The Computer Generation's Willingness to Pay for Originals when Pirates are Present – A CV study

By Håkan J. Holm*

Abstract: A contingent valuation method is applied to study subjects' willingness to pay for originals when illegal copies are freely available. The subjects consisted of 234 Swedish undergraduate students from the "computer generation". Only 2% of the "normal" (and 0% of the "elite") students were willing to pay the retail price for the original. However, the majority was prepared to pay a non-negligible amount for the original. Demand curves and profit maximizing behaviors are analyzed. The price elasticity of piracy indicates that piracy is insensitive to price cuts. The results have implications for the calculation of damages of piracy.

Keywords: Piracy, Contingent Valuation, Damages, Software.

JEL: K40, K43, L2, D40, Z10.

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1 Introduction

Although, the global software piracy rate has dropped significantly the last couple of years the total loss due to piracy has never been greater.[1] The industry's explanations to the drop in piracy rates include; i) increased presence of legal sales globally, ii) increased software support iii) price cuts in legal software iv) actions to promote legal purchases and to enforce laws on intellectual property rights.[2] The explanation to the increase in total loss despite the drop in piracy rates is the rapid increase in software consumption around the world. Hence, whereas the software industry has been partially successful in its war against piracy, one can conclude that it is an ongoing battle whose importance in terms of dollar value is growing.

A number of theoretical papers have explored various economic mechanisms and effects involved in piracy. From an economic perspective piracy may increase or decrease social welfare. On the one hand piracy may undermine the supply of originals, since software developers may be underpaid. On the other hand copying reduces monopoly prices and increases the quantity supplied. Liebowitz (1985) has shown that the relative market sizes of copies and originals, the substitutability between copies and originals and the copying technology all affect the social welfare effects of copying, which may be positive. Novas and Walkman (1984) and also Johnson (1985) recognize that if not producers of originals are protected against unlimited copying underproduction may result with negative consequences for social welfare. The conclusion from these studies may seem inconsistent, but Besen and Kirby (1989) show that the differences in directions can partially be explained by different assumptions regarding the extent to which property rights owners can appropriate the value placed on the originals by all users (i.e., including those who make the copies).

[1] According to the "1999 Global Software Piracy Report" (by the Business Software Alliance and Software & Information Industry Association) more than every third program used in 1999 was an illegal copy. The software industry's loss due to piracy is estimated in the report to $12 billions.
[2] See BSA and SIIA (1999).

More recently, additional mechanisms and effects of piracy have been analyzed. It is well known that network externalities may affect the demand of many goods that are subject to copying. Hence, copying can cause positive externalities and increase demand and profits for the firm that sells the original (see Conner and Rumelt, 1991; and Takeyama, 1994). Furthermore, copying makes social sharing of information goods easy, which also can increase the willingness to pay for these goods (see Bakos, 1999). On the negative side, expectations of a future illegal market for copies may also create expectations of future price cuts on the original. Takeyama (1994) shows that such expectations may cause immediate reductions in demand and profit for the seller of the original.

Although, there have been theoretical efforts to understand the economic consequences of illegal copying activities, it is difficult to find studies that empirically estimate the parameters judged to be important in markets exposed to piracy.[3] The purpose of this paper is to measure the willingness to pay for originals when illegal copies are available. The reason for doing this is that such a study will provide information about the degree to which consumers consider copies to be substitutes for originals, which is important in models that analyze the effects of copying.[4] Furthermore, estimations of the willingness to pay for originals have a potential practical value in the assessment of proper damage payments in trials against pirates. Despite, that studies of this type ought to be valuable we have not found any other studies of this kind in the economics literature. A purpose of the present study is to provide an example of a method that can be applied to empirical analyses of the economics of piracy.

A major problem with studies of this type is that the behavior under consideration (i.e., piracy) is an illegal activity, which means that no official market data are

[3] A few studies of piracy behavior and attitudes towards piracy are available (see e.g., Gopal and Sanders, 1997, and Cheng et al. 1997). These studies apply a somewhat different methodology and pose different questions than the present paper.
[4] See e.g., Liebowitz (1985) and Besen and Kirby (1989).

available for copies. To circumvent this problem we applied a contingent valuation (CV) method to study the additional willingness to pay for an original. Given this method we also had to choose a group that we wanted to study. We conjectured young people to be more advanced in their computer habits and in their attitudes towards piracy and therefore more interesting to study, partly because it is an important consumer group and partly because the attitudes of this group may tell us something about future consumer behavior.[5] A selected group of 330 Swedish undergraduate students filled in a CV questionnaire. From this selection two subgroups consisting of 234 students were selected for this study. One group (social science undergraduates) is considered to be representative for university undergraduates in Sweden and the other group (computer engineering undergraduates) belongs to the "elite" in terms of computer skills in their age group.

The outline of the paper is as follow. In section 2 we will give a brief theoretical interpretation of the data that are generated from the study. The method is presented in section 3, where we also discuss the CV – method. The results are presented in section 4 and finally some conclusions are presented in section 5.

2 Theory

In this section we will provide a brief theoretical background for our study. In the presentation we use the same notations and the same basic set up as Besen and Kirby (1989).

[5] From an international perspective young Swedes ought to be especially interesting, since Sweden is ranked among the top countries when different nations' relative progress in information technology adoption is measured and compared.

Let $V_o(x)$ and $V_c(x)$ denote the values placed by consumer *x* on an original and a copy respectively. If we by P_O and *r* denote the price of the original and the copy respectively, the consumer will buy an original if:[6]

$$V_o(x) - V_c(x) \geq P_o - r \qquad (1)$$

Now, in our study we let the subjects evaluate prices on originals that make them indifferent between copies and originals. Hence, each subject *x* is asked to evaluate their individual $P_O^*(x)$ such that $V_o(x) - V_c(x) = P_o^*(x) - r$. In the contingency we describe to the subjects an illegal copy is assumed to be available for free, which means that $r = 0$. As a consequence, $P_O^*(x)$ can then be interpreted as how much more subject *x* values the original in comparison to the copy.[7] The distribution of this additional willingness to pay for originals (AWTPO) will be important for the firms ability to generate profits in legal markets, where parallel markets for copies are present. This also means that the AWTPO may be decisive in a firm's or an industry's strategy against piracy. If the AWTPO is high, the price cuts necessary to drive out a significant number of pirates from the market may be small, which means that price cuts can be an efficient method to cope with piracy. On the other hand if the AWTPO is low other strategies like, say lobbying for more effective measures of protection of intellectual property rights, may be more profitable for the industry.

[6] We assume here that $V_o(x) - P_o \geq 0$.

[7] See the CV-question in Section 3.

3 Method

3.1 Design of the Study

This study applies a contingent valuation (CV) methodology, which means that subjects are asked to make a statement or a choice in a specific hypothetical situation. The question posed to the subjects was as follows:[8]

"Assume that your friend has a computer program that is priced in retail stores at SEK X and that you are very anxious to get. Assume also that you are offered to copy your friend's program for free. What is the maximum amount you would be willing to pay for the program in a retail store under these circumstances.

I would be willing to pay SEK _____."

To study the effect of different retail prices one group of subject received $X = 1000$ and one group got $X = 3000$.

The recruited university undergraduates can be divided into three groups with respect to their education programs. The first group that we denote as "social scientists" was recruited from the School of Economics and Management at Lund University. The other two groups were recruited from the Lund Institute of Technology (LIT). The first group of technology students consisted of computer engineering students and the second group followed a more "normal" program with respect to computers (environmental engineering). In this study we have excluded the last group from LIT, since this group was smaller and added little information to the present study.

Our ambition was to study the AWTPO among young students that deserve to be referred to as "the computer generation". Consequently, we excluded students over 25

years old.[9] We also excluded those that did not completely fill in their age and the AWTPO. We excluded 14% of the social science students and 8% of the computer-engineering students on the basis of these criteria.

The selection was governed by the desire to study subjects that can be expected to be advanced in terms of computer use and Internet habits. The reason for this is that although piracy is widespread already its full consequences are envisioned in the future when most households have computers and access to Internet. With this perspective in mind, it may be more interesting to study groups that are ahead than groups that are normal or even lag behind. In addition to this the group recruited constitute an important consumer group, which is interesting to study on its own right.

The selected subject groups are not representative in several aspects. First of all, from an international perspective Sweden is usually ranked as being one of the top countries when it comes to information technology with e.g., a high proportion of the population with Internet access.[10] Secondly, the subjects are young and consist of university students, a group with higher socioeconomic status and background than the average Swede at the same age. The group of social science students can be considered representative for university students in Sweden. The computer engineering students have chosen a technically demanding 4 years education focused on computer science and engineering. One can expect these students to be especially motivated, interested and talented when it comes to computers. Hence, this group is recruited from the "computer elite" in their age group and is clearly not representative for any larger group.

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[8] The question is translated from Swedish.

[9] The reason for choosing this age was not entirely arbitrary. It is reasonable to relate the age of the subjects to the development and diffusion of the computer technology in a study like this. A milestone in this process was IBM's introduction of the PC in 1981. After that computers became more and more common outside office. Assuming that the subjects started School at the normal age of seven (in Sweden), then none of our subjects had begun in School at the time the PC was introduced. The computer engineering students were on average one year old and the social science students where three years old in 1981.

[10] According to the IDC/World Times Information Society Index Sweden ranked first both in 1999 and 2000.

To minimize drop out rates the study was designed to limit the inconvenience for the subjects to participate in the study. The subjects were approached in connection to lectures and each subject received a questionnaire in the classroom directly after a lecture. After a brief information about the purpose of the study, the subjects were asked to fill in their questionnaires, which took about 5 minutes for most of the subjects.[11] The subjects were explicitly informed that the study was voluntary and that they were assured anonymity. The drop out rate was below 5% percent in each group.

3.2 The CV method

The CV-method is a commonly used method in a number of branches of economics to study willingness to pay for goods and contingencies for which markets do not exist.[12] For instance, in public economics the difficulty of assigning a value to a collective good has made environmental economists use CV studies to analyze the public's valuation of recreational areas, species threatened by exemption etc. Also health economics have used CV-studies to estimate the value of health and new treatments. However, the methodology has been criticized by several researchers. For instance, Diamond and Hausmann (1994) argue that since CV studies typically include so many sources to bias that are not controlled for, "contingent valuation surveys do not measure the preferences they attempt to measure" (Diamond and Hausmann, 1994, p 46).

In many cases we think that the critique of the CV-method is motivated. However, when alternative research strategies are lacking it can be argued that the

[11] In addition to the CV question the questionnaire also contained questions about age, sex, income, attitudes towards piracy etc. The results from these data will be presented in a separate study.
[12] By 1994 over 1600 papers and studies where reported to have employed the CV method. Institutions outside academia that used the CV -method included the Worldbank and governments agencies around the world. See Hahnemann (1994) for references.

information obtained from CV studies is clearly better than no information at all.[13] Furthermore, we think that the willingness to pay question used in this study has some advantages compared to many questions used in other studies. First of all, the question we use is cognitively simple. It does not involve complicated descriptions about probabilities that are common in other CV-studies.[14] Secondly, our good is not an abstract collective good for which there never has existed a market, but (in legal terms) a private and specific good (a computer program) for which there exist parallel markets.[15] Hence, one can expect that quite a number of the subjects have experienced real situations that are rather similar to the contingency described in the question. This is likely to help the subjects to make balanced evaluations.

4 Results

4. 1 The Demand for Originals

In this section we make two observation about AWTPO data from the group of social science students. The first observation relates to the willingness to pay the full retail price for an original.

Observation 1: Only 2 % of the social science students are willing to pay the retail price if a copy is freely available.[16]

[13] See Hahnemann (1994) for a defense of the CV-method.
[14] It is well known from psychology that subjects make simple mistakes in probability reasoning. See e.g., Kahneman and Tversky (1974) and Antonides (1991, chapter 13). It shall also be noted that worries that CV respondents do not correctly grasp the situation described to them are recurring in the guidelines suggested by the NOAA - panel to improve the CV-method. (See Portney (1994).
[15] Both legal and illegal markets may exist.
[16] Two subjects out of 93 that received a retail price of SEK 1000 and one subject out of 48 that received a retail price of SEK 3000 stated that they were willing to pay at most SEK 1000 and SEK 3000, respectively for the legal copy. None of the computer engineering students stated that they were willing to pay the full retail price.

It should be noted that the situation refers to a contingency where the subjects are supposed to be "very anxious" to get the program. This means that lack of interest in the product can be ruled out as explanation for the low fraction willing to pay the full price. Observation 1 clearly confirms what we already expected; the young generation will not shop in retail stores if a copy is available. What might be startling is the degree to which the subjects are unwilling to pay the retail price. After all, the copying activity is unlawful.

Does this mean that there is no demand at all for originals when a piratical edition of a program is available? Observation 2 clearly demonstrates that this is not the case.

Observation 2: Only 31% (17%) of the social science students have an AWTPO that is less than SEK 100 for the original with the retail price of SEK 1000 (SEK 3000).

Observation 1 and 2 clearly demonstrate that almost everybody in the computer generation consider piratical editions as an option, it also demonstrates that there is a demand for originals even if illegal copies are freely available. Basically, this means that there is a potential pricing option available to the firms. In order to analyze this option the distribution of AWTPO among the subjects must be studied. Since it can be assumed that each subjects is only interested in one unit of the good, we can construct a demand curve for originals by ordering the AWTPO observations in a descending order at the *x*-axis. Thus, for each price *y* (or AWTPO level) the value at the *x*-axis gives the number of subjects that have stated an AWTPO that is the same or higher than *y*. This can be interpreted as the quantity that can be sold at each price.

(Figure 1.)

We can see in Figure 1 that the demand curve is steep in the beginning, which is due to the fact that most subjects stated relatively low AWTPO values. By studying the data behind Figure 1 one finds that only 13% of the subjects are prepared to pay 50% of the retail price and about one third (32%) are prepared to pay 30% of it. The shape of the demand curve is similar (but even steeper) in the contingency the retail price was SEK 3000, which is evident in Figure 2.

(Figure 2)

4.2 Differences Based on Skill

One purpose with this research was to study if computer skills affected the subjects' AWTPO. The average AWTPO of social science students were SEK 215 for the SEK 1000 program and SEK 485 for the SEK 3000 program. The corresponding figures for the computer-engineering students were SEK 181 and SEK 273. This indicate differences between the groups in that the more computer oriented subjects were on average willing to pay 84% of the average AWTPO of the normal group for the less expensive original. The corresponding figure is 56% for the expensive program. Hence it seems that the skill affects AWTPO for originals the higher the retail price for the original is.[17]

In Figure 3 we present the demand for originals priced at SEK 3000 for both groups of students. It should be clear that demand is lower for computer engineering students. However, the differences do not seem to be one of form or character but of magnitude; the vast majority of subjects in both groups display a positive but small AWTPO.

(Figure 3)

We can thus make the following observation:

Observation 3: Subjects that are more computer skilled have on average a lower AWTPO than subjects that are less computer skilled. Furthermore, this difference seems to increase with the retail price of the original.

4.3 Optimal Pricing

Let us for the moment assume that the intellectual property owner can price discriminate so that he can target a price cut towards groups like the computer generation (with access to illegal copies) without any repercussions in other market segments.[18] In such a case the owner should act like a monopolist in order to maximize profits. Below we will analyze profit maximizing quantity and price levels for a monopolist that faces a demand curve of the one we obtained from the AWTPO data.

A common feature of digital information production is low constant marginal costs. However, the marginal costs differ depending how the product is packaged. Marginal costs is likely to be close to zero if the product can be downloaded by users from the Internet, but it can be non-negligible if the product is sold as package with manuals etc.

[17] A statistical analysis confirms this conclusion; whereas a two-sided t–test does not reject (p=0.208) that the subjects groups is drawn from the same population when the retail price is SEK 1000, the same test allows us to reject the same null-hypothesis at a significant level (i.e., p=0.02) when the retail price is SEK 3000.

[18] Although, one can imagine some strategy based on product differentiation it is hard to understand how an owner accomplish this in reality. Incentive compatibility constraints are likely to necessitate price changes on other markets. We shall briefly return to this issue in our last section.

The optimal pricing problem is summarized in Table 1, where the optimal prices can be obtained for different marginal cost levels.[19] If the marginal cost is 0 the optimal price is only 20% of the retail price (SEK 200). In this case 52% of the market is supplied with a legal copy, which means that piracy can be reduced by about 50% at monopoly prices in this case. However, the optimal price (and hence piracy levels) rises sharply for higher marginal cost levels; at a marginal cost of SEK 100 the optimal price is SEK 300 and if marginal cost increases to SEK 200 the optimal price is SEK 500. At a price of SEK 500, only 14% would by the legal copy.

(Table 1.)

Let us now summarize this exercise. If the studied subject group can be isolated and exposed to a specific pricing policy, the following observation can be made:

Observation 4: If the marginal cost were zero optimal pricing would lead the firm to cut prices by 80%. Even if such a price cut were made almost 50% of the computer generation subjects would still get an illegal copy. If marginal cost is one fifth of the original retail price (i.e., SEK 200) optimal pricing lead the firm to cut prices by 50%. If this price cut were made 86% of the subjects would still get an illegal copy.

4.4 The Price Elasticity of Piracy

To analyze how efficient price cuts are to reduce piracy rates more elaborately we suggest a measure denoted as the "price elasticity of piracy". This elasticity is defined as the

[19] In this analysis we use the demand curve for an original with a retail price of SEK 1000, when the subject group is social scientists. The demand curve is displayed in Figure 1.

proportional change in piracy rates divided by the proportional change in prices. If we compute the arc elasticity (for SEK 100 changes in prices) we get the figures that are presented in Table 2.

(Table 2)

By inspection of Table 2 it should be clear that the price elasticity of piracy is low indeed in most price intervals. This suggests that piracy activities are in general insensitive to price changes and that moderate price cuts only have small effect on piracy rates.

4.5 Estimating the Damages from Piracy

If some additional assumptions are made the AWTPO has some interesting interpretations for how much a seller of an original can be said to loose on a piratical edition of a certain size. To estimate this is important for, e.g., courts that need to make decisions on compensation for damage.

Let us assume that the AWTPO(x) is an individual constant for which $V_o(x) - V_c(x) = AWTPO(x)$ holds for various prices on copies r. This means that the highest possible price that the subject would be willing to pay for an original would be $P_O^*(x) = AWTPO(x) + r.$ From this equation a hypothetical demand schedule could be constructed from data like the one obtained in Figures 1-3. By calculating an optimal price and by multiplying this by the number of copies sold by the pirate we get an estimate of an upper bound on what the seller would be able to earn if he chooses an optimal pricing policy

towards the group that has bought the copies. Hence, we would get a generous estimation of the loss that the pirate incurs to the producer of the original.[20] In some cases compensation claims for damages are based on the number of copies sold times the retail price. At least for this subject group, such a retail price based procedure would dramatically overestimate damages. For instance, if the SEK 1000 program is sold on an illegal market at SEK 200, then according to our data each copy sold to the computer generation should not be valued above SEK 500.[21]

5 Conclusions

By using the contingent valuation method this paper evaluate the computer generation's additional willingness to pay for an original (AWTPO) when a copy is freely available. On the one hand the results indicate that copies and originals are not perfect substitutes. The majority of subjects are prepared to pay more than SEK 100 for an original in this situation. On the other hand, very few subjects are prepared to pay the retail price for the original even if they are asked to imagine themselves to be "very anxious" to get the program.

From the subjects' answers a demand schedule for the original is obtained. By analyzing the profit maximizing prices it is clear that dramatic price cuts would follow if a firm could isolate the subject group and target a price policy directly towards groups that usually have access to copies. Our results also have implications for the firms' and authorities' anti piracy strategies. The price elasticity of piracy indicates that the piracy rate is quite insensitive to price cuts for most price intervals. This suggests that moderate price cuts are likely to be a rather inefficient method to fight piracy in the computer generation.

[20] This requires, of course, that the AWTPO schedules are obtained from a group that can be considered representative for the buyers of the illegal copies.

It should be mentioned that our estimations rest on a partial analysis that focuses on estimating the willingness to pay for an original in a specific situation. From earlier theoretical studies we know that a lot of other mechanisms are involved when the effects of piracy are analyzed. These mechanisms have to be taken into account when general conclusions are made. However, it should be noted that it is likely that one of our main conclusions may be reinforced when other mechanisms are taken into account. We have found that although a pricing option exists, price cuts would hardly delimit piracy to a larger extent and the extra revenues earned from groups inclined to piracy would be low due to very low optimal prices. If we take into account incentive compatibility constraints from other market segments with higher prices and time consistency constraints (see Takeyama, 1994) then these mechanisms would make the price cuts even less profitable.

[21] Needless, to say the producer's marginal costs should be subtracted when indemnity is calculated.

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Tables

Price	Q	Profit (MC=0)	Profit (MC=100)	Profit (MC=200)
0	93	0		
100	71	7100	0	
200	48	9600*	4800	0
300	30	9000	6000*	3000
400	17	6400	4800	3200
500	13	6500	5200	4100*
600	4	2400	2000	1600
700	3	2100	1800	1500
800	2	1600	1400	1200
900	2	1800	1600	1000
1000	2	2000	1800	1600

Table 1: Profit levels at different prices and marginal costs. (Optimal profit levels are starred.)

Price	Q	% change in Prices	Piracy Rate (%)	Elasticity of Piracy
0	93	200	0	1
100	71	66.7	24	1
200	48	40.0	48	0,86
300	30	28.6	68	0.65
400	17	22.2	82	0.21
500	13	18.2	86	0,60
600	4	15,4	96	0.07
700	3	13.3	97	0.08
800	2	11.8	98	-
900	2	10.5	98	-
1000	2	-	98	-

Table 2: Price elasticity of Piracy at different price levels.

Figures (fig 1-3)

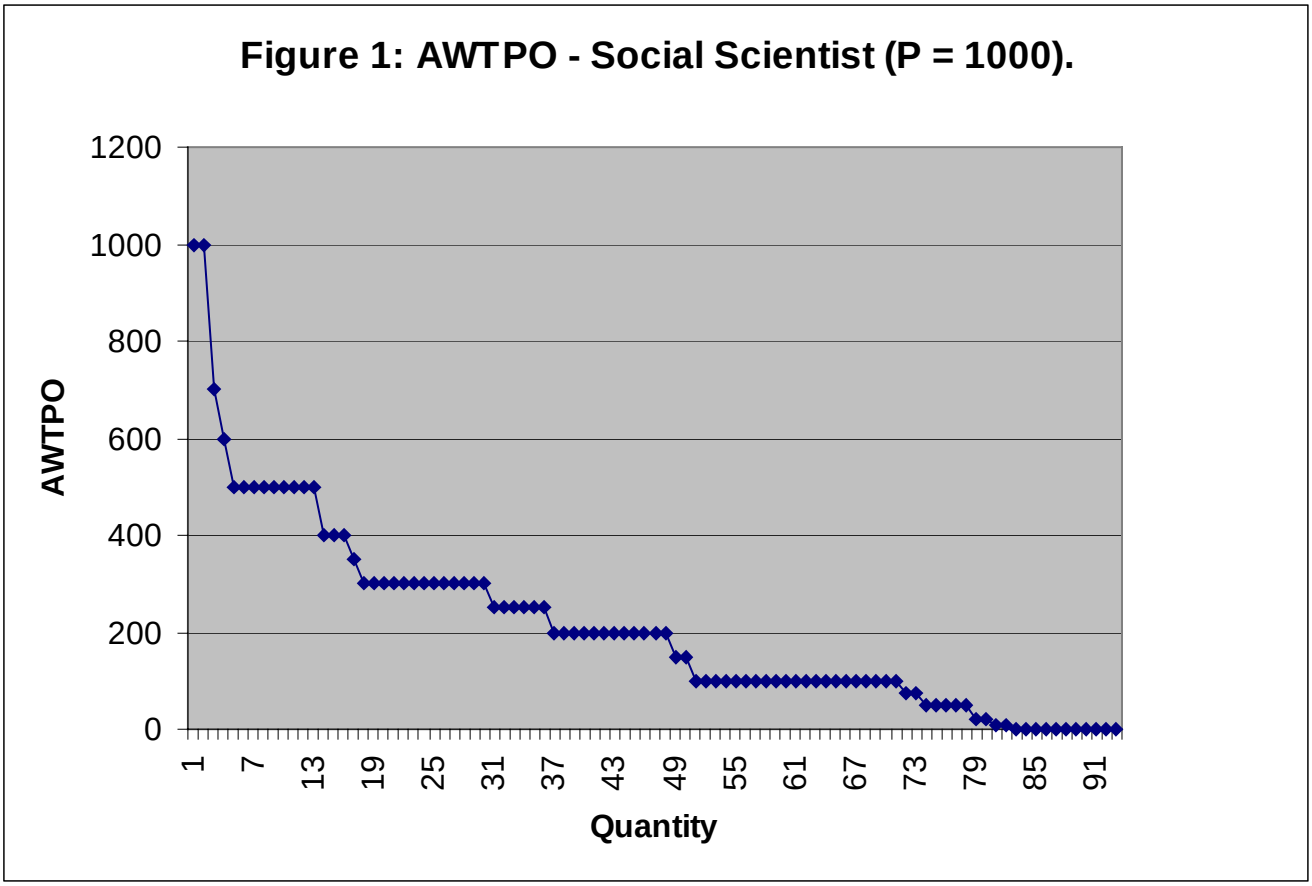

Figure 1. The cumulative distribution of AWTPO among social science students when the retail price was SEK 1000.

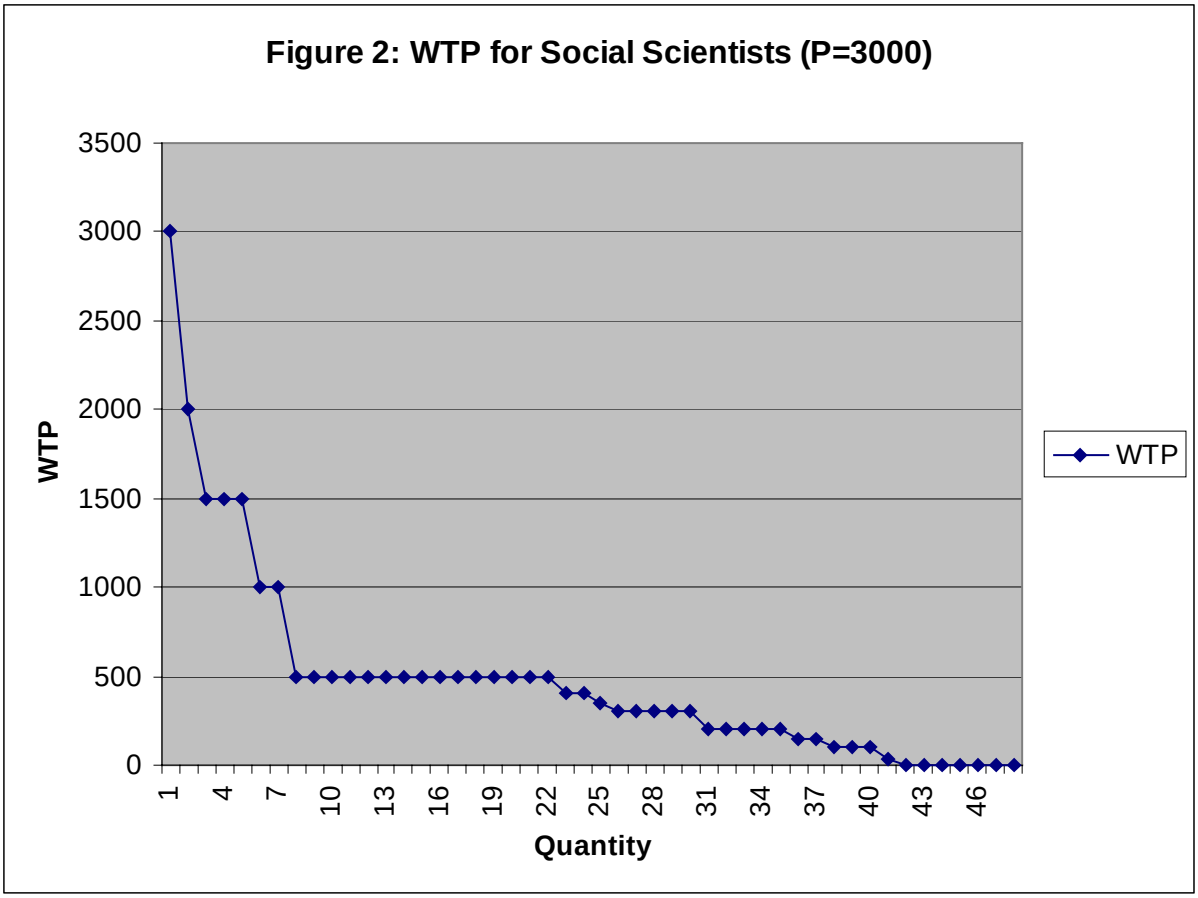

Figure 2. The cumulative distribution of AWTPO among social science students when the retail price was SEK 3000.

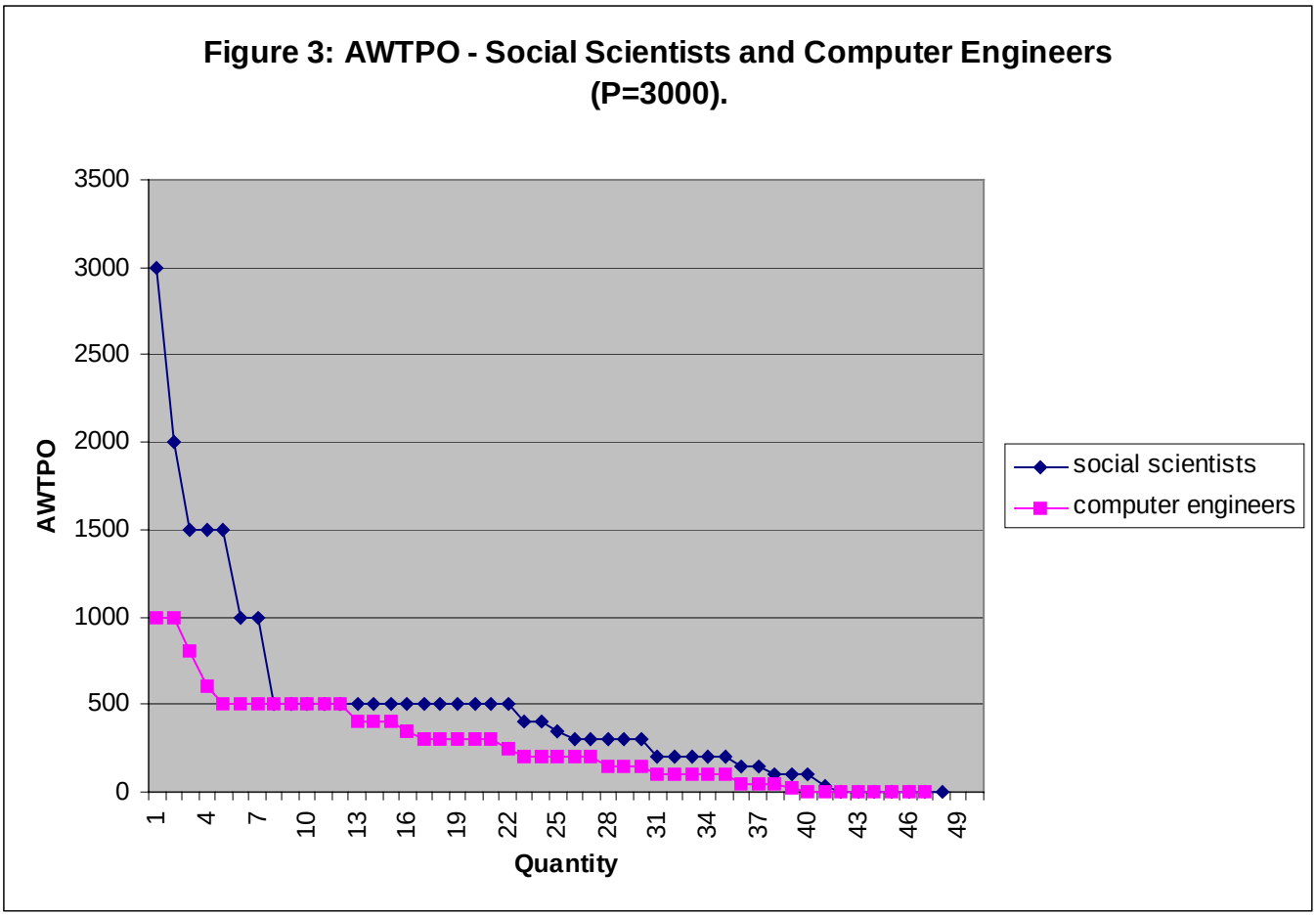

Figure 3. The cumulative distribution of AWTPO among social science and computer-engineering students when the retail price was SEK 3000.