Asymmetric Information: Theory and Applications

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Abstract

This paper discusses asymmetric information theory as presented in economics literature. We present the theory's implications for market behavior and the market institutions that are created to mitigate the adverse effects implied by the theory. Furthermore, we present some applications of the theory found in the literature and propose a new application of the theory.

KEYWORDS: Asymmetric information, signaling, screening

Contents

1 Introduction

Why are brand goods popular? Why does a McDonald's make more sales than a local competitor next door? Why do some people prefer to buy used cars from a used car salesman rather than from an individual? Of two job applicants with similar skills, why does the one with higher qualification get the job? All of the above, brands, used car salesmen, degrees and qualifications are examples of market institutions set in place to level information asymmetries.

It is empirically clear that people possess different information. The information they possess affects their behavior in many situations. Consider buying goods, for example, the seller adjusts the price of an item based on her knowledge of the prices of similar items on the market and the condition of the item among other factors. The buyer similarly can have information about the prices of similar items in the market. But what he probably does not have is the same depth of information about the quality of the item as its seller. There is clearly an information asymmetry between the two parties at issue.

The concept of information asymmetry was able to explain many common phenomena that could not be otherwise explained when it was first introduced in the early 1970s. Since then it has become a valuable tool in the field of economics and it is used to explain a diverse set of phenomena. Its significance was established well before the year 2001 when the original authors of the theory, George Akerlof, Michael Spence and Joseph

Stiglitz received the Nobel prize in Economic Sciences[1].

The purpose of this paper is to give the reader a good overview of the asymmetric information theory and its significance to economics research. We will discuss the theory and its applications based on economics literature.

The research problem set for this study can be characterized as follows:

- First of all we aim to study and explain the theory of asymmetric information and to study its implications. This includes explaining the key concepts of the theory and also finding out the strengths and weaknesses of the theory.
- Secondly, we want to find out some useful applications of the theory. We also want to see how well the theory holds in these instances.
- Lastly we will try to find some new applications where the theory could be utilized

The study will be conducted in the form of a literature review. Any empirical validation of the theories presented is out of the scope of this paper. We have also limited ourselves mostly to the field of economics. We will not try to find analogies from other fields of study[2]. This limitation to economics follows naturally as the theory was first introduced in that context and, although it has also been applied to other fields of study, there are more than enough subject material to discuss the theory in this field.

[1] Or more accurately the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel

[2] Natural sciences might prove an interesting field for evaluation

The intended audience for the paper is mostly students wishing to familiarize themselves with the concepts discussed. Other interested parties could include practitioners wanting to understand the theory of their markets better. However, as this is a review of literature and an introduction to the theory, the paper is not directly aimed at academic audiences familiar with the subject.

The rest of the paper is organized as follows. Section 2 outlines the key concepts of the theory. In section 3 we study the literature on the field for applications of the theory. In section 4 we then evaluate the strengths and weaknesses evident in the theory. In section 5 we briefly discuss the context of the theory in the form of other theories. Lastly, in sections 6 and 7 we draw our conclusions and lay some directions for further research.

2 Key Concepts of the Theory

In this section we outline the asymmetric information theory in more detail. We review the defining literature on the subject area, beginning with the ground-laying works of the Nobelists George A. Akerlof, Michael Spence and Joseph Stiglitz[3]. In this discussion we will lay out the key concepts of the asymmetric information theory.

The name asymmetric information theory is used throughout the paper to refer to the multi-disciplinary body of research based on the ideas presented in the Nobelists' papers.

[3]His 1976 paper is co-authored with Michael Rothschild

Papers considering the set of problems discussed here often also refer to the theory as the theory of *imperfect information*.

2.1 Akerlof 1970: Asymmetric Information, Adverse Selection, Counteracting Institutions

The concept of asymmetric information was first introduced in George A. Akerlof's 1970 paper *The Market for "Lemons": Quality Uncertainty and the Market Mechanism*[2]. In the paper, Akerlof develops asymmetric information with the example case of automobile market. His basic argument is that in many markets the buyer uses some market statistic to measure the value of a class of goods. Thus the buyer sees the average of the whole market while the seller has more intimate knowledge of a specific item. Akerlof argues that this *information asymmetry* gives the seller an incentive to sell goods of less than the average market quality. The average quality of goods in the market will then reduce as will the market size. Such differences in social and private returns can be mitigated by a number of different market institutions[4].[2]

Akerlof begins by assuming a model of the automobiles market where there are four kinds of cars; new cars and old cars, which both can be good or bad (the bad cars are commonly known as "lemons"). When buying a car there is a probability q that it is a

[4]These market institutions include brand names, guarantees, use of agents and learning from experience [6].

good car and a probability *1-q* that it will be a lemon. This is true for both new and old cars.

After owning the car for some time the owner acquires more information about the condition of the car and can assign a new probability to the event of the car being a lemon. As this probability can be assumed to be more accurate than the initial *q*, an information asymmetry between the owner and potential buyers has developed. The price of good cars and lemons stay the same as the potential buyers cannot tell them apart. Akerlof further argues that the price of a new car must be higher than an old car, because otherwise it would be possible to sell a lemon with the price of a new car and buy a new car with the lower probability *q* of it being a lemon. It must thus be that the owner of a car that is good and old is locked in his position. He cannot get the real valuation of his car from the market, because his car is better than the market average. He also cannot change to a new car because he cannot receive the price of a new car for his old car. This leads to the conclusion that most cars that are traded are lemons. Akerlof notes a similarity between this model where bad cars drive out the good cars and Gresham's law, but notes that in the cars model this situation is due to asymmetric information[5]. The process of the worse individuals (cars) starting to dominate the market is called *adverse selection*.

Akerlof then continues with a utility theoretic approach to calculating the size of the

[5]Sir Thomas Gresham lived in the sixteenth century. His famous law states that "bad coinage drives out good". This means that when coins are made of two metals, but still have the same face value, the one whose value as metal is less than its face value is spend first. Furthermore, if the value of the remaining coins is more as metal, they are not spent at all.

automobile market under asymmetric information. The result is that in the end no goods are traded at any price. He then modifies the model to reflect symmetric information and shows that transactions will now take place and that there is gain of utility to all parties over the asymmetric information situation.

The asymmetricity of information between parties in a market can be reduced through intermediary market institutions called *counteracting institutions*. A good example of such an institution is guarantees for goods. A guarantee allows the buyer sufficient time to reach the same level of information about the good as the seller before the buyer assumes full risk of the good being a lemon. Brand-names, chains and franchising are other examples of such market mechanisms that guarantee the buyer at least some level of quality. They also allow the owners of better than average goods to get the full value of their product when sold. Consequently they keep the market from reducing to the size of zero.

Akerlof also discusses several applications and examples of the theory in his paper. Some of these are discussed in section 3. As a further note, information asymmetry does not always lead to adverse selection. Under specific conditions *favorable selection* may take place as Boyan Jovanovic discusses in his 1982 paper[11].

2.2 Spence 1973: Signaling, Signaling Equilibrium

Michael Spence continues the ideas of George A. Akerlof in his 1973 paper *Job Market Signaling* [17]. He divides markets into two classes: those where there are few players in the market and they can establish a reputation as signalers and those where the players in the market are numerous and change frequently. Spence concentrates on the latter market where signals need to be interpreted without prior knowledge of the individual signaler. He uses job market as an example in the paper.

Spence models hiring employees as investment decisions made under uncertainty. The employer is not sure of the productive capabilities of an individual before hiring her. Even after hiring the productive capabilities are not immediately clear as some job specific training and learning has to take place. Spence reasons that because the capabilities of an individual take time to learn, hiring is an investment decision, and because the capabilities are not known beforehand with certainty, it is an investment decision under uncertainty. Spence parallels such an investment decision with a lottery.

The employer perceives a certain chance of winning in the lottery and a certain chance of losing. This chance of winning is determined by his prior experience in the job market and the *signals* a job applicant transmits and the *indices* she has. In Spence's terminology indices are immutable characteristics of an individual, like race or sex, whereas signals are the characteristics of an individual that the individual can manipulate. Spence uses education as the example manipulable signal in his model of the job market.

Using previous experience from the job market the employer can assign conditional probabilities to levels of productivity given a set of signals and indices. After hiring new employees and observing their behavior the employer adjusts his view of the probabilities.

Potential employees in this model, on the other hand, confront offered wage schedules based on their signals and indices. As they cannot change their indices, the model becomes from their viewpoint one of optimizing their wages reduced by their *signaling costs*. Signaling costs are the total costs of changing a signal, including money, time and psychic costs. Spence sets a critical assumption for the validity of the model that costs of signaling should be negatively correlated with productive capability. In the job market example this means that getting a qualification or a degree should be easier for more productive people.

We now arrive at Spence's model of information feedback in the job market (figure 1). In this model the job market works in iterations. First the applicants decide on their signaling based on maximization of the offered wages net of signaling costs, then the employer hires the applicants, observes their productive capabilities and adjusts his conditional probabilistic beliefs. Lastly the employer presents a new set of offered wages as a function of signals and indices and then the iteration starts again.

A *signaling equilibrium* is generated when the employers' beliefs are confirmed by the signaling they generate through the offered wage schedule. Signaling equilibrium is a stable state where the sellers (potential employees) in the market differentiate themselves

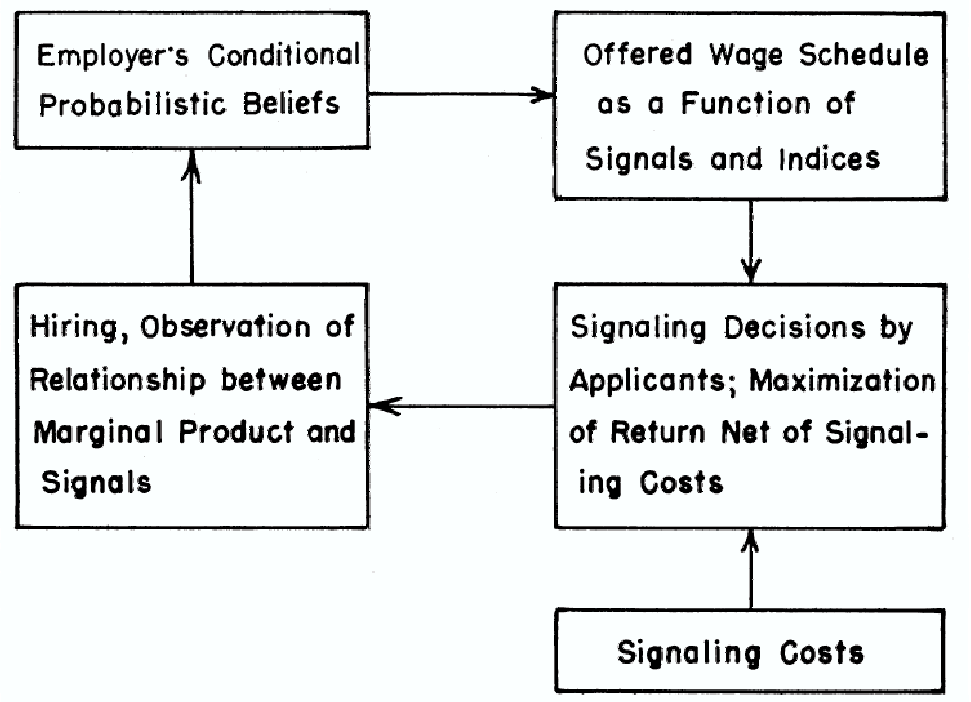

Figure 1: Informational Feedback in the Job Market[17].

from each other by signaling and thus reduce the information asymmetry between themselves and the buyer (employer). So, where in the asymmetric model without signaling the market size reduced to zero, signaling enable equilibrium to be generated with a market size of greater than zero.

Spence goes on to study the use of indices in place of signals. He studies sex as the differentiating index. The conclusion is that two groups with the same distributions of productivity, men and women, may after some time end up in different equilibrium. Based on the employees hired and their capabilities the model develops into one of the equilibria. This equilibrium may be different for the initially equals groups and can encourage different approach to acquiring education or to other signals. This leads to what Spence

refers to as a lower level equilibrium trap. This equilibrium, once acquired persists due to endogenous factors of the model and the equilibrium state. For example, the level of compensation for the lowest level jobs may be sufficiently high compared to education costs that most of individuals in a group prefer the lower level jobs.

The idea of signaling was also presented by George A. Akerlof [3], but he dubbed the signals *indicators*. As Spence's paper was published first, the term signaling is prevalently used in the literature.

2.3 Stiglitz 1975: Screening

In Spence's paper[17] the employees in the market select the signals they want to transmit in order to choose a suitable wage schedule. Joseph Stiglitz in his 1975 paper *The Theory of 'Screening,' Education, and the Distribution of Income*[18] explore whether this could be used by the seller (employer) to screen the applicants (potential employees) into categories that reflect their productivity or some other capability.

Stiglitz states that there are many important differences in the qualities of goods, individuals, brands and other items. He defines *screening* as identifying these qualities. Further, devices that perform screening activities are called *screening devices*.

Stiglitz develops the theory of screening using a simple model. Each individual has one characteristic, θ, which directly tells her productivity. In a non-screening situation each

worker will receive a wage proportional to the mean productivity of workers. If those workers with higher θ can be identified, they will receive higher wages. The high-θ individuals thus have an economic incentive to be identified. For simplicity, the model further assumes that there are only two kinds of individuals, with productivities of θ_1 (high) and θ_2 (low).

Stiglitz then introduces a screening process, which costs c per individual to perform, and is able to perfectly tell the two kinds of individuals apart. It is assumed that the cost c is more than the difference of wages justified by productivity of θ_1 and the mean wages, and that the cost c is also less than the difference of wages justified by productivity of θ_1 and that of productivity of θ_2. Stiglitz argues that there are two possible equilibria for this model (i) non-screening equilibrium and (ii) full-screening equilibrium. In the non-screening equilibrium all workers receive the mean productivity wages and as the cost of screening is more than the gain available, θ_1 workers do not have an incentive for screening. In the full-screening equilibrium all workers receive wages of the lower θ_2 productivity group if not screened into θ_1 category. θ_1 workers now clearly have an incentive for screening and will pay the cost c of the screening process. θ_2 individuals do not benefit from the screening and thus will not pay for it.

From this model Stiglitz makes some important observations. For example, the presence of the lower productivity individuals lowers the income of the higher productivity individuals, and on the other hand, the presence of the higher productivity individuals may increase the income of the lower productivity individuals. Furthermore, the social and

private returns of screening– by education, for example–differ. Screening involves costs, but only serves to redistribute the income in the population, so the social return is negative. The individual, on the other hand, may increase her own income, so the private return is positive to the high productivity individual screened.

Stiglitz continues to argue why having screening processes may still be better for the whole population than having no screening processes even though the social return of such an institution is negative. For example, he proposes that matching individuals to suitable groups and jobs happens only under a screening process and results in social returns. In the rest of the paper Stiglitz discusses the education system as a screening device in more detail.

Spence's [17] concept of signaling can, in Stiglitz's terminology, be seen as a screening device. Conversely, screening aims at leveling information asymmetries between parties in the market, so screening could also be labeled an instance of signaling.

2.4 Rothschild and Stiglitz 1976: Externalities

Michael Rothschild and Stiglitz in their 1976 paper *Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information*[15] continue the work of Stiglitz[18]. In this paper they study the effects of imperfect information using insurance market as an example.

Rothschild and Stiglitz propose the following model for insurance market. An individual will have an income of size W if he is lucky enough to avoid an accident and an income of $W - d$ if an accident happens. The individual can then insure herself against an accident by paying the insurance company a premium α_1. If an accident occurs the individual will be paid $\hat{\alpha}_2$. Thus her income in the two states no accident and accident without an insurance are (W, $W - d$) and with an insurance ($W - \alpha_1$,$W - d + \alpha_2$), where $\alpha_2 = \hat{\alpha}_2 - \alpha_1$. The resulting vector (α_1, α_2) is all that is needed to describe an insurance contract in this model.

The market itself only has two kinds of participants, those that sell insurance and those that buy insurance. Rothschild and Stiglitz use the expected utility theorem to formulate demand of insurance contracts caused by buyers. It follows from the theorem that with a probability *p* of an accident happening, the expected utility to an individual is

$$\hat{V}(p, W_1, W_2) = (1 - p)U(W_1) + pU(W_2), \tag{1}$$

where W_1 is the income of the individual when no accidents happen and W_2 is the income of the individual when an accident happens. The $U()$-function represents the utility of the income to the individual. The individuals are though to be risk-averse, so that $U'' < 0$. This means that increase in income is most valuable when the income is low and becomes almost insignificant as income gets higher. An insurance contract is worth $V(p, \alpha) = \hat{V}(p, W - \alpha_1, W - d + \alpha_2)$ to a buyer with probability p of an accident happening. It

should be noted that the value of not buying an insurance is $V(p,0) = \hat{V}(p, W, W-d)$, so contracts worth less than this are never bought.

The value of insurance contracts to the sellers is given by

$$\pi(p,\alpha) = (1-p)\alpha_1 + p\alpha_2, \tag{2}$$

where p is the probability of an accident happening to the individual to whom the contract is sold. This model assumes that the sellers (the insurance companies) are neutral to risk. So, contrary to the buyers, increase in income is worth the same to insurance companies at any point of current income. It is assumed that every contract whose value to the insurance company is greater than zero will be supplied.

The asymmetricity of information comes from the probability of an accident happening, p. It is assumed that the individuals know their probabilities, but the insurance companies only know the average probability of the population. The insurance companies want to sort their potential customers on the basis of their accident probability in order to offer different kinds of insurance contracts to different risk groups.

Rothschild and Stiglitz define a competitive equilibrium in the insurance market of their model as a set of contracts chosen by the customers to maximize their expected utility such that, (i) no contract in the set makes negative expected profits to insurance companies, (ii) there is no contract outside the equilibrium set that would make a nonnegative

profit if offered.

Figure 2 shows the expected income of an individual with symmetric information, that is, each individual has the same accident probabilities. Horizontal axis represents income in a no-accident state and vertical axis represents income in an accident state. The point E marks an uninsured state where income with no accident is high, but after an accident the income drops. $\bar{V}$ represents an indifference curve of an individual. That is, each point on the curve yields the same utility to the individual.

Policies bought in a competitive equilibrium state make zero expected profits, so that 2 will be zero:

$$\alpha_1(1-p) - \alpha_2 p = 0. \tag{3}$$

This set of policies that just break even is shown in figure 2 as the line EF. The point α^* in the figure has to be the equilibrium point, since all other points on the line EF are below the indifference line that touch the line in α^*. So, with symmetric information all customers buy the same insurance policy where the income in both states is the same.

This kind of equilibrium where everybody buys the same insurance contract is called a *pooling equilibrium*. Rothschild and Stiglitz argue in their paper that under asymmetric information no pooling equilibrium is possible and thus if equilibrium is found it is always of the second possible type: a *separating equilibrium*.

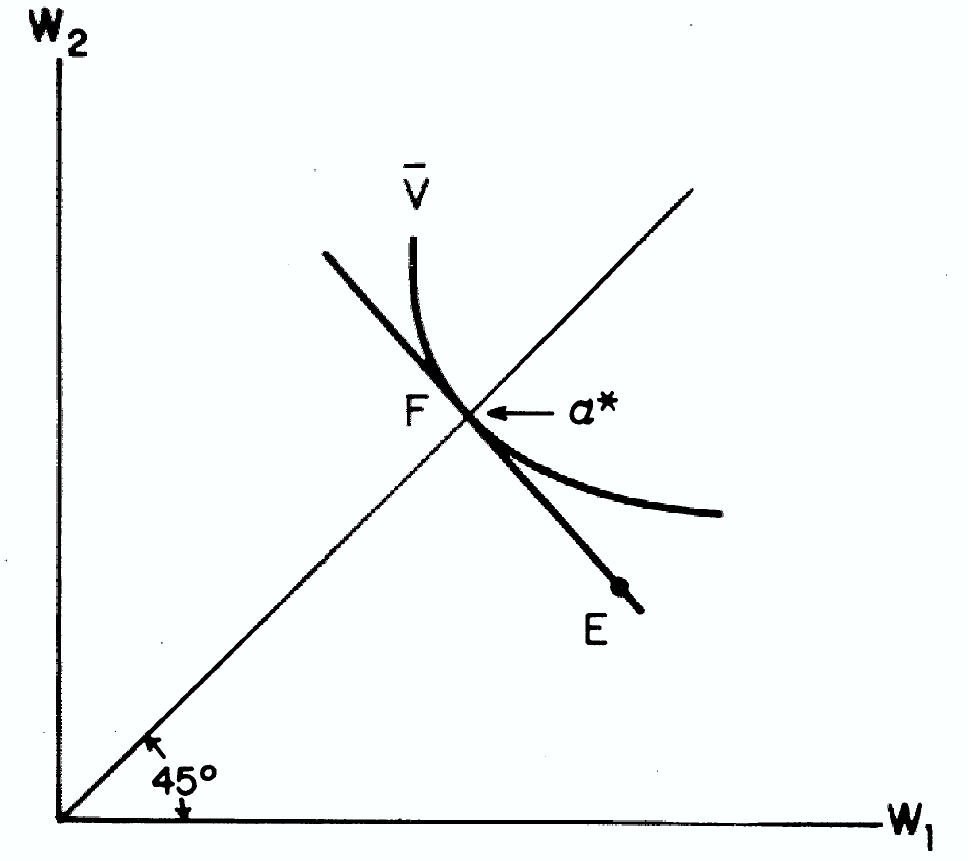

Figure 2: Income in no-accident and accident scenarios with symmetric information[15]. E is the uninsured state, F is an insured state, $\hat{V}$ is indifference curve of an individual and α^* is the point where income is the same independent of an accident happening.

Figure 3 shows the incomes for a market consisting of two groups of individuals, α^L and α^H, with a low accident probability and high accident probability, respectively. $\bar{U}^L$ and $\bar{U}^H$ are indifference curves for these groups.

Rothschild and Stiglitz state that the set of contracts (α^L,α^H) is the only possible equilibrium for a market with low and high risk customers. Furthermore they state that this may not even be equilibrium. This has several consequences. First of all, if the equilibrium

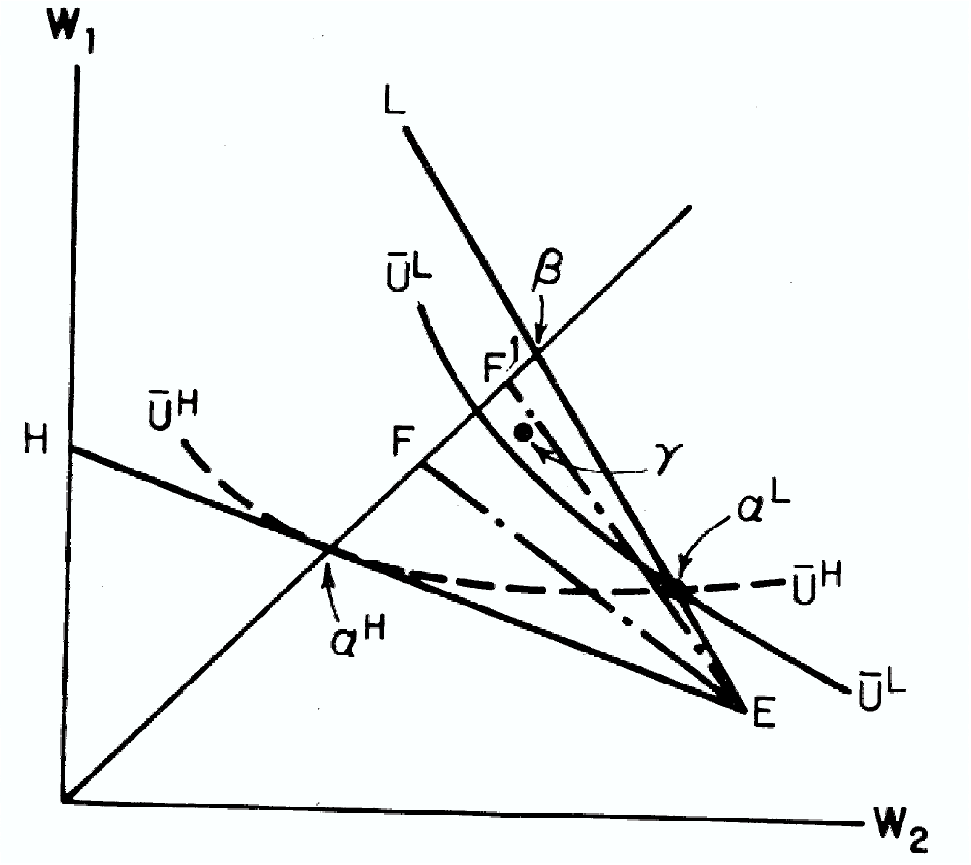

Figure 3: Income in no-accident and accident scenarios with asymmetric information[15]. E is the uninsured state, F, L and H are insured states, $\bar{U}^H$ and $\bar{U}^L$ are indifference curves, α^H and β are optimal insurance policies and α^H and α^L are the insurance policies actually offered.

exists, the high-risk individuals cause a *negative externality* by their being on the market so that the low-risk individuals cannot get their preferred insurance policy (β in figure 3), which they would get in a symmetric information market. Even though the low-risk individuals are worse off in this situation, the high-risk individuals are no better off than they would be in a symmetric information market.

If such equilibrium exists, however, it is possible to use it for screening applicants into

categories. The applicants will themselves choose the category that the insurance company would like them to choose.

3 Applications of the Theory

In this section we present some of the applications of the asymmetric information theory. The applications presented here are chosen so that they reflect the diversity of the possible applications of the theory.

3.1 Minimum Quality Constraints

Hayne E. Leland considers setting minimum quality constraints as a way to mitigate adverse selection in his 1979 paper[13]. He notes that markets that have quality constraints in place are typically characterized by information asymmetries. He deduces that because of adverse selection the efficiency of unregulated markets may be questioned when there are information asymmetries. Eliminating information asymmetries would be the ultimate solution for this, but the costs of acquiring it would be too high[6]. Thus other means need to be considered. An example of this is licensing, or posing minimum quality constraints, that Leland describes in his paper.

[6]This is assumed to be so by common knowledge.

What follows in Leland's paper is a mathematical formalization of both welfare in markets with asymmetric information and Akerlof's [2] ideas. After presenting the ideas as mathematical formalizations, Leland introduces the minimum quality constraint to the calculations. This shows that, in Leland's model, posing minimum quality constraints is the most advantageous in markets with (a) greater sensitivity of market size to quality variations, (b) low elasticity of demand, (c) low marginal cost of providing quality and (d) low value placed on low-quality service. Markets without these characteristics may be better off without minimum quality constraints. According to Leland's analysis the effect is even stronger when price falls with quality instead of rising as was assumed in Leland's initial model. He concludes that if the price of producing quality falls with rising quality it is always socially beneficial to pose minimum quality standards.

Leland then proceeds to study the effect of the producers themselves posing the quality constraints versus an independent agency. The outcome is that the industry itself will probably set the quality standards too high. Too high quality standards lead to reduced supply and higher demand and thus to higher profits to the industry. In this situation, the industry is behaving like a monopoly.

Leland extends the analysis to cover cases where the sellers can modify the level of quality offered. Because the benefits of raising quality accrues to whole group, sellers do not have an incentive to raise quality and end up with a quality change of zero. Thus the result of the analysis is the same.

3.2 Contingency Contracts

As an application of the asymmetric information theory, Joseph Stiglitz and Andrew Weiss in a 1983 paper study contingency contracts as employed in several markets[20]. A contingency contract is, for example, a loan contract where default of a payment prevents the individual from obtaining a new loan in the future. Stiglitz and Weiss find that contingency contracts and thereof the possibility of termination of contract stimulates behavior that the principal–the bank, the employer, the seller–finds desirable.

In the credit market raising interest rates introduces two undesirable effects: adverse selection, that is those who apply for the credit get riskier on average, and the incentive effect, that is the ones applying credit have an incentive to spend it on riskier projects[19]. In the job market a lower wage may result in lower effort put in the work. Thus in these markets worse contract terms for the agent–the buyer, the employee, the loan taker–also means worse terms for the principal.

These are examples of markets with moral hazards. Stiglitz and Weiss show that in such markets competitive behavior include *intertemporal linkages*. That is, if a loan contract, for example, is terminated, no other bank will give the agent a new loan. They conclude that the intertemporal linkage takes the form of contract termination only when (a) worse contract terms for the agent are also worse for the principal, (b) fees are constrained by legislation or (c) when agents who have low returns in early periods are likely to have low returns also in later periods.

Thus, because of the intertemporal linkages contingency contracts have incentive effects on the agents. Stiglitz and Weiss also deduce that because of these linkages there is more competition before any contracts are signed than afterwards. This is because agents who feel dissatisfied cannot costlessly move to another principal.

3.3 Used Pickup Truck market

Erik W. Bond studies the validity of Akerlof's lemons model[2] empirically in his 1982 paper about the used pickup truck market[4]. He proposes that if the lemons model holds, pickup trucks bought old should need more maintenance over time than those bought new. To account for normal wearing over time Bond compares second-hand and first-owner trucks of similar age and lifetime mileage.

The result of Bond's study is that there are no observable differences in the condition of new and used trucks. Bond suggests that the asymmetric information theory may still hold but in this market there are no great information asymmetries and the condition of a truck can be adequately observed when the transaction takes place.

In his 1984 paper[5] Bond evaluates the used pickup truck market further and includes trucks of age of more than ten years that were not accounted for in his earlier paper. In the over-ten-years-old group the second-hand trucks are found to have more problems than the non-traded trucks[7]. He offers the explanation that used trucks of age of less than

[7]Bond compares trucks traded in the last 12 months with those not traded in the last 12 months.

ten years are usually traded through dealers, who act as counteracting market institutions.

To conclude, it is not clear from Bond's analysis how well the asymmetric information theory holds in the used pickup truck market. However, the market for the oldest trucks seems to assert the value of intermediary market institutions like dealership brands and guarantees in balancing information asymmetries.

3.4 Job market

The job market was the example used by Spence[17] in his explanation of the concept of signaling. Stiglitz also used job market to study screening[18]. Sanford Grossman and Oliver Hart provide another example of using asymmetric information theory in examining the job market in their 1983 work[8]. They study the information difference between firms and their workers and the information that is revealed by the firm when it chooses a level of employment.

3.5 Other Contributions

Some of the other contributions to the theory of asymmetric information include Stiglitz and Weiss's work [19] where they study the effects of rationing credit to the market. The paper provides a theoretical explanation why it is profitable for banks to ration credits.

Samuelson [16] describe the effects of asymmetric information to bargaining process. He concludes that an uninformed buyer achieves her maximal attainable expected profit only when she can make a first-and-final offer which the seller can accept or reject. He also concludes that the presence of asymmetric information may preclude the possibility of reaching a mutually beneficial agreement. Samuelson suggests that in theory using an arbitrator in the bargaining process is the first best solution, but adds that the costs of such may in practice be too high.

Hansen has more recently applied the theory to the case of mergers and acquisitions[10]. He argues that the choice of exchange medium may have an effect on the success of the merger.

As elaborated above, Rothschild and Stiglitz used insurance market as a basis for their argument on their 1976 paper on externalities caused by asymmetric information[15].

Also, Juha Mattsson studies in his 2002 paper for this seminar [14] the venture capital market through the lens of asymmetric information theory. He concludes that asymmetric information and signaling are valid concepts for describing the problems facing entrepreneurs and venture capitalists.

3.6 New Applications of the Theory

The ideas of the asymmetric information theory can be utilized as such in many applications. One example of a new application of the theory is subcontracting.

The market for subcontracting projects can be seen as a market similar to the insurance market of Rothschild and Stiglitz's model[15]. Similar screening could be used to sort out the subcontractors with the best probability of succeeding.

Suppose that in the market for subcontracting contracts each contract specifies a fixed part and a varying part of payment. The varying part of payment is determined by the success of the project and the amount of effort used. Similar to the different insurance contracts, a set of subcontracting contracts can be devised by varying the ratio of fixed and varying payments. The potential subcontractors would then choose the combination that best suits their possibilities of succeeding and this would enable the company seeking for subcontractors to screen the potential subcontractors into categories with different risk.

The model proposed should still be studied further[8], but it illustrates the applicability of the asymmetric information theory across different fields of research.

[8]For example, a company looking for a reference deal might have hidden incentives when choosing from the set of deals offered to it. This could bend the results of the screening if not considered properly.

4 Strengths and Weaknesses of the Theory

In this section we evaluate and discuss the strengths and weaknesses of the theory. The discussion is based on the articles introduced above.

4.1 Strengths

One of the major strengths of the asymmetric information theory is the theory's ability to explain previously unexplained economic phenomena. Asymmetric information theory tells us that it may be impossible to distinguish good and bad quality, and this phenomenon can be used to explain, for example, the existence of counteracting market institutions. Similarly the economic justification for regulating quality cannot be found from the traditional theories[13].[9]

Secondly the theory acknowledges the meaning of information as a market determinant. As Rothschild and Stiglitz put it, "economic theorists traditionally banish discussions of information to footnotes" [15]. Thus asymmetric information theory emphasizes the meaning of information and its introduction started discussion on the validity of some of the traditionally held economical theories[15].

Certainly one of the strengths of the theory is also that it can be applied over multiple

[9] Retrospectively it is worth noting that Akerlof's 1973 paper was first rejected from being published[7]

disciplines. The theory was developed and most of the applications discussed in this paper are in the field of economics, but it has also been applied on other fields. For example, it has been used to analyze the effect of forgeries on the market of art paintings [21] and to study the model of propagation of the HIV[12].

The theory itself is simple to understand and utilize. The concept seems like "common sense" and is easy to understand. The complexity of analysis only comes from choosing a complex mathematical model to model the asymmetries of an application domain.

4.2 Weaknesses

Although a very useful tool, asymmetric information theory also has its weaknesses. The discussion here is based on our observations of the subject material presented.

The first potential problem relates to the models developed using the asymmetric information theory to assess the markets. Many of these models deal with highly simplified versions of the markets with few possible types of players or states. As is always the case with models, there is a possibility to become too enamored with the model and its mathematical manipulation to see the complexities present in a real world market. For example, Spence states in his 1976 paper that "[in some cases] There will be random variation in signaling costs that prevent the employer from distinguishing perfectly among individuals of varying productive capabilities."

The applications of the theory also only consider asymmetries in one direction. It may, however, be that there are also information differences in the favor of the other party.

The results of Bond's studies [4, 5] cannot completely be explained by simple utilization of the asymmetric information theory. Though this might not be due to a problem with the theory itself rather than due to insufficient study of the problem domain.

The weaknesses or potential problems introduced mostly have to do with the applications of the theory. The theory itself might be faulty in its simplistic assumptions. For example, the theory assumes that the buyers always know the average value of the items on sale. This kind of information may not always be available, typically in the case of unique market items. Although there will probably still be an asymmetry of information in these cases.

Also, the competitive dynamics assumed in the model are simplistic. Rothschild and Stiglitz assume a model where equilibrium can be reached on the insure market[15] with every policy traded making zero profits. The model does not consider substitute products, aggressive entrant to the market trading with negative profits and it also assumes same costs for producing the services for all companies. Taking such factors into account may have a profound effect on the results obtained with the model.

5 Relation to Other Economical Theories

Two theories that are the closest to asymmetric information theory are agency theory and the theory of incomplete contracts.

Agency theory is considered the first theory to explicitly consider the problems studied later in the formulation of the asymmetric information theory. Agency theory, first introduced in 1930 by Berle and Means[1] tells us that the benefit of companies' stockholders and that of their agents' are not always convervent. The same phenomenon could also be described in the terms of the asymmetric information theory.

The theory of incomplete contracts[9] builds on the foundation of the agent theory and the asymmetric information theory. The theory explains why it may be beneficial to leave contracts "incomplete", that is to not consider some rights explicitly, for example. The effect is caused by the "asymmetry of benefit" caused by giving all rights to the other party who then does not have an incentive to work for the benefit of those rights.

6 Conclusions

We studied the defining literature for asymmetric information theory and some of its applications. We also evaluated the strengths and weaknesses of the theory and proposed a new application of the theory.

Asymmetric information theory seems to be an intuitive model of competitive market behavior. Its key concepts –adverse selection, counteracting institutions, signaling and screening– are useful concepts that have been extensively used in later research. The theory is also utilized across several different disciplines, which adds to the theory's credibility.

The applications of the theory presented here develop the theory further and explain many important market institutions. It is clear from the material studied that the theory has several useful applications. The applications, however, are often theoretical rather than practical. This is explained partly by the material studied as no practitioner journals were used, but it is useful to note the possibility of differences. The implications are useful in the context of theoretical models, but their applicability to actual market problems should be thoroughly evaluated before implementation.

7 Further Studies

In here are collected some suggestions for future research on the area:

- The model of subcontracting should be developed further to learn its implications for the subcontracting business.
- Finding analogies to asymmetric information in economics in other fields, both natural and human sciences.

- Signaling itself; for example, what is the power of marketing as a form of signaling? Presumably there are differences in different kind of signals. Are these only differences in the capability of leveling asymmetries or is signaling also used for creating further asymmetries?

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