlof model – the risk of the odometer fraud that motivates search; low-mileage aged bad cars and the high-mileage good cars.

### Part I. Quantity to be purchased

We can derive the Cobb-Douglass utility function $U(Q,H)=Q^{(L+S)/T}H^{H/T}$ from the allocation of the time horizon $T$ between labor ($L$) and leisure ($H$) with respect to search ($S$) for mileage in order to get the optimal trade-off between consumption of miles $Q$ and leisure $H$. Here we presuppose that search represents ***any activity, which reduces the purchase price*** and it displays both labor and leisure in the time horizon like an ice squeezes out whiskey and soda from the glass under the Archimedes' principle[3]:

$$L+S+H=T; \quad (1.1)$$

$$(-\partial L/\partial S)+(-\partial H/\partial S)=1; \quad (1.2)$$

$$dH(S)=dS\frac{\partial H}{\partial S}=-dS\frac{H}{T};\rightarrow\frac{\partial H}{\partial S}=-\frac{H}{T}; \quad (1.3)$$

$$\frac{\partial L}{\partial S}=\frac{H-T}{T}=-\frac{L+S}{T} \quad (1.4)$$

$$\frac{L+S}{T}+\frac{H}{T}=1 \quad (1.5)$$

The optimal trade-off between consumption of miles $Q$ and leisure $H$ can be constrained by the equation of the marginal values of search, based on the famous Sigler's equation (Stigler 1961). If we substitute units of search in this equation by the time of search $S$ itself we can get the constraint for the utility function that represents the equality of marginal monetary values of search:

[2] The problem of the measureability of goods has the same long story as the measurability of the utility itself. For example, Euguen Slytsky in his notes on utility stated definitely that goods could be measured either by commercial units or units of consumption (Slutsky 2010).

[3] Both $\partial l/\partial S<0;\partial H/\partial S<0$ values appear in the "common model" of behavior, presented here. The analysis of the "leisure model" of behavior ($\partial L/\partial S<-1;\partial H/\partial S>0$), which produces Veblen effect $\partial Q/\partial H>0;\partial Q/\partial P>0$ (Malakhov 2015), stays beyond the scope of this paper (S.M.)

$$max\,U(Q,H)\ subject\ to\ w\frac{\partial L}{\partial S}=-w\frac{L+S}{T}=Q\frac{\partial P}{\partial S}\quad(2.1)$$

$$\Lambda=U(Q,H)+\lambda\left(w-\partial P/\partial S\frac{Q}{\partial L/\partial S}\right)\quad(2.2)$$

$$\frac{\partial U}{\partial Q}=\lambda\frac{\partial P/\partial S}{\partial L/\partial S}\quad(2.3)$$

$$\frac{\partial U}{\partial H}=-\lambda Q\frac{\partial P/\partial S}{(\partial L/\partial S)^2}\partial^2 L/\partial S\partial H=-\lambda\frac{w}{\partial L/\partial S}\partial^2 L/\partial S\partial H\quad(2.4)$$

$$MRS(HforQ)=-\frac{\partial Q}{\partial H}=\frac{Q}{H}\frac{(-\partial H/\partial S)}{(-\partial L/\partial S)}=\frac{Q}{H}\frac{H/T}{(L+S)/T}=\frac{Q}{L+S}\quad(2.5)$$

where $w$ is the wage rate; the value $\partial P/\partial S<0$ measures marginal savings on price per mile under the search *given* by the offer in the car shop; and the value $\partial L/\partial S<0$, ***the propensity to search***, represents monetary marginal costs of the search.[4]

As the result, when the search is efficient, the choice between bad car $Q_b$ and good car $Q_g$ can be presented as following (Fig. 1):

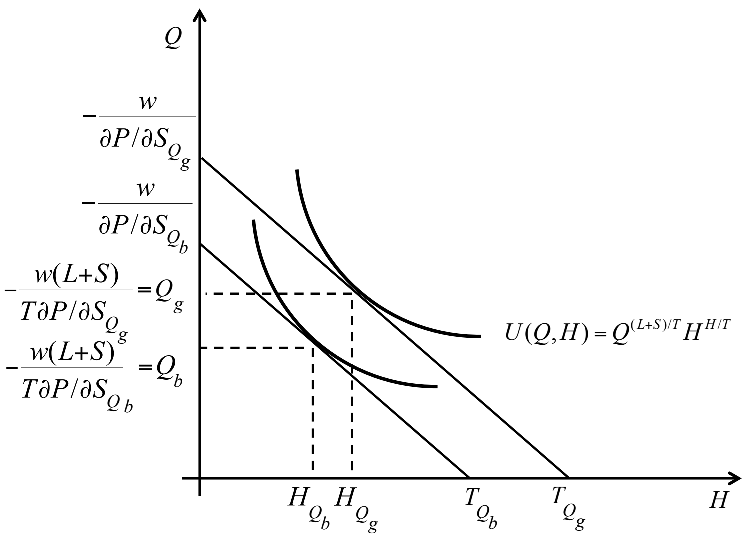


***Figure 1. Optimal choices for bad car and for good car.***

Here we can see that the aged bad car offers low mileage $Q_b$ and the good car $Q_g$ offers high mileage. 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 $\partial^2P/\partial S^2>0$, 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 car with regard to the expected mileage, he offers the discount on the $QP$ value. In our example this discount is equal to the value $Q\partial P/\partial S$. And in the case of greater discount on a good car we have $|Q_g\partial P/\partial S_{Qg}|>|Q_b\partial P/\partial S_{Qb}|$.

[4] The marginal utilities of consumption and leisure, presented in relative values, are equal at the equilibrium to the classical relationships $MU_Q=\lambda P$ and $MU_H=\lambda w$, presented in absolute values due to the change of the value of Lagrangian, which in this model is equal to the marginal utility of wage rate, or $\lambda=MU_w$(Malakhov 2018).

But on imperfect market the demand for high mileage should cut the price per future mile. 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, in spite of $|Q_g\partial P/\partial S_{Qg}|>|Q_b\partial P/\partial S_{Qb}|$, ***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.

We see at Figure 1 that under efficient search a consumer can optimize both choices with regard to his need in mileage – the purchase of a bad car and the purchase of a good car. But his individual marginal rate of substitution between consumption and leisure $MRS\ (H\ for\ Q)=Q/(L+S)$ – tastes and preferences - stays the same for both choices.

**Part II. Equilibrium price of one mile.**

However, the everyday shopping passes by the optimization problem. Here the quantity demanded $Q$ becomes the constant value and the price reduction $\partial P/\partial S$ becomes the variable value. Consumers determine quantities to be purchased, as G.Stigler proposed in the original equation, and they compare prices under price dispersion. But the analysis of the utility function with regard to its constraint gives us a possibility to transform the ***implicit*** optimization problem $(Q_{varible};H_{variable};w_{const};\partial P/\partial S_{const})$ into the ***explicit*** consumer choice $(Q_{const};H_{variable};w_{const};\partial P/\partial S_{variable})$. As a result, at the equilibrium the behavioral explicit choice matches the optimal implicit solution.

The transformation of the budget constraint (Equation 2.1.) gives us the concept of the equilibrium price under price dispersion:

$$w\frac{\partial L}{\partial S}=w\frac{H-T}{T}-w\frac{L+S}{T}=Q\frac{\partial P}{\partial S} \quad (3.1)$$

$$w(L+S)=-QT\frac{\partial P}{\partial S}=QP_e \quad (3.2)$$

*because*

$$MRS(H\ for Q)=\frac{\partial U/\partial H}{\partial U/\partial Q}=-\frac{w}{\partial P/\partial S}\partial^2 L/\partial S\partial H \quad (3.3)$$

$$\partial^2 L/\partial S\partial H=\frac{\partial(\partial L/\partial S)}{\partial H}=\frac{\partial(-(L+S)/T)}{\partial H}=\frac{\partial(H-T)/T}{\partial H}=\frac{1}{T} \quad (3.4)$$

$$MRS(H\ for Q)=-\frac{w}{\partial P/\partial S}\partial^2 L/\partial S\partial H=-\frac{w}{T\partial P/\partial S}=\frac{w}{P_e} \quad (3.5)$$

We see that the marginal rate of substitution between consumption and leisure doesn't depend on the purchase price. The purchase price is different for low-mileage car and high-mileage car. But when the consumer chooses between two cars he has the same trade-off between consumption and leisure for both options. This is equilibrium price of one mile that is equal for both options and makes the choice reliable.[5]

If we present the set of equations (3) in the graphical form, we get the following picture (Fig.2):

[5] It is easy to demonstrate that from the point of view of home production the equation $P_e=w(L+S)/Q=\partial w(L+S)/\partial Q$ is true, or the equilibrium price is equal to average and marginal costs of home production.

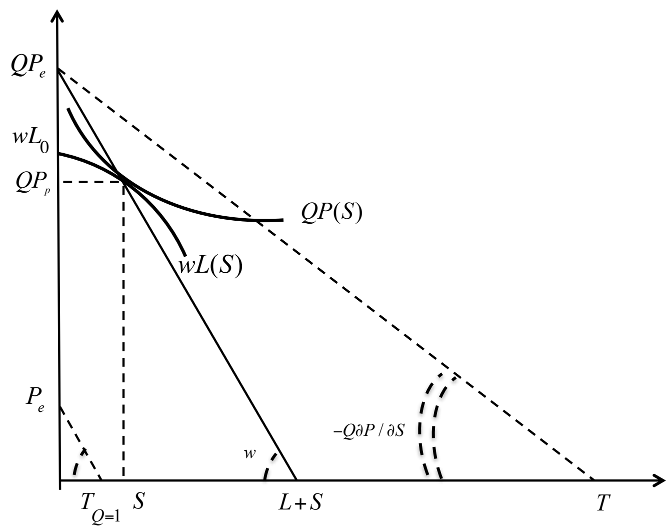


***Figure 2. Equilibrium price dispersion for the quantity demanded.***

Here we have the equilibrium price of a mile $P_e$, the equilibrium expenditures on the quantity demanded $QP_e$, the willingness to pay $wL_0$, and the purchase price for the quantity demanded $QP_p$. The shape of the expenditures' curve $QP(S)$ is given by the assumption of the diminishing efficiency of search, or $\partial^2 P/\partial S^2>0$, and the shape of the monetary costs' curve $wL(S)$ is derived from the Equation 2.1 as $\partial^2 L/\partial S^2<0$.

This picture immediately discovers the consumers' heterogeneity. Indeed, there are consumers with zero search costs and consumers with positive search costs (Stahl 1989). Consumers with zero search costs, i.e., *shoppers*, are ready to pay $QP_e$. Indeed, *"the price in the high-price stores is the reservation price of shoppers with high willingness to pay, not their maximum willingness to pay for the good."* (Diamond 1987, p.434). But consumers with positive search costs, i.e., *searchers*, are ready to pay only $wL_0$ and they finally spend $QP_p$.

The equilibrium price mechanism works as following. If the consumer decides to stop the search on the suboptimal level, he doesn't equalize marginal costs of search with its marginal benefit. The absolute value of marginal loss is less than the marginal gain, or

$$\left|w\frac{\partial L}{\partial S}\right| < \left|Q\frac{\partial P}{\partial S}\right| \quad (4.1)$$

$$w(L+S) < QP_e \quad (4.2)$$

The suboptimal purchase results in the low value of total costs of purchase with regard to the equilibrium price expenditures. It means that the searcher can re-sell the bought item to the shopper (Fig.3).

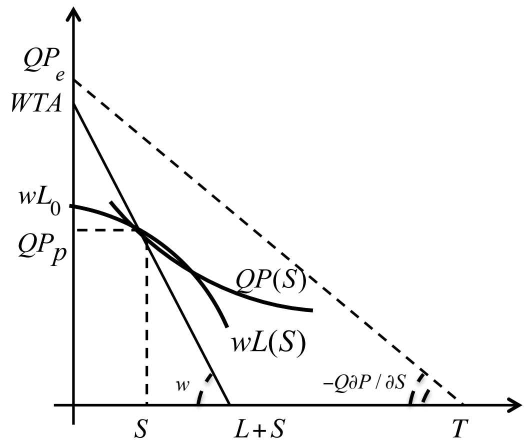


***Figure 3. Suboptimal purchase***

If he does it, he immediately switches on the mechanism of Walrasian arbitrage that shifts the equilibrium price down until it cleans up suboptimal purchases from the market. ***The market is in the equilibrium when searchers make optimal purchases and their willingness to accept or to sell (WTA) is equal to the willingness to pay (WTP) of shoppers.***

Although the resale practice is regulated, the Walrasian arbitrage finds its way because producers are looking for shoppers. *"When there are enough customers with high willingness to pay, we have the emergence of stores specializing in selling to them."* (Diamond, op.cit.)

Aircraft companies sell fast track services in different ways in order to provide shoppers with the right to cut the line. Amusement parks have also started selling the right to jump the queue.

And searchers also follow this practice. The line-standing business where searchers sell the right to jump the queue to shoppers has emerged in different areas – from entertainment industry to medical services.[6]

Coming back to the market of mileage, we can easily discover signals of the Walrasian arbitrage. Illegal taxicabs, sometimes known as pirate taxi or *gypsy cabs* are widespread not only in developing, but also, in spite of strict regulations, in developed countries.[7] Illegal drivers are selling miles to impatient consumers.

But in order to sell a mile for a shopper, the searcher should fill his car with gas and oil and – to drive. He becomes a producer with his car as a major input. The same thing happens in the household. The family buys a car in order not to pay the price for a mile in taxi. Other words, ***driving become a specific form of home production***. A family faces the traditional option – ***to buy*** a mile in taxi, ***or to produce*** it at home. And while this activity reduces the purchase price, here the price of a mile in the taxi, driving takes the form of the search after the purchase. Indeed, we can buy the steak in the shop and make a meal – either to consume it, or to sell. It means that home production itself becomes a specific form of the search that decreases the equilibrium price of the steak in the restaurant. The search costs are divided with regard to the purchase between *ex ante* search costs and *ex post* search costs.

The notion of *ex post* search costs looks invalid but gets sense when we remember that we are buying not a car, but expected miles. And from the point of view of consumption cycle these *ex post* costs with regard to the moment of purchase become preparatory *ax ante* costs – washing, fueling – now with regard to the moment of following consumption of miles. However,

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[6] Readers can find the brilliant overview of this practice in "What Money Can't Buy", written by Michael J.Sandel *Excerpt*, 2012 (http://discourseinprogress.com/what-money-cant-buy/)

[7] "Les taxis clandestins, plaie des aéroports parisiens" (Le Parisien, le 21 novembre 2018).

in order not to put all these costs in the same bundle we use in the static model the notion of *ex post* search costs.

And we can re-write the Equation 3.2 in the following form:

$$WTA_{searcher} = WTP_{shopper} \quad (5.1)$$

$$w(L + S_{ex\,ante} + S_{ex\,post}) = QP_e \quad (5.2)$$

But the mile demanded by the shopper is the mile in taxicab where he bears neither *ex ante*, nor *ex post* search costs. Thus, the equilibrium price for the market, either for lemons, or for new cars is the price for a mile in taxicab.

While the equilibrium price for a mile is unique for these markets, the equilibrium expenditures are not. The market establishes different equilibria for expenditures with regard to the expected mileage. But the expenditures on expected miles are equal to the price of a car. It means that on the surface we get ***two-price equilibrium*** for good cars and bad cars.[8]

As a result, the choice between two optimums, presented at Figure 1, gets the following complete presentation of the equilibrium price dispersion (Fig.4):

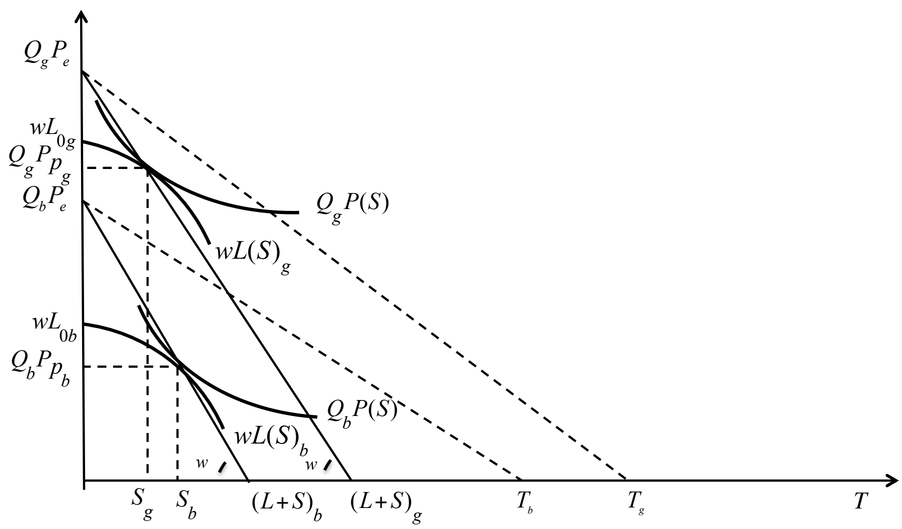


***Figure 4. Optimal expenditures for good car and for bad car***

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. While equilibrium expenditures on the mileage represent the equilibrium price of the car itself, we see that ***under efficient search the automobile market is fragmented by the two-price equilibrium***.

But we should keep in mind that when total expenses on purchase of a bad car are less than for a good car the purchase price for a mile in good car is less that the purchase price for a mile in a bad car. ***The decrease in expected mileage raises the purchase price for a mile in a bad car till the options to buy or to lease and to rent or to take taxi become reliable***.

**Part III. Pleasurable search**

We see, that the willingness to pay for the expected mileage $wL_0$ is equal to the willingness to pay for the car as well as the purchase piece of the expected mileage $QP_P$ is equal to the price of this car. It is not the same with the equilibrium price. The willingness to accept or

[8] The reporting format of this paper limits the review of the voluminous literature on price dispersion, which can be found in "Information, Search, and Price Dispersion" (Baye et al. 2006).

to sell $QP_e$ is equal not to the willingness to sell the car, but to the willingness to sell expected mileage that covers all costs of the mileage to be sold. The willingness to sell the mileage gives us the possibility to analyze the structure of these costs.

If we take driving as a form of home production we accept it as the dual activity. 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). The last consideration is true for driving, because we can buy miles on the market.

We see that the driving not only reduces transportation expenditures of the family with regard to taxi but it can also provide pleasure. Here, the pleasure and savings are not competitive goals. But they really become competitive, when the search becomes tedious and it cuts the time of leisure enjoyment.

It seems that all these considerations needs the introduction of search as well as opportunity costs of money into the utility function. However, this way increases significantly the set of assumptions that result in cumbersome calculations, which immediately appeal to Alfred Marshall, who told once, "*when a great many symbols have to be used, they become very laborious to any one but the writer himself*" (Marshall 1920[1890], p.12). The static analysis of choice between the good car and the bad car provides enough tools to describe the pleasure of search as well the role of the opportunity costs of money, i.e., the interest rate.

We can presuppose that the opportunity costs of money affect the initial choice of expected mileage. When the interest rate is high, the consumer chooses the cheap bad car. When the interest rate falls, the consumer can buy the good expensive car. What happens here with the allocation of time? The Equations (3.1; 3.2) are true for both choices. It means that the increase in the expected mileage $Q$ raises not only the total costs $w(L+S)$ but the absolute value of the propensity to search $|\partial L/\partial S|=|-(L+S)/T|$. The greater expected mileage needs the greater time horizon. But according to the Equation (1.5) the share of leisure time in this new time horizon $H/T$ will be less than for the low expected mileage.

The Equation (1.3) tells us that the share of leisure time exhibits the trade-off between leisure and search, or $H/T= - \partial H/\partial S$. It means that the increase in expected mileage changes the leisure-search trade-off.

On the other hand, the constant $MRS\ (H\ for\ Q) = w/P_e=Q/(L+S)$ gives an idea that total non-leisure time $(L+S)$ should rise at the same rate with the expected mileage $Q$. But we know that the purchase price of a mile falls with the increase in the expected mileage. It means that the price of a car $QP_P=wL$ rises slowly, or $\partial wL/\partial Q>0$ but $\partial^2 wL/\partial Q^2<0$ and $\partial^2 L/\partial Q^2 <0$. And in order to keep the value of $MRS\ (H\ for\ Q)$ constant we should increase the time of search faster, or $\partial^2 S/\partial Q^2 >0$. These considerations discover the re-allocation of time under increase in mileage.

The increase in the expected mileage takes place when opportunity costs of money, i.e., marginal utility of real balances, are low. In addition, the increase in the expected mileage cuts the marginal utility of a mile. But under the constant $MRS\ (H\ for\ Q)$ it means, that the marginal utility of leisure also falls. Indeed, while the share of leisure in the time horizon falls with increase in the expected mileage, the amount of leisure time rises. We can expect that ***the marginal utility of leisure follows the marginal utility of real balances***. At the margins, for low expected mileage under high opportunity costs of money the search cuts significantly labor and keeps leisure almost untouched and for the great mileage under low opportunity costs of money the search substitutes primarily leisure time, keeping here labor time almost untouched.

The traditional consumption-leisure optics can tell us that this phenomenon takes place because low mileage complements leisure, while high mileage substitutes it. But this way needs the re-consideration of the constant $MRS\ (H\ for\ Q)$ that could be true with the constant equilibrium price $P_e$ only with the change in the wage rate $w$ that makes senseless the initial problem of the choice between a good car and a bad car. Nevertheless, the idea of complementarity/substitutability finds its way, here with regard to the search. Low-mileage choice tells us that search and leisure are complements, while for a good car the search starts to substitute leisure. ***The search becomes pleasurable***.

It might become pleasurable even before the purchase. The idea to buy a good car can make pleasurable the journey across the Rhine, like looking at windows in the downtown makes evening promenades more pleasurable.

And it keeps its pleasure after the purchase. By the driving the consumer makes efforts to derive utility from the mileage, like by the lawn mowing he makes efforts to derive utility from the garden. Both activities might be pleasurable.

But if the driving of a good car is pleasurable, it substitutes primarily leisure time, keeping labor time almost untouched. It means that the purchase price of high-mileage good car doesn't fall significantly with regard to the initial $WTP=wL_0$, or $wL=QP_P \approx wL_0$. ***The possibility to substitute leisure by driving, i.e., search ex post, reduces bargain efforts with regard to the high willingness to pay for high-expected-mileage car***.

On the other hand, we can expect tough bargaining for the purchase of the low-mileage bad car because there the search is the real necessity that cut primarily labor time. This conclusion looks like a paradox. And it was really described like the paradox of little pre-purchase search for big-ticket items (Grewal and Marmorstein 1994), which illustrated the satisficing approach to the purchase of durables (Kapteyn at al. 1979). In addition, R.Thaler presented that paradox like an anomaly:

*"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 \$25 clock radio than to save the same amount on the purchase of a \$500 television."* (Thaler 1987, pp.110-111).

This so-called "anomaly" was explained once by the simple mathematics of the model of search, presented here (Malakhov 2015). Here we get an additional confirmation of the validity of the marginal approach to the analysis of search. But the effect of pleasurable search in the choice of a car is not limited by driving. It increases the general readiness of customers to bear after-purchase costs and results in ***the willingness to take care*** of good big-ticket items.

**Part IV. Willingness to take care**

The re-allocation of time under increase in expected mileage discovers the asymmetry of labor and search costs per mile.

$$\frac{w(L_g + S_{g\,exante} + S_{g\,expost})}{Q_g} = P_e = \frac{w(L_b + S_{b\,exante} + S_{b\,expost})}{Q_b} \quad (6.1)$$

$$\frac{wL_g}{Q_g} = P_{Pg} < P_{Pb} = \frac{wL_b}{Q_b} \Rightarrow \frac{w(S_{g\,exante} + S_{g\,expost})}{Q_g} > \frac{w(S_{b\,exante} + S_{b\,expost})}{Q_g} \quad (6.2)$$

We see that search costs per mile in the good car $Q_g$ are greater than in the bad car $Q_b$. If we follow the conclusion that the cheap car takes more pre-purchase search than the expensive car, we get *ex post* search costs per mile in the good car much greater than in the bad car. Moreover, if we omit the assumption of the asymmetry of the pre-purchase search and take it proportional to the expected mileage, we get *ex post* search cost per mile still greater for the good car:

$$\frac{wS_{g\,exante}}{Q_g} < \frac{wS_{b\,exante}}{Q_b} \Rightarrow \frac{wS_{g\,expost}}{Q_g} >> \frac{wS_{b\,expost}}{Q_g} \quad (7.1)$$

$$\frac{wS_{g\,exante}}{Q_g} = \frac{wS_{b\,exante}}{Q_b} \Rightarrow \frac{wS_{g\,expost}}{Q_g} > \frac{wS_{b\,expost}}{Q_g} \quad (7.1)$$

One of the possible explanations of this asymmetry is the change in the manner of driving. We can presuppose that the driving in the good car is more careful and it needs more attention and more efforts. But it is not enough to explain the asymmetry of *ex post* search costs per mile. It is well known that old car with limited expected mileage needs more technological maintenance. Other words, technological maintenance costs rise exponentially with the age of a car (Lapasinskaite and Boguslauskas 2005). If it is true, it means that after-purchase costs per mile, mean or average, should be greater for the bad car.

The opposite effect presumes that there some other *ex post* costs above technological maintenance costs. And we can derive them very illustratively, if we take total expected after-purchase costs, divide them by the expected mileage and get the $wS_{ex\,post}(Q)$ function. Then we deduct technological maintenance costs $MC(Q)$ and find very specific costs that we can describe as the costs of the ***willingness to take care*** of good car $WTC(Q)$ (Figure 5):

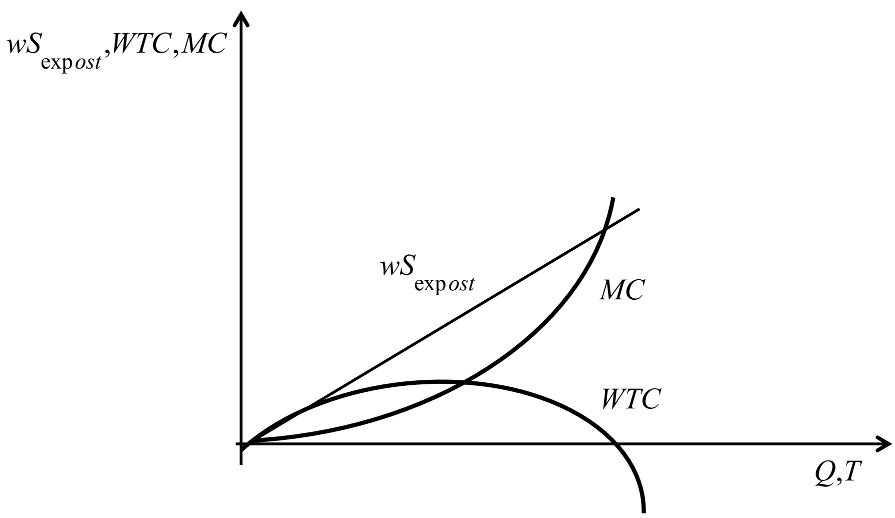


***Figure 5. The costs of the willingness to take care***

We see that at the beginning of the product lifecycle the costs of willingness to take care exceed the costs of technological maintenance. But once these costs become negative. It happens when we stop to think about clean shoes when we get into the car and we stop to drive slowly before the *relantisseurs*. Other words, the willingness to take care becomes negative, when we begin to use the car carelessly that increases costs of technological maintenance.

Mathematically, the *WTC* doesn't appear when pre-purchase costs for a good car are disproportionally high. But this assumption doesn't look plausible with regard to the product lifecycle, when time of use by definition is significantly greater than the time of search.

The phenomenon of the willingness to take care seems to be universal for durables, especially in housing, where new furniture is cleaning frequently. Of course, it needs more profound both psychological and economic analysis. But even here it is evident that the willingness to take care is tied with the pleasurable search, i.e., dual activity of home production that can be also treated as leisure. The pleasurable search works like a vehicle for the willingness to take care. And when the pleasurable search decreases primarily leisure, leaving labor almost untouched, or $QP_P=wL\approx wL_0=WTP$, we can say that ***the willingness to take care supports the willingness to pay***.

However, the *WTC* makes a part of the total *wS* costs that create the difference between the willingness to pay and the willingness to accept or to sell. Here we come to the problem of the *WTP-WTA* gap. While the literature on this subject is very voluminous, we concentrate the analysis on the particular optics of ***the endowment effect*** because the model presented here challenges this concept of the prospect theory. Here we see that the *WTP-WTA* gap is produced by search costs. The idea of the endowment effect is based on the specific utility function of the prospect theory, where individuals evaluate their gains and losses asymmetrically (Kahneman and Tversky 1979). The experimental trading of tokens and Cornell coffee mugs discovered the important difference between the willingness to pay and the willingness to sell. According to the theoretical conclusion, that disparity had been produced by the endowment effect, or the feeling of possession (Kahneman et al. 1990). The idea of the willingness to take care flourishes on the same ground. While the experimental tests of *WTP-WTA* gap pretended to refute the theorem of Coase, we proceed to the study of the willingness to take with regard to this theorem and introduce into the analysis of the choice between two cars the externality of the dust and the externality of the odometer fraud.

## Part V. The willingness to take care under the theorem of Coase

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).

Washing and cleaning represent the willingness of consumers to take care of their cars with regard to the externality of dust. Buying a good car, we are ready to keep it clean just at the moment of purchase. But washing and cleaning are common in the presale preparation. And this fact tells us that the willingness to take care contributes to the negotiation between seller and buyer.

The problem of odometer fraud is more sophisticated but it serves like a good illustration for the theorem of lemons.

In March 2018 *le Centre des Consommateurs*, published the review "Car-Pass or how to be sure of a vehicle's mileage":

*"According to the European Parliament "studies estimate the share of tampered vehicles between 5 % and 12 % of used cars in national sales and between 30 % and 50 % in cross-border sales, accumulating to a total economic damage between EUR 5,6 and 9,6 billion in the whole Union." The manipulation of mileage meters is widespread for example in Germany where it affects more than 1 out of every 3 vehicles and causes approx. 6 billion euros worth of damage per year. This practice in Germany is especially harmful to the many foreign consumers who cross the Rhine to find the car of their dreams."*

Buying a good car, we can ask the seller all documentation on technological maintenance in order to confirm the state of the vehicle. Here the problem of *WTC* appears. These costs are not documented. The seller could pass the relentisseurs slowly to prevent the damage of shock absorbers. But the fact that shock absorbers have not been replaced for years can produce the opposite effect and the buyer can deduct the costs of shock absorbers' replacement from the purchase price. If he doesn't, an economist tells that here the positive externality of trust works (Arrow 1985). But we think that the solution lies much deeper. The consumer is neither naïve, nor blind. But, being fascinated by the car of his dreams, ***the buyer is ready to bear costs of the externality of hidden defects like he is ready to bear costs of the externality of the dust***. Of course, everything has its price and the willingness to take is not unlimited. But the answer of the seller to question about the state of shock absorbers – if you brake before the relentisseurs, they will serve another couple of years – satisfies the buyer not only because he trusts in it, but because seller's answer just corresponds to his idea how he will take care of the car and how he will drive it.

This simple reasoning challenges the following conclusion of the prospect theory:

"*According to the Coase theorem, the allocation of resources to individuals who can bargain and transact at no cost should be independent of initial property rights. However, if the marginal rate of substitution between one good and another is affected by endowment, then the individual who is assigned the property right to a good will be more likely to retain it."* (Kahneman et al. op.cit., pp.1339-1340).

Here the authors express doubts in the so-called "***invariance hypothesis***" of the theorem of Coase (Medema and Zerba 2000, *Encyclopedia of Law&Economics*, p.838). But we can see that at any moment of its lifecycle ***the equilibrium price of a car is equal to its expected mileage times the equilibrium price of a mile in taxi, or*** $QP_e$. It means that for the expected mileage the equilibrium price of the traded car stays the same whether it is sold or not. Thus, the final allocation of resources is invariant under alternative assignment of property rights. The market keeps the expected mileage in any way.

The *WTA* of expected mileage is a good starting point to understand the reservation price of the seller. It corresponds to the actual state of the car, carefully used before. The sale redistributes expected costs of driving and maintenance to the new customer. The problem appears with *WTC* costs, which are individual. That's why the best moment to sell happens when *WTC* costs of the car's owner like transaction costs in the standard Coasean analysis ***become equal to zero***. Here, the seller, who doesn't calculate theoretical marginal values, but who knows perfectly his car, behaves ***as if*** he subtracts from the equilibrium price predictable driving and necessary maintenance costs and gets his reservation price. Here, the problem of the *ex ante MC* technological costs appears, because the seller wants to recover it. But ***it doesn't mean that he is sunk-costs' sensitive***. While the trade-off between the *ex ante WTC* and *ex post MC* technological costs always exists, the important *ex ante WTC* costs reduce *ex post MC* technological costs, and the reservation price as the value, net form driving and maintenance costs, will be higher. And when a potential buyer has positive *WTC*, his enthusiasm to cut labor costs, i.e., the purchase price $wL=QP_P$, will be limited by the pleasurable search, and $wL=QP_P \approx wL_0=WTP$.

The "as if" assumption works also against the odometer fraud. The important discount, proposed often by unfair sellers, with regard to the willingness to pay for a good car usually creates doubts in the real state of the car and its lifecycle. If the consumer rejects this advantageous offer, he behaves ***as if he is rational*** because under the unique equilibrium price $P_e=-T\partial P/\partial S$ the greater absolute value of the price reduction per mile $|\partial P/\partial S|$ means the short time horizon $T$. Like all assumptions of this kind, here the "as if" hypothesis also hasn't the absolute power, but it diminishes significantly the negative effect of the odometer fraud.

But if there is no odometer fraud, i.e., ***if standard Coasean transaction costs are equal to zero***, the new owner of the car, if he starts to sell the mileage, adds to the purchase price expected costs of driving, care, and maintenance in order to get his willingness to sell, which again will be equal to the equilibrium price $QP_e$. Here we don't suppose that tastes and preferences of the buyer and seller are identical. But, as we can see, a trade-off between purchase price, costs of driving, care and maintenance with regard to habits, i.e., driving manner usually exists. Paying less, the new mileage's seller, or the taxi driver will bear more *WTC* costs, for example, to make the cab more comfortable in order to stay competitive and to sell the mileage to *shoppers*.

We see that on the theoretical basis the analysis presented here confirms the theorem of Coase. If the seller has zero *WTC* costs and the buy has positive *WTC* costs, the asset, here the good car, is redistributed for its more efficient use, regardless how initial property rights have been assigned, as it is stated by the ***"efficiency hypothesis"*** of the theorem of Coase (Medema and Zerba 2000, op.cit). Moreover, this is the *WTC* phenomenon, which enables the efficiency of the transaction.

The sale of the bad car, when the search, i.e., driving, looses its pleasure and the *WTC* becomes negative, illustrates the other side of the problem and explains also the results of the experimental tests of the endowment effect. Usually the tough bargaining concentrates on the technological maintenance costs, incurred by the seller, i.e., $wS_{ex\ ante}$ costs, which are included by the buyer in his willingness to sell the car. When coffee mugs didn't presume the pleasurable search, the buyers cut their willingness to pay, like it happens with bad cars. And the *WTP-WTA* gap appears, here due to the reluctance to buy.

The reluctance to sell also might be explained by the search model, presented here. According to the model, the willingness to accept is equal to the willingness to pay only between *shoppers*, i.e., consumers with zero search costs. And the participants in the experiments were *searchers*. Although the costs of transactions in those experiments had been artificially eliminated, ***the search costs, here, the costs of decision-making, stayed positive.*** When the milkman appears at the door unexpectedly, the hostess should decide whether to accept his price or to go the store. The authors of those experiments discovered partly that problem, when they analyzed not only the reluctance to sell, but also the reluctance to buy. However, the upgrade of the experiment with Cornell coffee mugs by the option to keep the mug and take it home, had not facilitated the decision but made it more difficult, because it enlarged the optics of possible outcomes. The decision-making to buy or not to buy a big-ticket item can take days and weeks. The coffee mugs are not big-ticket items, but it doesn't mean that the decision efforts, even the answers to the questions – is it a need a want, can we wait, is it an impulse buy, will we actually use it, if somebody were to give us cash, will we take that instead - i.e., their *ex ante* search costs are equal to zero. While the *ex post* costs in those experiments could be taken as zero search costs, the costs of decision-making could not.

This interpretation of the *WTP-WTA* gap corresponds to the results of the other experimental trading with coffee mugs, which challenged the *WTP-WTA* disparity (Plott and Zeiler 2005). Moreover, "*the comparative experiments demonstrate that WTP-WTA gaps are indeed sensitive to experimental procedures. By implementing different procedures, the phenomenon can be turned on and of.*" (Plott and Zeiler, op.cit., p.542). In general, "*a review of the literature reveals that WTP-WTA gaps are nor reliably observed across experimental designs*", and if it appears, it might be explained, "*that responses in experiments reflect* ***a type of internal search process*** *in which subjects use paid practice rounds along with trial and error to "discover" what their preferences are.*" (op.cit., p.543).

**Conclusion**

The paper presents a study of the marginal scenario of the theorem of lemons when the hypothetical market failure takes place and nobody buys cars but everybody gets taxi. This marginal scenario opens the way for the analysis of the demand for mileage. This analysis discovers the psycho-economical need of consumers to take care of big-ticket items, here the cars with high expected mileage, after the purchase. ***The willingness to take care supports the demand for good cars and enables the redistribution of used cars for its more efficient use.***

The paper doesn't enlarge the analysis of the asymmetry of information and it uses here only the framework of the theorem of lemons. Nevertheless, the idea of zero willingness to take care can contribute to the understanding of the phenomenon of moral hazard.

However, the hypothesis of the existence of the willingness to take care needs its verification otherwise than by field studies. If economists and psychologists accept this hypothesis, they should take care of the methodology of field studies, especially of the experimental design in order not to get the desired confusion.

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