The Market for Peaches

Jonathan Bonham and Thomas Hemmer*

May, 2026

Abstract

In this paper we seek to provide some alternative perspective on overcoming the obstacles to trade under asymmetric information identified by Akerlof (1970). One of the main branches of the literature presumed to address this problem, the so-called Voluntary Disclosure literature, has relied critically on some form of perfect ex-post verifiability. However, this literature, while motivated by Akerlof (1970), rarely study markets where the "Lemons" problem is present. We use a Mechanism Design approach to identify specifics that help to reduce this problem. We argue that these features are standard features of real world markets and also a key reason why they can function. Of particular importance is that the likelihood of making a sale being price sensitive and the ability to segment the market. We study the role of this on the liquidity of free markets and the amount of unverifiable quality information that can be credibly shared.

*Preliminary, incomplete and rough draft. Please do not circulate or quote.

1 Introduction

A key catalyst for the advent and growth of the Information Economics literature focused on the implications of information asymmetries in open markets is Akerlof (1970). The elegant and powerful illustration of the detrimental consequences of information asymmetries for trade and the ensuring discussion of the countless real-world phenomena that cannot be motivated in the standard (Edgeworth Box) model of markets had seismic implications for the quest to understand the features that do make real world lemon-markets work.

Remedies for the "Lemons" problem of Akerlof fame, such as ways of credibly sharing information and commitments to satisfaction (warranties, for example), fairly quickly became main focal points as manifested by either a Mechanism Design approach or models of information sharing in versions of generic markets. A key jumping off point for the split can be found in Grossman (1981) who demonstrated that if the veracity of information shared can be checked ex-post directly or indirectly and if it is possible to commit to sufficient penalties for misrepresentations and credible enforcement of such, costlessly verifiable disclosures or, in case of indirect verifiability, warranties, can completely eliminate the "Lemons" problem.

Of course, the Grossman approach does carry some major draw-backs and is perhaps better thought of as identifying the extreme cases/conditions that, if present, would eliminate all imperfections and thus the need for any other common practices such as trust building and regulation. In particular, and again, maybe a bit unfairly, the main argument can be summarize as if market break downs (or friction leading to too little trade) are caused by the presence of persistent information asymmetries, then just assume them away. Specifically, make all information in markets verifiable (at least to some degree) at no cost and make liars liable, and then the presence of unverifiable information is no problem no more.

While this perhaps (or perhaps not) is an oversimplification, it fundamentally has remained the foundation of two of the main strands of the information economics literature to date. The "Voluntary Disclosure" (VD) literature relying heavily of some form of ex-post verifiability while the "Mechanism Design" (MD) literature generally focused on indirect verification. And while many important insights have been gained citing Akerlof as a key motivation for so many of the key inquiries in the VD literature, we argue in this paper that many of these insights have little to do with the "Lemons" problem for two key reasons. First, the problem really only exist when information is unverifiable. And second, market failure can only occur when markets are allowed to fail. Most of the literature we have in mind deviates in important ways from the setup in which the "Lemons" problem is defined in at least one of these two ways.

We also endeavor to highlight what we consider another (key) misdirect in the foundation of the VD literature. That is that the properties of verifiable disclosure that became the focal point for tackling the "Lemons" problem. This is somewhat surprising because all fundamental VD papers do reference Akerlof as a key motivation despite verifiable disclosure is not at all the focus of Akerlof. Rather, it is on restoring liquidity to markets where quality uncertainty exists. The VD literature, instead, largely focuses on markets where the is no room for market failure and where quality uncertainty can to some degree be directly eliminated.

What we offer here is a documentation of these discrepancies and how they impact the insights that we think of as fundamental. For example, the wonderful paper of Jovanovic (1982) (and related Verrechia (1983)) have completely different market structures than that of the classical (linear) Edgeworth box (implicitly) relied on in Akerlof (1970) and as a result provides insights on disclosure and market failure that are incompatible with the original "Lemons" problem. The same is true in the case of Dye (1985) (and related Jung and Kwon (1988)) and papers based there on. As a matter of fact, non of the classical results in the disclosure literature motivated (explicitly) by Akerlof actually can be replicated in the basic Akerlof (Edgeworth box) set-up. Costly ex-post verifiability simple leads to partial market failure while the present of uninformed sellers leads to partly market failure if there are too few of them and and, not surprisingly, perfectly functioning market if there are enough!

After having documented these critical limits to insights that rely on some version of Grossman's perfect ex-post verification, we address the fundamental question of how markets such as the one in Akerlof can overcome the lack of ex-post verifiability paired with steep penalties that is the more representative state of affairs? This may seem odd as Akerlof's very point is that without remedies of some sort, they can't. We argue that one of the most basic features of free (Edgeworth Box) markets is exactly that the potential parties may choose to walk away and often, but not always, do. We then illustrate that one of the conditions for some trade and disclosure to become possible, is that walking away is more likely to occur for higher priced assets.

For example, as we will show, when sellers may have different levels of patience, liquidity, disposable income or for some other reason are more compelled to walk away upon hearing a higher asking price, this threat alone may be sufficient to keep sellers honest while not necesarrily incentivicing full disclosure. Moreover, not every asset will necessarily be traded. As a result we demonstrate that while the standard results of the VD literature do *NOT* transfer to the (Edgeworth box) setting of Akerlof, they actually do arise naturally in this setting when disclosures are not verifiable at *ANY* cost, but buyers for whatever personal reason walk away to perhaps search for a lower priced deal they can afford.

We argue that unlike disclosure verifiability, the likelihood of making a sale being tied to the asking price is a completely central and integral part of how markets work. Yet this central feature of markets has also been completely absent from the VD literature, probably because the heavy handed verifiability assumption, along with the other deviations from free markets, did allow for obtaining seemingly reasonable results. The much more reasonable and real-worldly feature of unverifiable information and unknown price sensitivity however do deliver the results in the Akerlof environment and as such opens up a new avenue for exploring drivers of disclosure and market failure, both theoretically and empirically!

Although entirely missing from the VD literature, the idea we are pursuing here is of course not new at all. Indeed, our inspiration for introducing this feature into the VD literature can be found in the classic paper of Myerson (1979). Specifically, his example. In this example the information asymmetry is about an individual's preferences, which are generally entirely non-verifiable. The reason why honest disclosure and "trade" happens is exactly due to a non zero probability that it may not! And while this is part of an optimally designed mechanism under the revelation principle, the walking away is such an integral part of the definition of a free market mechanism. We pursue this idea of designing an optimal market mechanism, what makes it enforceable and compare the properties with real world free markets that have proven themselves successful.

A second key to overcoming the "Lemons" problem, at least in the setting of Akerlof, is the ability to subdivide the market into smaller segments. That is, while the threat of walking away is critical, this feature only work over finite ranges and in the case of the specific model of Akerlof, such ranges are shorter than the range of all types. Thus the ability to subdivide the population of used cars into, for example, lemons and peaches, perhaps by relying on a set minimum standards such as the car must pass a 30 point inspection, will be needed. We consider a case where this is possible and focus our attention on the market for peaches for reasons we will discuss later.

The remainder of the paper proceeds as follows. In section 2 we illustrate how key results from the VD literature do not replicate themselves in the Akerlof setting and thus do not really address the so-called "Lemons" problem. Then, in Sections 3 and 4 we show that the optimal market mechanism in the Akerlof setting rely on the real risk that parties may not trade and demonstrate how much trade can actually take place and how much truthful disclosure will occur. Finally, Section 5 concludes.

2 VD vs. Akerlof

As briefly discussed in the Introduction, a key foundation for the VD literature is the section on "unraveling" in Grossman (1981). While the key feature behind the result is of course the perfect ex-post verifiability, of equal importance is the existence of a formal enforceable mechanism to make lied-to buyers (at least) whole by any seller that is found to be lying. Grossman further deviates from Akerlof by making the seller's private information about the value of the good to the buyer - the known value to the seller is zero who thus always want to sell. While the latter deviation from Akerlof is inconsequential in this case - the Grossman unraveling result transfers directly to the market setting of Akerlof - we highlight it here as a point of reference for what is to follow.

So consider now the first key deviation from Grossman, namely that of costly ex-post verification introduced by Jovanovic (1982). The paper introduces the fixed cost verification in two alternative market settings. First the exact same as that of Grossman and then in a more refined one which we will return to after addressing the first, first. Importantly, Jovanovic does NOT consider the case of costly disclosure in a market setting like that in Akerlof. Rather than simply examine the implications of costly verifiable disclosures within the confines of Akerlof, Jovanovic provides alternative market structures as the basis for his analysis. We will return to that too.

The key result in the first of the Jovanovic settings is the fundamental disclosure result that if the cost are neither too high or too low (zero) sellers with low value assets prefer to be identified simply as such (and suffer a discount) rather than pay the verification cost. The second market setting examined in Jovanovic is one where the seller actually have private (and perfect) information about his *own* value of the asset. The twist here is that there is (white noise) uncertainty about how the value to the seller translates into value to the buyer. This sets up a value function to the buyer based on some reasonable information updating upon a truthful disclosure such as, perhaps, Bayesian. Specifically, any deviation from the buyer's priors (or the ex-ante average) is weighted by less than one. With that (and the Goldilocks cost) both partial market failure (too few high value assets trade) and less than full disclosure (low value asset owners pool).

While elegantly insightful, intuitive and seemingly non-controversial, the results from either setting clearly do not transfers to the standard market setting of Akerlof.

Because sellers and buyers in the Edgeworth market are free to walk away and because they assign non-zero value to the assets they hold, they of course will never sell at a lower price than that they value the item at themself. Accordingly, no pooling will occur for assets that are traded - sellers that find the verification cost too steep walk away. Those that do not, pay and trade. Thus, in Akerlof, adding costly verifiable disclosure just implies partial Grossman, partial Akerlof - the bottom of the market drops out, the top trades at a justifiable cost.[1]

The key alternative to Jovanovic in the partial disclosure VD literature is that of Dye (1985). The verifiability assumption here seemingly is just a convex combination of Grossman and Akerlof - a random sub-set of the sellers have perfect and costlessly verifiable information, the rest do not. With that, the disclosure behavior is the same as in Jovanovic. Those with sufficiently unfavorable verifiable information choose to not disclose. Here not due to cost avoidance but rather by pooling with sellers that cannot verify their information at any cost thus making the imposters look better than the really are. As such, the sellers with no verifiability information bears the cost here - not directly through costly verification but buy having to accept a lower price.

That last point is also one of two reasons why this result, as simple as it is, does not obtain in the setting of Akerlof. Because a group of sellers (the uninformed) here is being taken advantage of, the Dye result hinges critically on them not being able to walk away. Unlike as in the case of Grossman, the assumption that the seller value the good at zero is therefore of critical importance in this case. [2] The second reason

[1]In Jovanovic, it is the sellers with the best assets that drop out. While seemingly a trivial difference it is critical to having individuals with low value assets sell but not disclose.

[2]But the standard assumption that those taken advantage of are uninformed actually isn't really relevant when the seller assigns no private value to the item he is seeking to sell. Every seller want to sell even if they know the exact value to the buyer and just cannot verify it!

is that it is privately informed sellers is the source of the "Lemons" problem. Adding back some sellers that are uninformed can obviously only help!

So consider adding into the set-up of Akerlof a group of uninformed sellers with no way of communicating this credible while letting the rest of the sellers be of the Grossman type. With (as in Akerlof) quality uniform on [0, 2], the uninformed type all believe that their asset is of (personal) value "one" and will just withdraw from the market if they cannot secure "one" as the non-disclosure price. But for buyers to be willing to offer the price of "one," the (sellers') expected value of the pool must be $1/\beta$, where $\beta > 1$ is the value to the buyer of an asset valued at one by the seller (3/2 in the case of Akerlof where $t \in [0, 2]$).

This value will of course also be the maximum asset value of an informed type that will join the pool, so the average quality of the assets of those choosing strategically to pool is $1/2\beta$, with the pool the being an equilibrium with sellers with an average value of

$$k \times 1 + (1 - k) \times 1/2\beta = 1/\beta$$

or

$$k = \frac{1}{2\beta - 1},$$

where k is the conditional probability that the seller in the pool is uninformed.

Because all uninformed will be pooling while only $1/2\beta$ of the informed will do the same, for this to be true, the fraction of uninformed sellers must be such that

$$\frac{\rho}{(1 - \rho)/2\beta + \rho} = k,$$

or, in the Akerlof case of $\beta = 3/2$, $\frac{\rho}{1-\rho} = 1/3$. Accordingly, if less than 25% of sellers are uninformed, only the informed join the market, disclose and trade. The uninformed do not participate at all. However, once the uninformed population reaches 25%, they can join in trading making 50% of sellers trade as a pool while the rest of the informed disclose and trade. Of course, as the share of uninformed grows, less and less sellers disclose and the market is less and less distorted with fewer and fewer are priced at below their value to the buyers.

That said, it could also be worth noting, that being able to costlessly verify disclosures may not overall benefit trade. To see this, suppose for the sake of argument that $\beta = 6/5$. Per the discussion above it is then not possible to form a pool that is acceptable to the uninformed group unless $k = 5/7$ and, thus, ρ being slightly greater than .51. Now suppose that $\rho = .51$ so that the uninformed refrain from selling all together. Only the informed 49% will disclose and trade. So, consider instead an alternative case where the informed sellers' information is entirely unverifiable at any cost. In this case, informed sellers face the choice of not selling or being pooled with the uninformed and sell. Let $\bar{t}$ denote the highest informed type willing to join such a pool. Then, $\bar{t}$ must satisfy

$$\frac{6}{5} \times \left(k \times 1 + (1-k) \times \frac{\bar{t}}{2} \right) = \bar{t},$$

or $\bar{t} = 1.006$. Thus, 100% of the uninformed and a tad more than 50% of the informed pool and sell for a total just above 75% market participation by sellers, significantly above the 49% if costless verifiability was available.

Finally, we would be remiss if we did not address Crawford and Sobel (1982) in this context as it is the foundational paper for the part of the VD literature that do not rely on ex-port verifiability to generate results. Their setting, however, is more akin to a team where one member's action benefit both parties, rather than an open market. Information is shared because, while not perfectly, the members have a fundamentally shared interest in the "right" action be taken. Notice also that there is no room for "market" failure in their setting. Even in the babbling equilibrium case where no information is shared the then uninformed "receiver" still acts.

3 Less is More

In this section we abandon the ad-hoc perfect ex-post verifiability approach of the VD literature and instead attempt to identify features of real world markets that make them function in the shadow of Akerlof. In particular, we take a Mechanism Design/Revelation Principle approach to gain a better understanding of the widespread existence of markets where the participating parties private information is completely unverifiable, what makes them function and, of course, how information can be/is shared in such markets. The approach we take in this section is of course not to argue or even suggest that every market is designed optimally or even centrally by some authority. Rather, we simply try to identify a benchmark for evaluating features of lemon-infested markets that make them somehow still exist and function as a practical matter.

With this we return to the setting of Akerlof (1970) but armed with the arbitrator of Myerson (1979). Thus, in our terminology, the sender (seller) owns a car with quality t and distribution $\psi(t)$ uniform on some interval or continuous type-set T, and can disclose any quality type $d \in D(t) = D = T$. The sender chooses whether to sell the car ($\gamma_s(d,t) = 1$) or walk away ($\gamma_s(d,t) = 0$), and the receiver (buyer) chooses whether to buy the car ($\gamma_r(d) = 1$) or walk away ($\gamma_r(d) = 0$). The sender and receiver have the following (Akerlof) utility functions, where $p(d)$ is the price paid for the car if it is sold conditional on disclosure d:

$$U_s(p(d), \gamma_s(d,t), \gamma_r(d), t) = \begin{cases} p(d) & if \quad \gamma_s(d,t) = \gamma_r(d) = 1 \\ t & otherwise \end{cases} \tag{1}$$

$$U_r(p(d), \gamma_s(d,t), \gamma_r(d), t) = \begin{cases} \beta t \, - \, p(d) & if \quad \gamma_s(d,t) = \gamma_r(d) = 1 \\ 0 & otherwise \end{cases}$$

Notice that at any price $p(d)$, aggregate utility is β_t if the car is sold and t if it is not, so social welfare is maximized when trade occurs for all $\beta \geq 1$. Assume that in addition to designing the pricing function $p(d)$, the arbitrator can force market failure by prohibiting trade. Specifically, $\gamma_a(d) = (p(d), \varphi(d))$, where $\varphi(d)$ is the probability that the arbitrator prohibits trade conditional on disclosure d. The arbitrator's problem is then given as follows:

$$\max_{\delta,p,\varphi} \sum_{t \in T} \sum_{d \in D} U_a(p(d), \varphi(d), \gamma_s(d,t), \gamma_r(t), t) \delta(d|t) \psi(t)$$

$$s.t. \quad \sum_{d \in D} ((1-\varphi(d))p(d) + \varphi(d)t)\delta(d|t) \geq \sum_{d \in D} ((1-\varphi(d))p(d) + \varphi(d)t)\hat{\delta}(d|t) \quad \forall \hat{\delta}, t \quad (2)$$

$$\sum_{d \in D} ((1-\varphi(d))p(d) + \varphi(d)t)\delta(d|t) \geq t \quad \forall t \ s.t. \ \gamma_s(d,t) = 1$$

$$\sum_{t \in T(d)} (\beta t - p(d))(1-\varphi(d))\psi(t|d, \gamma s = 1) \geq 0 \quad \forall d \ s.t. \ \gamma_r(d) = 1$$

The first constraint, $(IC_{s\delta})$, ensures that the sender is willing to adopt the arbitrator's proposed disclosure strategy. The last two constraints, (IC_s) and (IC_r), ensure that both the sender and the receiver are willing to engage in trade.

Consider now for simplicity, the sake of argument, and in the spirit of Akerlof (1970), a linear pricing function $p(d) = a + wd$ and a linear prohibition probability function, $\varphi(d) = \alpha + \omega d$. Then the sender's expected payoff given a disclosure d is given as

$$(1-\varphi(d))p(d) + \varphi(d)t = (1-\alpha)a + \alpha t + (\omega t - a\omega + (1-\alpha)w)d - w\omega d^2,$$

which is maximized at

$$d = \frac{(t-a)\omega + (1-\alpha)w}{2\omega w}.$$

Importantly, then, it follows that if $\omega w \neq 0$, then senders of different types have different utility-maximizing disclosures! Combining equation (4) with $d = t$ yields

$$(2w-1)\omega t = (1-\alpha)w - a\omega,$$

which is true for more than one t if and only if $w = \frac{1}{2}$ and $\omega = \frac{1-\alpha}{2a}$. Thus truthful disclosure $\delta(d|t) = \delta_{dt}$ satisfies (ICsδ) for $p(d) = a + \frac{d}{2}$ and $\varphi(d) = \alpha + \frac{1-\alpha}{2a}d$.

Now substituting the truthful disclosure conditions into the sender's participation constraint, (IC_s), it reduces to

$$t \leq 2a,$$

Conversely, substituting the truthful disclosure conditions into the receiver's participation constraint, (IC_r), reduces it to

$$t \geq \frac{2a}{2\beta - 1},$$

Thus, with $\beta > 1$, if $a > 0$, then both participation constraints are met for the non-empty set of types,

$$t \in \left[\frac{2a}{2\beta - 1}, 2a\right] \equiv [\hat{t}, \bar{t}].$$

[3]Accordingly, it is not possible to elicit trade under full disclosure for every type. For example, if $a = 1$ and $\beta = 3/2$, then all constraints are satisfied for types $t \in [1, 2]$, whereas some constraints are violated for $t < 1$ and there is no trade for $t \geq 2$.

To further characterize the surplus-maximizing linear pricing and trade prohibition

[3]Of course, for $\beta \geq 2$ the "Lemons" problem disappears and truthful disclosure is no longer required for trade.

functions, note that

$$\alpha = -\tfrac{1}{2(\beta-1)} \Rightarrow \varphi(\hat{t}) = 0$$
$$a = 1 \Rightarrow \varphi(\bar{t}) = \varphi(2) = 1$$
$$a > 1 \Rightarrow \varphi(\bar{t}) = \varphi(2) < 1.$$

In particular, the probability of trade prohibition can be minimized to zero at the cutoff $\hat{t}$. Moreover, while $a > 1$ increases the cutoff $\hat{t}$, it also causes a lower probability of trade prohibition $\varphi(2)$, implying a trade-off when choosing $a \geq 1$. Specifically, it can be shown that if α is chosen such that $\varphi(\hat{t}) = 0$, then the surplus maximizing choice of a is $a = \frac{2\beta-1}{(1+6(\beta-1))^{\frac{1}{3}}} > 1$.

In addition to the declining probability of trade for higher quality units, the splitting of the surplus is critical here. The optimal pricing function is such that at $p(\hat{t})$, the entire surplus (the gain to trade) is allocated to the seller, while at $p(\bar{t})$, the entire surplus is allocated to the buyer. This seems to make perfect sense if one were to think of the optimal (linear) mechanism as a property of a working market. When demand is at its highest, i.e., at the low end of the quality range, sellers would likely have all the market power, while when demand is very thin as in the case of the highest priced assets, the market power advantage goes to the illusive buyer.

The implication here, is that in order to get some trade in the $t \in [0, T]$ case, at a *minimum*, two things must be the case. First it must be possible to separate the market into (at least) two groups; the "peaches" that exceeds some minimum standard $\hat{t} > 0$, and the true "lemons" that do not.[4] If this is possible, the worst lemons are

[4]Akerlof also suggests that minimum standards (such as the Nobel Prize) are helpful however for different reasons than the purpose they serve here.

sold with probability zero while the peaches can be sold with some positive probability $1 - \varphi(d)$. In sum, market segmentation combined with an exogenous probability of market failure in the market for peaches can serve as a partial antidote to complete endogenous market failure as in the case of Akerlof.[5]

As suggested by the analysis and discussion above, $a = 1$ represents a key benchmark in the "Lemons" setting. In this case the failure function in this particular case spans the range from $\varphi(1) = 0$ to $\varphi(2) = 1$. Of course, the determinants of a is not a focal point here. If markets are optimally designed, a depends on the specified objective defining what optimal is. However, note that if $a < 1$ there will also be market failure at the "top" end of the market because there will not be room for increasing the threat of failure with higher values of d to deter the sender from overstating. Thus truth-telling and trade beyond some $t < 2$ becomes infeasible. Also note (from (8)) that as a decreases from "1" the range of assets that can trade shrinks which is what making lower values of a less desirable from a liquidity standpoint.

That said, however, the key properties we identify seems to correspond perfectly to properties of most (all more likely) open markets. In particular, that free markets are free - as in Akerlof. Indeed, we show that with very little more than being able to exclude the worst apples and the willingness to walk away perhaps due to an item not being affordable, the peaches can trade at least with some likelihood, and information is shared at least to some degree honestly. Our analysis is meant to be suggestive in nature as we aim to provide new directions rather than a specific model or some sort of new dogma.

[5]Minimum standards are sufficient here. However, having several standards such as, for example, the grading of eggs might be even better.

The optimal (linear) Market Mechanism identified above was mainly obtained for the purpose of suggesting how and why open and free markets actually can work in the absence of verifiability and extreme consequences for lying. Still, we find the three features that emerge from this analysis intuitive and of some potential for guiding further studies of more organically organized markets. First, there is a minimum quality threshold for goods to be individually traded. Junk must somehow else be bundled or sit on someone's front lawn and some mechanism must exist to separate the peaches from the lemons. Second, surplus must be split in a way that allocates more to the buyer as the quality of the good increases. Finally, the higher the equilibrium price at which a good must trade at, trading must be less likely to occur. The higher the claimed quality, the less likely the potential buyer must be willing to buy!

Formal mechanism design aside, the first feature, while interesting in its own right, should not really be that controversial. Some sort of simple rules to segment markets seem both doable and and appear common in practice. Consider, for example, that some used car dealers offer only "certified" used cars where perhaps the certification stems from passing a "30 point inspection" or something like that. Other dealers on the other hand provides nothing of the sort but instead offer terms such as "no credit - no problem." The provision of some minimum standard seems to correspond quite nicely to some minimum level of a. A 30 point inspection does of course not tell the whole story, but it may well put a floor under t, the quality of the cars being offered for sale. No credit - no problem markets are for what is below the floor - cars that trade not because of their inherent value, but because of the mis-fortunes of the prospective buyers.

What people bring to market and at what price a deal can be reached seem also to be easily understood as integral parts of any functioning market. Markets are often "exclusionary" in that you know before entering that it is a flea market or and upscale one. And while haggling may be part and parcel of some markets, many have "fixed" prices with the potential for coupons or a special deal just for you. In other words, allocating surplus does seem to be a major concern for the parties involved at it does appear that markets that work do so exactly because both sides consider the allocations available such that they wish to participate.

However, while the third "optimal" market mechanism feature identified above may be considered equally natural, it turns out to be of critical importance for our specific purposes here and therefore also perhaps in need of a bit more discussion before we proceed. In particular because the prohibition of trade, while not entirely uncommon, does not appear to be common either. Obviously many transactions do require regulatory approval such as M&A activities, infrastructure projects, home remodeling and so on. And at least for the first two of these examples it might appear from casual empiricism that the more significant the surplus involved, the greater the likelihood that a regulator may block the deal which would make the regulatory intervention potentially consistent with an optimal mechanism: facilitating some trade and honest disclosure.

We interpret this feature of a functioning market differently, however. Specifically, in our view the "walking away" behavior seems part and parcel of free markets and we think there are good reasons why such behavior exists. In Akerlof buyers are limited in their buying ability as a group by their *aggregate* income. In the real world, individual buyers are limited by their personal income. Demand for assets of different price points should be (and is) dependent on individuals, and not all buyers as a collective, ability to pay.

In particular, many buyers may not be looking for the perfect and thus most expensive car - only the most discerning and wealthy few may have the income or feel comfortable or able to generate the liquidity required on short notice. At the other end of the market, presumably, any shopper that is frequenting the market actively would have what it takes to buy at some price. While this of course is again only suggestive in nature, more generally we argue that it is the very inability or reluctance of many buyers to buy more expensive offerings that makes some buying (and selling) possible here.

It seems to make a lot of intuitive and practical sense that there are more available buyers for the low cost assets while demand becomes increasingly scarce as the price increases. In the $a = 1$ case it would indeed be optimal if there is no reluctance to buy when a seller offers to sell at the lowest price (optimally) available in the upper half in the market while no-one buys from a seller that demands the highest possible price. Sellers disclose honestly in this case and the low end sellers capture the entire gain from trade (as demand is high) while at the very top, where demand is very limited, sellers must compete harder and the gains will therefore go to the buyers.

4 Liquidity and Disclosure

While some trade and truthful disclosure is possible in free markets as demonstrated above we recognize both the limits of the argument and the relevance for most functioning markets that involve disclosures. Surely open and free markets are less than perfect. In our analysis they must have some of the qualities identified above if they are to function. But a perfect match, optimal liquidity and full, honest disclosure is not, at least not always, how markets are perceived to function. Opacity seems to be a key feature of many situations of trade and surely is a central point of attention in the academic literature on disclosures.

With that in mind consider a simple deviation from an optimal peaches market examined above as follows. Suppose that the most costly available asset is always illiquid while the least costly is completely liquid as in the case where the optimal market is limited to exactly the upper half ($a = 1$) of the Akerlof quality distribution.[6] While again only suggestive in nature, consider now the case where $a > 1$, but where the market is still having the same liquidity properties such that $\varphi(a) = 0$ and $\varphi(2) = 1$ and for simplicity being linear, so that

$$\varphi(d) = \frac{d-a}{2-a}.$$

In other words, a market where the demand is more sensitive to price than what is optimal; trades that should optimally happen do not due to the more severe constraint on buyers income or liquidity.

What is of interest to us here is, that such a reduction in trade also leads to a reduction in disclosure. The friction we identify is (fortunately) somewhat different from any of those reducing disclosure in the VD literature. Higher quality sellers choose to pool with sellers with lower quality goods to reduce the risk of being shut out. In other words, it becomes better to take a lower price instead of running the risk of not selling at all. What is novel here is that when higher quality sellers masquerade as someone of lower quality (who cannot escape), the lower quality sellers are the ones

[6]This is the case when as in Akerlof $\beta = 3/2$ which is what we also assume in what follows.

suffering an expected loss. While they do get a better price by being included in a pool with higher quality sellers, their decreased chance of trading more than offsets this benefit.

The trade-off between getting a lower (average) equilibrium price for your goods vis-a-vis reducing the (average) probability that no-one want to buy from you seems completely natural to us as well. For example, when selling your house the realtor more than likely will discuss the implication of choosing an asking price for how quickly the house is expected to sell. To avoid not selling within a reasonable time frame or having to take the house off the market altogether, reducing the price below what the property could fetch absent information asymmetries, appears to be a very common strategy.[7]

Before proceeding, we wish to establish that with buyers being "oversensitive" to prices, full truthful disclosure can no longer be an equilibrium. Suppose it was. Then some type, say $\tilde{t}$, would be priced at $p(\tilde{d}) = a + \tilde{t}/2$, if trade occurs and a probability that it won't of $\varphi(\tilde{d}) = (\tilde{t} - a)/(2 - a)$. The expected overall utility for this individual thus is

$$EU_s = \varphi(\tilde{d}) \times \tilde{t} + (1 - \varphi(\tilde{d})) \times p(\tilde{d}).$$

But the effect of marginally understating his type is the negative of

$$\frac{\delta EU_s}{\delta d} = \frac{\tilde{t}}{2-a} - \frac{a + \tilde{t}/2}{2-a} + \frac{1 - \tilde{t}/2}{2-a},$$

which is strictly negative for $a > 1$. Accordingly, if some type $\tilde{t}$ is believed to be telling the truth, he will lie and claim to be a lower type.

[7]Pooling is part and parcel of this behavior too as setting the price just below some cut-off, say $300,000, is presumed to expose you to a different group of buyers than if you price it just above.

So consider instead a pool of types of length I, that is the difference between the highest and the lowest member in this pool. Relatively higher quality sellers will continue to pretend to be of lower value until for (high) marginal pool member, type δ for specificity, staying in that pool is equally as good as leaving; that is the marginal type in this pool is at the indifference point. Rationally, buyers should assign the average value to the pool, which we denote by $\overline{p}_I(\delta)$. Because, we have $p(d) = a + d/2$, the price assigned to any pool of length I with the highest type being type δ must thus be

$$\overline{p}_I(\delta) = p(\delta) - \Delta p_I,$$

where $\Delta p_I = I/4$. Similarly, it seems reasonable that buyers would have an average propensity, $\overline{\varphi}_I(\delta)$, to walk away from buying at that price meaning that

$$\overline{\varphi}_I(\delta) = \varphi(\delta) - \Delta\varphi_I,$$

where

$$\Delta\varphi_I = \frac{\delta - a}{2 - a} - \frac{\delta - I/2 - a}{2 - a} = \frac{I/2}{2 - a}.$$

It turns out being helpful considering the hypothetical case where the marginal (highest) type in a pool is facing the the decision of staying vs. revealing his type honestly and be treated accordingly. The indifference condition for the highest type, δ, in this pool then is

$$\overline{p}_I(\delta)(1 - \overline{\varphi}_I(\delta)) + \delta\overline{\varphi}_I(\delta) = p(\delta)(1 - \varphi(\delta)) + \delta\varphi(\delta),$$

which, using the expression for $\varphi(\delta)$ from above, simplifies to

$$\Delta p(\overline{\varphi}(\delta) - 1) = \Delta\varphi(\delta - p(\delta))$$

or also using the above expressions for Δp_I and $\Delta\varphi_I$,

$$I = 4(a - 1) \equiv I_0.$$

Notice that we nowhere made reference to the lowest type in the derivation here. Accordingly, any pool that makes the highest type indifferent between disclosing and staying in the pool must be of length I_0 regardless of "location." Now of course no such pool could be sustained on its own because the lowest types would refuse to stay unless a is the lowest type in the pool. But this particular "unit" pool is useful as a benchmark for several reasons.

Denote by γ the lowest type in the interval of length I such that

$$\gamma = \delta - I.$$

The impact on the expected value to the lowest type, γ, of being included in this pool rather than being treated individually then can be found as

$$(p(\gamma) + \Delta p_I)(1 - \overline{\varphi}_I(\gamma)) + \gamma\overline{\varphi}_I(\gamma) - p(\gamma)(1 - \varphi(\gamma)) - \gamma\varphi(\gamma),$$

$$\Delta p_I(1 - \overline{\varphi}_I(\gamma)) - \Delta\varphi_I(p(\gamma) - \gamma)$$

which after substitution yields

$$-\frac{a-1}{2(2-a)} \times I - \frac{1}{8(2-a)} \times I^2 \tag{3}$$

Similarly, the impact on the expected value to the highest type if he was to be included in a pool of size J rather than being treated individually can be obtained as

$$(p(\delta) - \Delta p_J)(1 - \overline{\varphi}_J(\delta)) + \delta\overline{\varphi}_J(\delta) - p(\delta)(1 - \overline{\varphi}_J(\delta) - \Delta\varphi_J) - \delta(\overline{\varphi}_J(\delta) + \Delta\varphi_J),$$

which after appropriate substitutions simplifies to

$$\frac{a-1}{2(2-a)} \times J - \frac{1}{8(2-a)} \times J^2. \tag{4}$$

So consider now the case where the highest type in the interval of length J is indifferent between staying in this pool or being the lowest member of the adjacent pool of length I (and vice versa). That is where the above two expressions are equal. For simplicity and wlog, let $I = BI_0$, $B \geq 0$, and $J = (B+\kappa)I_0$, with $\kappa > -B$. Substituting into expressions (3) and (4) and setting them equal, this indifference condition simplifies to

$$-B - B^2 = B + \kappa - B^2 - 2B\kappa - \kappa^2$$

or

$$-\kappa^2 + \kappa(1-2B) + 2B = 0$$

or

$$\kappa = 1.$$

Accordingly, suppose for the sake of argument that $B = 0$. Then, the intervals starting from the top of the the range of peaches will be of length I_0, $2I_0$, $3I_0$ and so on. The implication of this is straightforward. If we, for example, had a situation where K pools were to form, the combined length of such K pools with indifference points is then proportional to the triangular number for the number of such pools, K, in that the combined length is given as

$$\frac{K(K+1)}{2} \times I_0.$$

Obviously, that $\frac{K(K+1)}{2} \times I_0$ is equal to $2 - a$, and thus matches the length of the range of tradable peaches, is measure zero. So suppose K is the largest integer for which $\frac{K(K+1)}{2} \times I_0$ is less than $2 - a$. Then, by simply adding an interval of length BI_0 at the top of the range, where $BI_0 = {}^{\left(2-\mathrm{a}-\frac{\mathrm{K(K+1)}}{2}\times \mathrm{I_0}\right)}/_{(\mathrm{K}+1)}$, and also adding intervals of the same length to each of the initial K, senders at the boundaries of the now $K + 1$ intervals remain indifferent between the two adjacent intervals. Also, note that because $\overline{p}_{I_0}(2) = 2$, B must be no greater than one for type 2 to be willing to participate in the highest pool. Therefore, K *must* be the largest integer for which $\frac{K(K+1)}{2} \times I_0$ is less than (or equal to) $2 - a$.

Finally, it seems worthwhile to point out that for

$$I_0 \geq 2 - a,$$

which in the present model set-up means $a \geq 1.2$, all sellers of peaches pool at a price $\overline{p}_{2-a}(2) \geq 2$ while buyers walk away with probability $\overline{\varphi}_{2-a}(2) = .5$. No credible disclosure can take place and the market for peaches is a standardized supermarket type where the price is fixed and only some minimum level of quality can be assured. In other words, raising the minimum standard, a, may lead to less disclosure and more quality uncertainty faced by the consumer.

5 Summary

In this paper we suggest a new way to address the “Lemons” problem of Akerlof (1970) in his free market (Edgeworth Box) framework. We first note that the voluntary disclosure literature deviates from Akerlof in that it relies on ex-post verifiability of a seller’s disclosure and/or limitations to sellers ability or willingness to walk away. Of course, if information can be verified and sufficiently severe consequences for lying can be imposed and implemented the fundamental source of the original “Lemons” problem isn’t meaningfully present in the model.[8] And of course, if sellers cannot (or will not) walk away at any price, the potential for market failure is off the table as well. Consequently, as we illustrate, standard classic results at the heart of the disclosure literature do not obtain in the type of free market of Akerlof.

Our approach attempts to identify features of a free market setting where some credible disclosure can support some trade when the parties are free to walk away and where disclosures cannot be verified. The foundation for our analysis is the mechanism design approach of Myerson (1979). That is we first study the properties of an optimal solution to the “Lemons” problem by introducing an arbitrator that can dictate the terms of trade in the specific market setting of Akerlof where potential buyers and sellers have agreed to adhere to the rules provided by the arbitrator.

[8] If verification is costly, information asymmetry persists only if sellers think it is too expensive to eliminate it.

As in the example of Myerson (1979) the key to getting honest disclosure without verifiability is to tie the likelihood that the parties will be allowed to execute trade to the disclosure. Accordingly, the arbitrator specifies a pricing function and a trade prohibition function such that sellers disclose truthfully and both parties would prefer to trade. In the spirit of Akerlof our analysis is suggestive in nature and to keep the link to the original linear Akerlof setup and further choose to focus linear pricing rules and a probabilistic trade prohibition functions.

We show that for the specific model parameters of Akerlof getting trade (when allowed) is feasible but only for sub-segments of the market. Thus, in addition to price and prohibition, for the market to partially reopen, it must be possible to separate the "peaches" from the "lemons" by, for example, imposing some crude minimum standards such as a used car having to pass a 30 point inspection, accreditation for colleges or USDA certified beef. We focus on the market for "peaches" is a case where "peaches" can be separated from "lemons."

Although our solution originates in mechanism design we argue that regular markets do seem to have the features of the mechanism we obtain. Certified minimum standards are common place, branding of marketplaces serve to rule our unwanted experiences and so on. People, while agreeing on valuations, do not always buy at any price. Liquidity, wealth etc. differ and while we all would like to buy the most valuable item in the world, most cannot afford to do so. Thus, the liquidity chasing the most valuable assets as a general rule is less than for lower priced, less valuable ones. And prices that allocates the surplus according to the strength of the demand seems not only to be central to the very definition of a free market, it also central to facilitating trade.

We finally illustrate that when the price sensitivity of demand is higher than that of an optimal mechanism, trade remains possible, but full disclosure does not. With our specific model structure only intervals can be communicated and when the sensitivity becomes too high no disclosure is no longer feasible. Intervals, when disclosure is possible, are decreasing in length as the quality of the asset increases with the most precise disclosure for the best. Thus we have provided a new ideas for frameworks useful for understanding the role of non-verifiable information and new opportunities for linking disclosures to market segmentation and liquidity.

6 References

Akerlof, G., 1970, The Market for "Lemons:" Quality Uncertainty and the Market Mechanism. Quarterly Journal of Economics, pp. 488-500

Crawford, V., and J. Sobel, 1982, Strategic Information Transmission. Econometrica 50, pp. 1431-1451.

Dye, R., 1985, Disclosure of Nonproprietary Information. Journal of Accounting Research 23, pp. 123-145.

Grossman S., 1981, The Informational Role of Warranties and Private Disclosure about Product Quality. Journal of Law and Economics 24, pp. 461-483.

Jovanovic, B., Truthful Disclosure of Information. The Bell Journal of Economics 13, pp. 36 - 44.

Jung, W., and Y. Kwon, 1988, Disclosure When the Market Is Unsure of Information Endowment of Managers. Journal of Accounting Research 26, pp. 146-153.

Myerson, R., 1979, Incentive Compatibility and the Bargaining Problem. Econometrica 47. pp. 61-73.