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by

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THE WILLINGNESS-TO-ACCEPT/WILLINGNESS-TO-PAY DISPARITY IN REPEATED MARKETS: LOSS AVERSION OR 'BAD-DEAL' AVERSION?

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Abstract
Several experimental studies have reported that an otherwise robust regularity – the disparity between Willingness-To-Accept and Willingness-To-Pay – tends to be greatly reduced in repeated markets, posing a serious challenge to existing reference-*dependent* and reference-*independent* models alike. This paper offers a new account of the evidence, based on the assumptions that individuals are affected by good and bad deals relative to the expected transaction price (*price sensitivity*), with bad deals having a larger impact on their utility (*'bad-deal' aversion*). These features of preferences explain the existing evidence better than alternative approaches, including the most recent developments of loss aversion models.

Keywords: WTA/WTP disparity, price sensitivity, bad-deal aversion, reference-dependence, loss aversion.

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The disparity between the Willingness-To-Accept (WTA) and Willingness-To-Pay (WTP) measures of value has been one of the most widely studied behavioural regularities in the last four decades. The disparity – which has been documented in a large number of contingent valuation and experimental studies[1] – poses serious challenges to Hicksian consumer theory and its applications to welfare economics. While in Hicksian consumer theory WTA and WTP can reasonably be expected to differ only by a few percentage points (Willig, 1976; Randall and Stoll, 1980) many studies have reported differences of much higher orders of magnitude. Such large disparities suggest that indifference curves are not reversible (Knetsch, 1989), and imply that the impact of policies that produce changes resource allocation be evaluated indifferently using the two measures, nor can the resulting welfare changes be approximated by changes in consumer's surplus. If improvements and deteriorations are regarded as highly asymmetrical, the Coase theorem no longer holds. Even in the absence of transaction costs, the outcome of a negotiation critically depends on the allocation of property rights.

Yet, recently, several studies have found that the extent of the disparity is greatly reduced for experienced traders (List, 2003a, 2004) and when agents repeatedly interact in experimental markets (e.g. Shogren et al., 2001; Loomes et al., 2003).

Taken at face value, this whole body of evidence poses a theoretical puzzle. On the one hand, the existence and robustness of the disparity in one-off situations seems to indicate that preferences depart from the assumptions of standard consumer theory in systematic ways. This has led to the development of reference-*dependent* models that incorporate such departures (e.g. Tversky and Kahneman, 1991; Sugden, 2003; Köszegi and Rabin, 2006; Loomes et al., 2009). On the other hand, preferences elicited in experimental markets, in which subjects face feedback, repetition, and incentives, appear sometimes to be compatible with the properties generally assumed in reference-*independent* economic models.

This paper offers a solution to this puzzle based on an alternative account of the WTA/WTP disparity. The proposed explanation combines reference-independent consumer theory with a uni-dimensional notion of reference point represented by the expected transaction price. This modelling approach uses Wicksteed's (1910) intuition that buyers' behaviour is significantly affected by whether they regard prices as 'cheap' or 'dear', and extends early analyses of reference prices (e.g. Thaler, 1985; Putler, 1992).

In the model, agents have reference-independent valuations for consumption goods, as in standard consumer theory. In addition, they are assumed to be *price sensitive* and *'bad-deal' averse* in their transactions. This means that they like making good deals and dislike being ripped off (*price sensitivity*), and that the pain associated with bad deals is greater than the pleasure derived from same-sized good deals (*'bad-deal' aversion*). Good and bad deals are defined relative to the *expected price* of the transaction. These intuitive assumptions turn out to explain the evidence of experimental markets better than competing explanations, including the latest developments of reference-dependent consumer theory based on the well-known notion of *loss* aversion (e.g. Loomes et al. 2009; Köszegi and Rabin, 2006).

The remainder of this paper is organised as follows. Section 1 summarises the stylised facts concerning the WTA/WTP disparity. The basic model is presented in Section 2. Section 3 derives WTA and WTP for price sensitive and bad-deal averse agents, while Section 4 applies the model to repeated auctions. Section 5 discusses the model's implications and the related theoretical literature. Section 6 concludes.

[1] For a review see Horowitz and McConnell (2002).

1. THE DISPARITY BETWEEN WTA AND WTP: STYLISED FACTS

The numerous studies that investigate WTA/WTP disparities in one-shot and repeated market experiments have highlighted a series of regularities, which will be used as a benchmark to assess the descriptive plausibility of various theoretical explanations that have so far been put forward.

This paper is mainly concerned with four stylised facts. The first is the WTA/WTP disparity itself. The second is the tendency for the disparity to decay when WTA and WTP are elicited in repeated markets. The third is represented by the so-called *shaping effects*, that is, the tendency of WTA and WTP valuations reported in repeated markets to move in the direction of observed market prices. The fourth and final stylised fact is the finding that WTA and WTP tend to be different when elicited in different versions of the same demand-revealing auction mechanism. The empirical support for each of the stylised facts is summarised below.

1.1 The WTA/WTP disparity

The WTA/WTP disparity appears to be an extremely robust and replicable phenomenon. It has consistently been found in contingent valuation studies (e.g. Hammack and Brown, 1974; Freeman, 1979; Rowe et al., 1980; Schulze et al., 1981), one-shot experiments (e.g. Knetsch and Sinden, 1984; Boyce et al., 1992; Bateman et al., 1997), and in repeated market experiments (e.g. Coursey et al., 1987; Shogren et al. 1994, 2001; Knetsch et al., 2001; Loomes et al., 2003). In a recent review, Horowitz and McConnel (2002) report that the median ratio between mean WTA and mean WTP in forty-five of these studies is 2.6 (median 7.2). With rare exceptions, most notably Plott and Zeiler (2005), there seems to be unanimous agreement in the literature about the existence of the disparity as an empirical regularity.[2]

1.2 The decay of the disparity

As mentioned in the introduction, several experimental studies have shown that the extent of the WTA/WTP disparity tends to be greatly reduced when valuations are elicited in repeated experimental markets. Most of the studies documenting this decay have used variants of the Vickrey auction (Vickrey, 1961).[3] In a k^{th}-price buying (respectively, selling) auction, n players submit a bid to buy (sell) one unit of a commodity. The players submitting the $k-1$ highest (lowest) bids buy (sell) one unit at a price equal to the k^{th} highest (lowest) bid ($2 \leq k < n$). The value of k is usually known in advance, but in the random variant it is randomly determined after valuations are submitted. In what follows, the person submitting the k^{th} highest (lowest) bid will be referred to as the marginal trader. The marginal trader sets the price and is just not willing to trade at that price. When values are *private*, as it can be confidently assumed in most of the literature reviewed in this Section, Vickrey auctions promote truthful revelation of values, for bidding one's true valuation for the good is a (weakly) dominant strategy.[4] In addition, since determining the market price only requires that bids are rank-ordered, these auctions are also relatively easy to implement in the lab.

Starting with Coursey et al. (1987), experiments employing various variants of this auction mechanism have usually documented a tendency for the initially strong disparity to get reduced over successive rounds. The decay has been found to be particularly pronounced in the 2nd-

[2] As explained in Section 6.1, Plott and Zeiler's (2005) hypothesis that WTA/WTP disparities are due to errors and misconceptions seems to be insufficient to explain the evidence reviewed here.

[3] Kahneman et al. (1990) use a different market institution, in which the price is determined so as to equate demand and supply once bids and asks are submitted. They report significant undertrading throughout repetitions, but the evolution of bids and offers cannot be clearly seen from their data.

[4] This is not necessarily the case in common value auctions (see Milgrom and Weber, 1982).

price version. For example, Shogren et al. (1994) report that initial WTA/WTP ratios of two or more decrease to much lower values after ten repetitions, with final ratios often not significantly greater than one. Similar findings are reported by Shogren et al. (2001), and Knetsch et al. (2001).[5] For various types of goods and numbers of repetitions, the pattern seems to be the same: the disparity tends to decay when subjects interact in 2nd-price auctions. Using the median-price version of the auction, in which buying and selling prices are comparable,[6] Loomes et al. (2003) find that the disparity generally persists – although in a less pronounced way – after six repetitions, but is completely eroded at the level of the market prices. It seems, therefore, that the second stylised fact can be stated more precisely as a general decay of the disparity, accompanied by its complete erosion at the margin.

1.3 Shaping effects

The decay of the disparity has been interpreted as suggesting that individuals' underlying preferences have the property that WTA ≈ WTP as in Hicksian theory. However, as Loomes et al. (2003) note, the convergence of valuations in 2nd-price auctions can be explained by much simpler mechanisms. In fact, in a 2nd-price auction with more than three traders, mean WTA would decrease and mean WTP would increase if all participants revised their valuations in the direction of observed market prices, simply because there are relatively more sellers whose WTAs are higher than the market price, and relatively more buyers whose WTPs are lower than the market price. They label this tendency a *shaping effect*, because it suggests that the market *shapes* valuations rather than revealing them. A confirmation of this conjecture is the finding, reported by Knetsch et al. (2001), that in 9th-price auctions with ten traders per group average WTA tends to increase, while average WTP decreases as the market is repeated.[7] And this evidence is consistent with Cox and Grether's (1996) finding that past prices are significant predictors of reported valuations.

Loomes et al. (2003) also provide more evidence in favour of the shaping hypothesis. They conduct median-price auctions in which traders report valuations for either a *low-value* or a *high-value* lottery. Depending on whether the majority of traders are endowed with the high- or the low-value lottery, the market price will tend to be relatively higher or lower, producing systematically different price feedback. Loomes et al. report that, as the market is repeated, valuations move in the direction of the price feedback as predicted by the shaping hypothesis. Reconciling shaping effects with the existence of consistent preferences appears to be a rather challenging task.

1.4 Sensitivity to the auction rules

The fourth and last regularity is not a stylised fact by virtue of its repeated occurrence, but because of its interesting implications and the fact that none of the existing models is able to explain it. The regularity consists in the unexpected difference between initial valuations for different, but from a theoretical point of view equivalently demand-revealing, versions of the Vickrey auctions. This finding, reported by Knetsch et al. (2001) using the 9th- than in the 2nd-

[5] Harless (1989) also uses the 2nd-price auction in a one-shot within-subject design, reporting a non-significant median WTA/WTP ratio of 1.33, but his sample size (23 subjects) is quite small compared to the other studies.
[6] This is not true in general for the other non-random versions of the auction. In a 2nd-price auction with more than three players, for example, if traders report their true valuations, the buying price should be higher than the selling price.
[7] Braga et al. (2009) conduct a similar comparison of the 2nd-price and second-to-last auctions for lottery tickets. In their experiment, subjects not only receive feedback on market prices, but also on the outcome of the lottery. Although they do not report such an extreme divergence in the evolution of WTA valuations over repetitions, they find evidence that valuations *do* tend to move in the direction of observed prices. Strikingly, this finding also holds true when they use the random version of the auction, in which market prices are much more erratic signals.

price auctions, is also observed in a within-subject design in which the same individuals simultaneously take part in the two auctions. In both occasions, mean WTA (WTP) in the first auction period is higher (lower) in the 9th- than in the 2nd-price version, as if subjects were anticipating the price to be different in the two cases. This sensitivity of valuations to the auction rules suggests that not only do institutional features affect behaviour after feedback is provided, as shown by shaping effects, but they can have an impact even before any information is fed back to subjects. As will be explained in Section 5, none of the existing explanations for the disparity can explain this finding. On the contrary, the model presented in the next Sections nicely fits with all the stylised facts.

2. THE MODEL

In a recent article, Brown (2005) has reported that, contrary to what one would expect according to the most popular versions of reference-dependent theory (Tversky and Kahneman, 1991; Köszegi and Rabin, 2006), if subjects are asked to 'think aloud' when stating their WTA and WTP valuations, and to motivate any discrepancy between the two values, they mention the pain associated with departing with endowments extremely rarely (less than 3% of the occasions). By far, the most recurrent motivations are associated with some notion of intrinsic utility (35% overall), seeking a good deal or avoiding a bad deal (17%), and some reference to the cost or price to pay to acquire the good in question (14%).[8] These findings inspired the theoretical model presented in this Section.

In the model, agents have reference-independent preferences for money and consumption goods, which, consistently with standard consumer theory, are such that WTA ≈ WTP. In addition, depending on how the actual price compares with the expected price, they derive extra positive utility from good deals – i.e. buying low, selling high – and negative utility from bad deals – i.e. buying high, selling low. This tendency is labelled *price sensitivity*, because the ex ante evaluation of a transaction depends on the expected price, which becomes the agent's reference point. For a given absolute discrepancy between the actual and the expected price, the impact of a bad deal is assumed to be larger than that of a good deal. This feature of preferences is named *bad-deal aversion*.[9]

A possible justification for using the expected price to evaluate a transaction comes from the fact that most of the transactions that people ordinarily make require them to decide whether or not to trade at the posted price. What is assumed here is that, when they are faced with the related, though more unusual, decision of stating a WTA or a WTP valuation, they construe the problem in as close a way as possible. They form an expectation of what the price will be and consider the counterfactual situations of trading at other prices. Given their expectations, the WTA and WTP valuations are determined by the value of the actual price that leaves them indifferent between trading and not trading.

These ideas are most easily formalised in a simplified scenario with only two goods, money (m) and a consumption good (x). Agents derive utility from how much of m and x they consume,

[8] The percentages are obtained from Brown (2005, Table 2, p. 373), which categorises subjects' responses according to the reported motivation. The loss aversion figure is the sum of the values in rows 11 and 12; the intrinsic value percentage refers to rows 1 and 2, seeking a good deal to row 3, and the price to pay to acquire the good to row 4.

[9] The label 'bad-deal aversion' is used here to differentiate it from the general notion of loss aversion, i.e. the idea that, relative to a reference point, losses loom larger than corresponding gains. In most applications of reference-dependent theory, loss aversion applies to changes of holdings of goods relative to a multi-dimensional reference point (current endowment, customary consumption, or expected transaction outcome), and it is often assumed that it does *not* apply to money outlays (e.g. Tversky and Kahneman, 1991). By contrast, bad-deal aversion only applies to (expected) losses of *money* relative to the expected price, and only matters if transactions actually occur. In this sense, bad-deal aversion can be regarded as a form 'loss aversion without endowment effect' (Brown, 2005).

and from the *net monetary gain* of the transaction (z) leading to the particular (m, x) combination. Their utility function takes the form:

$$U(m, x, z) = v(m, x) + f(z) \tag{1}$$

where

$$z = \Delta x \cdot (p^e - p) \tag{2}$$

In Equation (2), Δx is the change in the quantity of *x*, which is positive when agents buy and negative when they sell, p^e is the expected price of the transaction, and *p* is the actual price.[10] Positive monetary gains $(z > 0)$ are regarded as *good deals*, while monetary losses $(z < 0)$ are *bad deals*. In a buying scenario, $(\Delta x > 0)$, good deals consist in paying less than expected $(p^e > p)$ and bad deals in paying more $(p^e < p)$. In a selling situation, $(\Delta x < 0)$, good deals occur for prices above expectations $(p^e < p)$, and bad deals for prices below $(p^e > p)$.[11]

According to Equation (1), the overall utility of any (m, x, z) combination is given by the sum of a reference-independent component, $v(m, x)$, and a reference-dependent component, $f(z)$. The function $v(m, x)$ is assumed to be twice continuously differentiable, and such that $\frac{\partial v}{\partial m} > 0$, $\frac{\partial v}{\partial x} > 0$, $\frac{\partial^2 v}{\partial m^2} \le 0$, $\frac{\partial^2 v}{\partial x^2} \le 0$, and $\frac{\partial^2 v}{\partial m \partial x} \ge 0$. In other words, the reference-independent utility is increasing at a non-increasing rate in both *m* and *x*. The function $f(z)$ reflects the impact of good and bad deals. It is assumed to be differentiable everywhere except at $z = 0$, and to possess the following properties:

$$f(0) = 0 \tag{3}$$

$$\frac{\mathrm{d}f}{\mathrm{d}z} \ge 0 \qquad (z \ne 0) \tag{4}$$

$$f(\tilde{z}) + f(-\tilde{z}) \le 0 \qquad \tilde{z} \ne 0 \tag{5}$$

Equation (3) implies that $U(m', x', 0) = v(m', x')$ for all (m', x') pairs. Thus, the model reduces to reference-independent utility if there is no trade $(\Delta x = 0)$, or if trade occurs at the expected price $(p = p^e)$. Given (3), expression (4) entails that good deals have a non-negative impact on utility, while bad deals have a non-positive effect. Expression (5) states that the absolute impact of a bad deal cannot be smaller than that of the corresponding good deal. Although $f(.)$ can be kinked at $z = 0$, this is not necessary for the qualitative results of the model. In what follows, (3)–(5) are assumed to hold throughout, and the following definitions apply.

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[10] In principle, Δx can be interpreted as either the *expected* trade at p^e, or the *actual* trade at *p*. Although the distinction is irrelevant for what follows, the latter interpretation is more in the spirit of the argument.

[11] The presence of expectations in the utility function, which is not a common modelling approach in economics, is reminiscent of the utility transformation introduced by Geanakoplos et al. (1989) in their psychological games. Geanakoplos et al. assume that the utility associated with a given combination of strategies depends not only on the outcomes that the strategies produce, but also on players' prior beliefs about which strategy will be played. In the present context, for a buyer the expected price can be interpreted as their belief about what the other player will charge. The utility associated with the final outcome of a transaction will depend on how the actual price compares with this belief, with higher levels of utility for good deals and lower for bad deals. I thank Steffen Huck for pointing out this similarity.

Definition 1 (Price sensitivity) *Preferences satisfy* ***strict (weak)*** *price sensitivity when expression (4) holds strictly (weakly). There is* ***zero*** *price sensitivity when expression (4) holds as an equality for all z.*

Definition 2 (Bad-deal aversion) *Preferences are said to satisfy* ***strict (weak)*** *bad-deal aversion when expression (5) holds strictly (weakly). There is* ***zero*** *bad-deal aversion when expression (5) holds as an equality for all z.*

The model is stated in terms of *weak* price sensitivity and *weak* bad-deal aversion, of which *strict* and *zero* price sensitivity and bad-deal aversions are special cases. Bad-deal aversion, in whatever form, requires weak price sensitivity, while zero price sensitivity also entails zero bad-deal aversion, for it means that $f(z)=0$ for all *z*. As will be shown in Sections 3 and 4, the qualitatively interesting results of the model are easier to illustrate for strict price sensitivity and/or strict bad-deal aversion.

Equation (1) can also be used to formally define WTA and WTP. In general, the WTA is the minimum amount of money that compensates an agent for giving up part of her endowment, while the WTP is the maximum amount of money she would be willing to sacrifice for an increase in the quantity of another good. The following definitions of WTA and WTP will be used.

Definition 3 (WTA) *Consider an agent endowed with* (m_0, x_1)*, who is contemplating selling* $x_1 - x_0$ *units of x,* $x_1 > x_0$*, at a unit price of p, when expecting the price to be* p^e*. Her WTA is the positive change in m,* Δm*, at which she is just indifferent between selling and keeping her endowment, with* $\Delta m = -p\Delta x$*, and* $\Delta x = x_0 - x_1 < 0$*. In other words, WTA is the value of* Δm *satisfying:*

$$v(m_0 + \Delta m, x_0) + f(p^e \Delta x + \Delta m) = v(m_0, x_1) \tag{6}$$

When *zero* price sensitivity and *zero* bad-deal aversion are imposed, $f(z)=0$ for all z. Then, Equation (6) reduces to:

$$v(m_0 + \Delta m, x_0) = v(m_0, x_1) \tag{7}$$

The value of Δm at which (7) is satisfied defines the *reference-independent* WTA (RIWTA). Also notice that, for a person who is just willing to accept the expected price, $\mathrm{WTA} = -p^e \Delta x$, which in turn gives $p^e \Delta x + \Delta m = 0$. Equation (6) again reduces to Equation (7). The WTA of a person who is just willing to accept the expected price coincides with her RIWTA.

Definition 4 (WTP) *Consider an agent endowed with* (m_0, x_0)*, who contemplates buying* $x_1 - x_0$ *units of x at a unit price of p, when expecting to pay* p^e *per unit. Her WTP is the positive change in money,* Δm*, that leaves her indifferent between buying and not buying, with* $\Delta m = p\Delta x$*, and* $\Delta x = x_1 - x_0 > 0$*. That is, WTP is the value of* Δm *satisfying:*

$$v(m_0 - \Delta m, x_1) + f(p^e \Delta x - \Delta m) = v(m_0, x_0) \tag{8}$$

Under *zero* price sensitivity and *zero* bad-deal aversion, $f(z)=0$ for all z. Then, Equation (8) becomes:

$$v(m_0 - \Delta m, x_1) = v(m_0, x_0) \tag{9}$$

The value of Δm for which Equation (9) is satisfied corresponds to the agent's *reference-independent* WTP (RIWTP). When she is just willing to pay the expected price, $\text{WTP} = p^e \Delta x$, so that $p^e \Delta x - \Delta m = 0$. In such a situation, Equation (8) reduces to Equation (9), implying that the WTP of a person who is just willing to pay the expected price is equal to her RIWTP.

For analysing the small quantity changes typically considered in the experimental literature, the model can be simplified as follows. Let γ be a positive constant representing the marginal rate of substitution between x and m computed at the buyer's endowment, (m_0, x_0), that is:

$$\gamma = -\left.\frac{\partial v/\partial x}{\partial v/\partial m}\right|_{(m_0, x_0)}$$

For sufficiently small changes in the quantity of x, the marginal rate of substitution between x and m will be treated as constant and equal to γ. Then, the reference-independent utility function $v(.)$ can be written in normalised linear form as:

$$v(m, x) = m + \gamma x \tag{10}$$

When the change in the quantity of x is small, that is, when Δx approaches zero, z also approaches zero. Letting $\alpha = \lim_{z \to 0^+} \frac{\mathrm{d}f}{\mathrm{d}z}$ and $\beta = \lim_{z \to 0^-} \frac{\mathrm{d}f}{\mathrm{d}z}$, Expressions (3)–(5) imply that $\alpha \geq 0$ and $\beta \geq \alpha$.

For small quantity changes, $f(z)$ can then be written as:

$$f(z) = \begin{cases} \alpha z & z > 0 \\ -\beta z & z \leq 0 \end{cases}$$

or, more concisely as:

$$f(z) = \alpha \max(z, 0) + \beta \min(z, 0) \tag{11}$$

In this limiting scenario, weak price sensitivity requires $\alpha \geq 0$, strict price sensitivity entails $\alpha > 0$, and zero price sensitivity, which also implies zero bad-deal aversion, requires $\beta = \alpha = 0$. Since $\beta \geq \alpha$, bad-deal aversion requires weak price sensitivity, with $\beta \geq \alpha$ and $\beta > \alpha$ representing weak and strict bad-deal aversion respectively. Strict price sensitivity *and* strict bad-deal aversion make the reference-dependent component strictly increasing, two-piece linear, and kinked at $z = 0$.

Substituting (10) and (11) into (1) gives a simple expression for the overall utility function $U(.)$, which holds in the limiting case:

$$U(m, x, z) = m + \gamma x + \alpha \max(z, 0) + \beta \min(z, 0) \tag{12}$$

In what follows, this will be referred to as the *special case* of the model. Given its linearity, the special case makes the application of the model to the typical experimental set up in which only one unit of the consumption good is either bought or sold (i.e. $|\Delta x| = 1$) very straightforward. With no loss of generality, the endowment of a person who contemplates buying one unit of x, (m_0, x_0), can be normalised to $(0,0)$. The corresponding initial endowment of a person who is selling one unit, (m_0, x_1), becomes $(0,1)$. The WTA valuation for giving up one unit of x and the WTP valuation for buying one unit can now be easily derived.

Let $F(p, p^e)$ denote the *net* utility of selling one unit of x at price p when the expected price is p^e. Using Equation (12) yields:

$$F(p, p^e) = p + \alpha \max(p - p^e, 0) + \beta \min(p - p^e, 0) - \gamma$$

$F(p, p^e)$ is monotonically increasing in p and two-piece linear, with a kink at $p = p^e$, where it equals $\overline{F}(p) = p - \gamma$, the net utility of selling one unit of x in the reference-independent case. According to Equation (6), the WTA can be found as the value of p satisfying the condition that $F(p, p^e) = 0$. Then, simple algebra shows that:

$$\text{WTA}(p^e) = \begin{cases} \dfrac{1}{1+\beta}\gamma + \dfrac{\beta}{1+\beta} p^e & \gamma < p^e \\ \dfrac{1}{1+\alpha}\gamma + \dfrac{\alpha}{1+\alpha} p^e & \gamma \geq p^e \end{cases} \tag{13}$$

Similarly, let $G(p, p^e)$ denote the net utility of buying one unit of x at price p when the expected price is p^e. Equation (12) implies:

$$G(p, p^e) = \gamma - p + \alpha \max(p^e - p, 0) + \beta \min(p^e - p, 0)$$

$G(p, p^e)$ is monotonically decreasing in p, two-piece linear and kinked at $p = p^e$, where it equals $\overline{G}(p) = \gamma - p$, the reference-independent utility deriving from buying one unit of x at price p. Then, Equation (8) defines the agent's WTP as the value of p for which $G(p, p^e) = 0$, that is:

$$\text{WTP}(p^e) = \begin{cases} \dfrac{1}{1+\alpha}\gamma + \dfrac{\alpha}{1+\alpha} p^e & \gamma < p^e \\ \dfrac{1}{1+\beta}\gamma + \dfrac{\beta}{1+\beta} p^e & \gamma \geq p^e \end{cases} \tag{14}$$

Equations (13) and (14) show that under (weak) price sensitivity and (weak) bad-deal aversion, WTA and WTP become functions of the expected price. These expressions are all that is needed to prove the main results of the paper, which are presented in the next two Sections. Section 3 explores the relationship between WTA and WTP, showing under which conditions WTA exceeds WTP. Section 4 applies the model to the case of repeated Vickrey auctions.[12]

[12] The results presented in the next two Sections are derived for the special case, for it has the advantage that the RIWTA and RIWTP valuations coincide, and that the expressions for WTA and WTP are easy to work out. The general case has to deal with the extra complication coming from the fact that RIWTA and RIWTP are not equal. However, entirely analogous results can be proven for the general case using a second-order Taylor expansion of *v*(.).

3. GENERAL RESULTS

In this Section, price expectations are treated as *exogenous*, and the special case of the model (Equation (12)) is used to explore the implications of price sensitivity and bad-deal aversion for the WTA and WTP valuations. Before turning to that task, Result 1 shows that the special case always implies WTA = WTP for zero price sensitivity and zero bad-deal aversion.

Result 1 (Reference-independence) *For sufficiently small changes in the quantity of x, zero price sensitivity and zero bad-deal aversion imply* WTA = WTP = γ = RIWTA = RIWTP *for all* p^e.

Proof. In the special case, zero price sensitivity and zero bad-deal aversion entail $\beta = \alpha = 0$. $\mathrm{WTA} = \mathrm{WTP} = \gamma$ follows from substituting this condition into Equations (13) and (14). $\gamma = \mathrm{RIWTA} = \mathrm{RIWTP}$ follows from observing that the conditions $F(p, p^e) = 0$ and $G(p, p^e) = 0$ reduce to $\overline{F}(p) = 0$ and $\overline{G}(p) = 0$ respectively when $\beta = \alpha = 0$, with $\overline{F}(p) = p - \gamma$ and $\overline{G}(p) = \gamma - p$. Since $\overline{F}(p) = 0$ and $\overline{G}(p) = 0$ define RIWTA and RIWTP in the special case, $\mathrm{RIWTA} = \mathrm{RIWTP} = \gamma$.

QED

Result 2 (Effect of price sensitivity) *For sufficiently small changes in the quantity of x, strict price sensitivity implies:*

i) $\gamma < \mathrm{WTP} \le \mathrm{WTA} < p^e$ if $\gamma < p^e$

ii) $\gamma = \mathrm{WTP} = \mathrm{WTA} = p^e$ if $\gamma = p^e$

iii) $p^e < \mathrm{WTP} \le \mathrm{WTA} < \gamma$ if $\gamma > p^e$

Proof. In the special case, strict price sensitivity entails $\alpha > 0$. Irrespective of bad-deal aversion $(\beta \ge \alpha)$, the result follows immediately from noting that WTA and WTP in Equations (13) and (14) are weighted averages of γ and p^e. As such, they always lie between these two values.

QED

Leaving aside the relationship between WTA and WTP, which mainly depends on bad-deal aversion (see Result 3 below), the main implication of Result 2 is that the WTA and WTP valuations always lie between the reference-independent valuation and the price expectation. When the agent expects the price to coincide with her reference-independent valuation, she is willing to accept no less, and willing to pay no more, than this value. When she expects a higher price, she *overasks* and *overbids*, that is, both her WTA and her WTP exceed her intrinsic valuation. Intuitively, selling for as little as γ results in a bad deal that leaves the agent worse-off relative to not selling. On the other hand, bidding only γ prevents her from buying at advantageous prices. By overasking, the agent discounts the disutility of a bad deal, while by overbidding she takes into account the extra pleasure deriving from making a good deal. Similarly, when the price expectation lies below the intrinsic valuation, agents *underask* in order not to forgo possible good deals, and *underbid* to avoid making bad deals. This tendency appears whenever agents are (strictly) price sensitive $(\alpha > 0)$, regardless of whether they are bad-deal averse or not $(\beta \ge \alpha)$.

As the following Remark stresses, a closer look at Equations (13) and (14) shows that price sensitivity has another important implication.

Remark 1 *WTA and WTP are increasing in the price expectation p^e.*

Price expectations determine if a given actual price p represents a good or a bad deal, the size of which is a function of the absolute difference between the two prices – see Equation (2). The larger this difference, the larger the impact on overall utility and on WTA and WTP.

The following result shows what happens when agents are not only price sensitive, but also bad-deal averse.

Result 3 (Effect of bad-deal aversion) *For small quantity changes, strict price sensitivity and strict bad-deal aversion imply:*

i) $\gamma < WTP < WTA < p^e$ if $\gamma < p^e$

ii) $\gamma = WTP = WTA = p^e$ if $\gamma = p^e$

iii) $p^e < WTP < WTA < \gamma$ if $\gamma > p^e$

Proof. In the special case, strict price sensitivity and strict bad-deal aversion imply $\beta > \alpha > 0$.

i) WTA and WTP are weighted averages of γ and p^e. The weight attached to the smaller of the two values, γ, is higher for WTP than for WTA. When $\beta > \alpha$, $1/(1+\alpha) > 1/(1+\beta)$. Since weights always add up to one, $\alpha/(1+\alpha) < \beta/(1+\beta)$, that is, the larger value, p^e, is weighed more in WTA than in WTP.

ii) This follows immediately from substituting $p^e = \gamma$ in any of the expressions in (13) and (14).

iii) Same as *i)*. Compared to WTP, WTA gives more weight to the higher, and less to the lower, of γ and p^e.

QED

The following Remark shows that bad-deal aversion $(\beta > \alpha)$ is a necessary condition for the WTA/WTP disparity to occur, and that the size of the disparity depends on the distance between the intrinsic valuation and the expected price.

Remark 2 *Equations (13) and (14) imply that the difference between* WTA *and* WTP *increases with the distance between γ and p^e. That is:*

$$\text{WTA} - \text{WTP} = \frac{\beta - \alpha}{(1+\alpha)(1+\beta)} \cdot |\gamma - p^e| \qquad (15)$$

The intuition behind Result 3 can be illustrated with reference to Figures 1 to 3. In each Figure, $F(p, p^e)$ represents the net utility of selling one unit of x at price p when the expected price is p^e for a strictly price sensitive and strictly bad-deal averse agent whose intrinsic valuation is γ. It is monotonically increasing in p, kinked at $p = p^e$, with a slope of $1+\beta$ for $p < p^e$, and $1+\alpha$ for $p > p^e$. The corresponding net utility in the reference-independent case, $\overline{F}(p) = p - \gamma$, is depicted as the increasing straight dashed line with a slope of 1. $G(p, p^e)$ and $\overline{G}(p)$ are the net utilities of buying one unit of x in the reference-dependent and reference-independent case

respectively. $G(p, p^e)$ is monotonically decreasing in *p*, kinked at $p = p^e$, and sloped $-(1+\alpha)$ for $p < p^e$ and $-(1+\beta)$ for $p > p^e$. $\overline{G}(p)$ is the straight dashed line with a slope of -1. Both $F(p, p^e)$ and $G(p, p^e)$ are steepest for prices that correspond to bad deals.
As explained in Section 2, WTA and WTP are defined by the condition that the net utilities of selling and buying are equal to zero. In the reference-independent case both conditions are satisfied for $p = \gamma$, where the $\overline{F}(p)$ and the $\overline{G}(p)$ curves intersect. That is, if preferences are reference-independent, both WTA and WTP equal the intrinsic valuation. When price sensitivity and bad-deal aversion are added, this is no longer true in general. WTA is defined by the condition $F(p, p^e) = 0$, while WTP satisfies $G(p, p^e) = 0$. Figures 1 to 3 refer to the three possible cases.

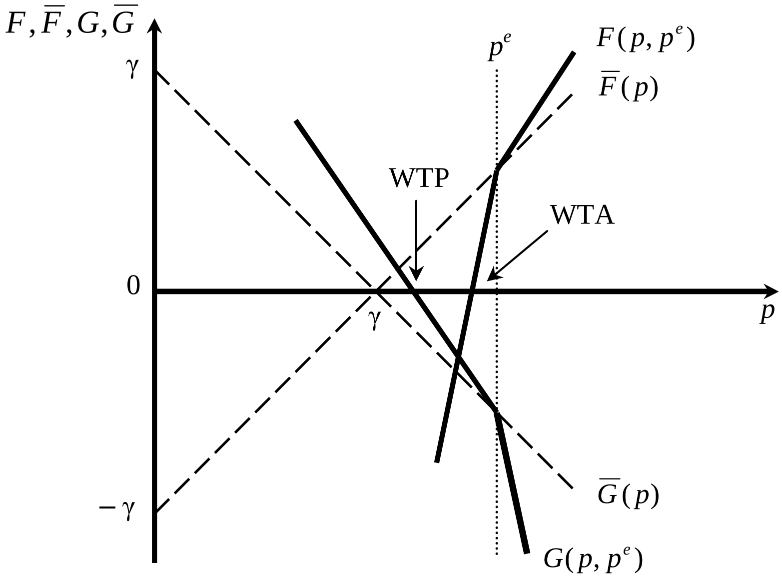

Figure 1 – WTA and WTP when $\gamma < p^e$

If $\gamma < p^e$ as in Figure 1, $F(p, p^e)$ cuts the horizontal axis where its slope is $1+\beta$, while $G(p, p^e)$ cuts it where its slope is $-(1+\alpha)$. This makes WTA greater than WTP. In other words, overasking is a result of price sensitivity *and* bad-deal aversion, while overbidding is only due to price sensitivity.
When $\gamma = p^e$ as in Figure 2, the four curves all intersect the horizontal axis where $p = \gamma$. If the agent does not make good nor bad deals, there is no disparity, and WTA and WTP are both equal to the intrinsic valuation γ, as in the reference-independent case.

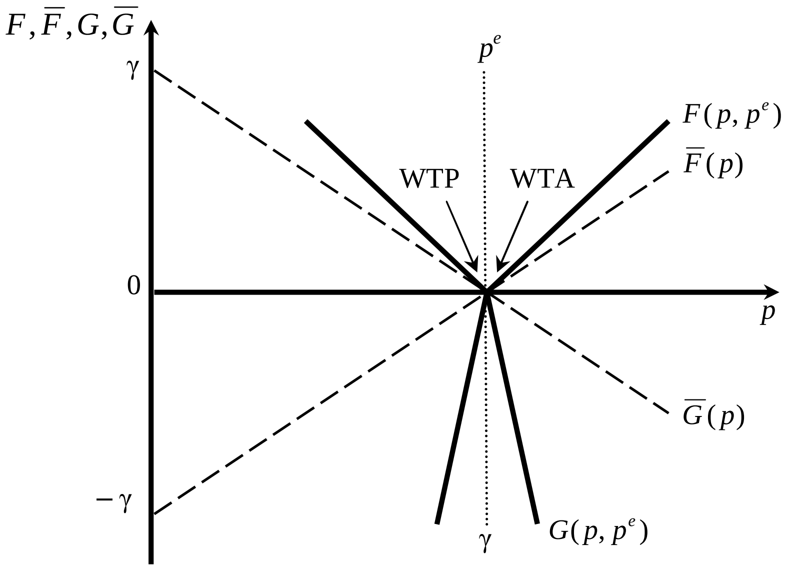

Figure 2 – WTA and WTP when $\gamma = p^e$

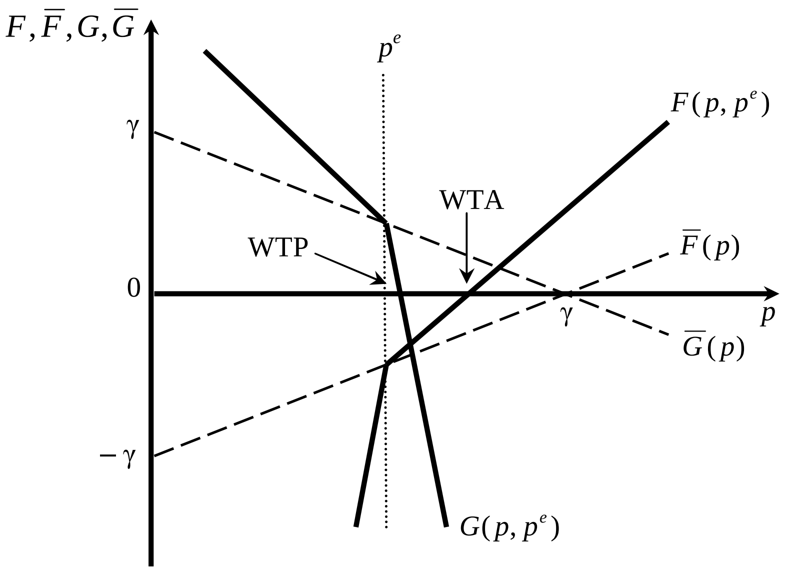

Figure 3 – WTA and WTP when $\gamma > p^e$

Finally, when $\gamma > p^e$ as shown in Figure 3, the agent underasks because of price sensitivity – the $F(p, p^e)$ curve cuts the horizontal axis where its slope is $1+\alpha$ – and underbids because of both price sensitivity and bad-deal aversion – the $G(p, p^e)$ curve intersects the p axis where its slope equals $-(1+\beta)$. Again, WTA exceeds WTP because of bad-deal aversion.

Since there is no a priori reason for the expected price to always coincide with the reference-independent valuation, bad-deal aversion is the key to explain the first stylised fact. Interestingly, for any given level of bad-deal aversion, if the distribution of price expectations is more dispersed for goods which are not ordinarily traded in markets than for market goods, Remark 2 leads to expect a larger disparity for the former than for the latter, as reported by Horowitz and McConnell (2002).

4. BIDDING IN REPEATED VICKREY AUCTIONS

This Section explores the implications of price sensitivity and bad-deal aversion for bidding behaviour in repeated k^{th}-price selling (buying) auctions. Since most applications deal with relatively small quantity changes, the analysis that follows will be based on the special case of the model.

Unless otherwise stated, it is assumed that *n* traders take part in a finite number of auction rounds, T. Players are indexed by $i = 1,\ldots,n$, so that $\gamma_1 \le \gamma_2 \le \ldots \le \gamma_n$, where γ_i is the reference-independent private valuation of trader *i*, while auction rounds are denoted by subscript $t = 1,\ldots,T$. The notation will be slightly modified to account for this. Quantities that only vary across individuals have subscript *i* only (e.g. α_i, β_i, γ_i, RIWTA_i and RIWTP_i), quantities that only vary over time have subscript *t* only (e.g. the market price, p_t), and quantities that vary across individuals and over time have both subscripts (e.g. p_{it}^e, WTA_{it}, and WTP_{it}).

The dependence of WTA and WTP on the expected price – see Equations (13) and (14) – suggests a natural way in which the model can deal with repetition: the feedback provided after each round changes individuals' expectations of the market price, and so their valuations. Based on this feature, bidding behaviour in repeated Vickrey auctions is analysed on the assumption that, conditional on their p_{it}^e, in each round traders correctly report their $\text{WTA}_{it}(p_{it}^e)$ and $\text{WTP}_{it}(p_{it}^e)$.

The following Result shows the conditions under which, treating price expectations as *exogenous*, the *n* traders will display a WTA/WTP disparity at the aggregate level in any auction round *t*.

Result 4 (The WTA/WTP disparity) *If* $\beta_i > \alpha_i > 0$ *for all* $i = 1,\ldots,n$*, and, in any period t,* $\gamma_i \neq p_{it}^e$ *for some i, then:*

$$\frac{1}{n}\sum_{i=1}^{n}\text{WTA}_{it}(p_{it}^e) > \frac{1}{n}\sum_{i=1}^{n}\text{WTP}_{it}(p_{it}^e)$$

Proof. The Result is a direct implication of Result 3.

QED

When *n* strictly price sensitive and strictly bad-deal averse agents take part in both the selling and buying auction, a disparity between mean WTA and mean WTP is very likely to arise. For example, this happens if price expectations are the same for all traders and there is variation in intrinsic values, or viceversa. When different groups of subjects take part in the two markets, the Result holds under similar conditions if the two groups are random draws from the same population.

The next two Results illustrate how expectation updating can influence bidding behaviour.

Result 5 (Shaping effects) *If price expectations are revised in the direction of previously observed market prices, then* WTA *and* WTP *will show the same tendency.*

Proof. This is a consequence of Remark 1. $\mathrm{WTA}_{it}(p_{it}^e)$ and $\mathrm{WTP}_{it}(p_{it}^e)$ are increasing in p_{it}^e. As such, they vary in the same direction as p_{it}^e.

QED

Result 5 offers the expectation updating mechanism as the candidate for explaining shaping effects. In principle, any mechanism based on feedback such that price expectations are revised towards the market price observed in the previous period is potentially able to produce a shaping effect on WTA and WTP valuations. An example of a simple mechanism with this property is the *adaptive* expectations rule, $p_{it}^e = \delta p_{i,t-1}^e + (1-\delta) p_{t-1}$, where $0 \leq \delta < 1$, according to which the price expectation in period *t* is a weighted average of the previous period's actual and expected prices. The model's ability to produce shaping effects hinges on price sensitivity.

Result 6 (Sensitivity to the auction rules) *If the n agents expect the market price in a k^{th}-price selling (respectively, buying) auction to be higher (respectively, lower) than the price in the j^{th}-price version, $2 \leq j < k \leq n$, then, for all i,* $\mathrm{WTA}_{i1}(p_{i1}^e)$ $(\textit{respectively}, \mathrm{WTP}_{i1}(p_{i1}^e))$ *will be higher (respectively, lower) in the former than in the latter case.*

Proof. As for Result 5, this is also a straightforward implication of Remark 1.

QED

Because of price sensitivity, the model can display the sensitivity of stated valuations to the auction rules observed by (Knetsch et al., 2001). What is required is a basic understanding of the market mechanism. Agents just need to realise that, for a given set of bids, the selling (buying) price is going to be higher (lower) in a 9th- than in a 2nd-price auction.[13]

Price expectations have been so far treated as exogenous to the market. When they are *endogenous*, a rational expectations market *equilibrium* can be defined as a situation in which expectations are correct for all traders, that is, when $p_i^e = p^*$ for all i, where p^* is the equilibrium market price.[14] The following Result holds.

Result 7 (Equilibrium bidding) *Consider a k^{th}-price selling (respectively, $(n-k+1)^{th}$-price buying) auction with n traders, $2 \leq k < n$. Let V_i be the* WTA *(respectively,* WTP *) valuation of trader i. If $p_i^e = p^*$ for all $i \in \{1, n\}$, then:*

i) $\gamma_i < V_i < p^*$ if $\gamma_i < \gamma_k$

ii) $\gamma_k = V_k = p^*$

iii) $\gamma_i > V_i > p^*$ if $\gamma_i > \gamma_k$

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[13] For this to happen, it is not essential that agents anticipate the price sensitivity of others. If they do, the effect can be even stronger, as the whole distribution of valuations on which they base their price expectations shifts in a consistent direction.

[14] From now on, the time subscript, *t*, is suppressed to ease notation.

Proof. Consider a k^{th}-price selling auction, so that $V_i = \mathrm{WTA}_i$. The proof for the $(n-k+1)^{th}$-price buying auction is entirely analogous. According to Result 2, when $p_i^e = p^*$, agent i can be in one of the three situations depicted in Figures 1 to 3. Either: a) $\gamma_i < V_i < p^*$, or b) $\gamma_i = V_i = p^*$, or c) $\gamma_i > V_i > p^*$. Remember that the γ_i's are indexed from lowest to highest, so that $\gamma_1 \leq \gamma_2 \leq \ldots \leq \gamma_n$. This implies that the k^{th} lowest intrinsic valuation is γ_k. Now also rank the V_i's from lowest to highest. According to a), traders whose $\gamma_i < \gamma_k$ will have a rank lower than k, while those with $\gamma_i > \gamma_k$ will have a rank higher than k. This proves $i)$ and $iii)$. It also implies that the trader whose $\gamma_i = \gamma_k$ will have the k^{th} lowest V_i. Since this becomes the market price, and the market price is equal to the expected price for all traders, for the marginal trader Equation (13) entails that $\gamma_k = V_k = p^*$. This concludes the proof.

QED

Result 7 illustrates how, even in the presence of price sensitive and/or bad-deal averse traders, Vickrey auctions still maintain desirable demand-revealing properties. The market price reflects the reference-independent valuation of the marginal trader. Although other traders' reported valuations do not coincide with their intrinsic values, everyone makes the *optimal* decision in terms of how the market price compares to the reference-independent valuation. In other words, the equilibrium outcome – i.e. trading/not trading – for each player is the same as the one that would result from reporting the reference-independent valuation.

The implications of Result 7 are best seen in the context of median-price auctions with an odd number of traders, in which, if agents bid their intrinsic valuations, the selling and buying prices coincide. This also holds in equilibrium with strictly price sensitive and strictly bad-deal averse agents. However, in the latter case, an aggregate disparity persists if intrinsic values differ across traders, for WTA equals WTP only for the marginal trader. Depending on the initial dispersion of price expectations, the overall disparity is very likely to be attenuated by the process through which they converge to the equilibrium price, closely reproducing the pattern documented by (Loomes et al., 2003).

5. BAD-DEAL AVERSION VERSUS LOSS AVERSION

A number of explanations for the WTA/WTP disparity have been put forward in the last four decades. Some have argued that it arises due to the lack of substitution possibilities (Hanemann, 1991; Adamowicz et al., 1993; Shogren et al., 1994)), to costly information acquisition (Kolstad and Guzman, 1999), to the incompleteness of preferences (Mandler, 2004), or to evolutionary pressures (Huck et al., 2005). However, the idea that preferences are reference-dependent, initially proposed by Thaler (1980) and formalised by Tversky and Kahneman (1991), has by far received the most attention. The argument regards the disparity as a consequence of *loss aversion*, which makes the pain associated with giving up an item that is part of one's endowments larger than the pleasure due to the acquisition of the same item.

As noted in the introduction, however, any explanation of the disparity has to come to grips with the apparently conflicting evidence that the disparity, so pronounced in one-off decisions, tends to be greatly reduced in repeated markets, as well as being able to explain the other stylised facts documented in Section 1. It seems that the key ingredients that any explanation needs in order to be able to accomplish this are two: a mechanism that produces the disparity, and a mechanism through which experience leads to its general decay and its erosion at the margin. Three approaches in the literature seem to fit these requirements, the *standard preferences plus* *error* approach, the *anomalies plus shaping* approach, and the *endogenous reference-dependent approach*.[15]

The standard preferences plus error approach regards the disparity as the product of errors that individuals are liable to make when facing an unfamiliar situation for the first time (e.g. Plott and Zeiler, 2005). With repetition and incentives, they may *discover* their consistent preferences (Plott, 1996) through a process of *value* learning – the understanding of features of their own preferences – and *institutional learning* – the understanding of how to best satisfy those preferences in the context of the specific trading institution (Braga and Starmer, 2005). As far as the stylised facts are concerned, however, this approach encounters several difficulties. In the case of shaping effects, one would have to accept that the same process that is eliminating an error (i.e. the WTA/WTP disparity) is also promoting new ones (i.e. the systematic influence of market prices on valuations). Explaining the sensitivity to the auction rules would require more sophisticated mechanisms behind the errors that produce the disparity in the first place.

The anomalies plus shaping approach revolves around Loomes et al.'s (2003) *shaping hypothesis* that individuals use the observed market prices as an anchor when revising their valuations. The disparity can be explained as a result of some form of 'anomalous' behaviour, for instance in terms of loss aversion, though it is probably more in the spirit of the approach to regard it as a consequence of people having imprecisely defined preferences and using simple heuristics to work out initial valuations.[16] Not surprisingly, this approach can accommodate shaping effects and the general decay of the disparity, but its complete erosion for market prices and the sensitivity of valuations to the auction rules require some extra features (e.g. underlying reference-independent preferences) or some ancillary assumption, which seem very likely to conflict with the general flavour of the approach.

Models belonging to the endogenous reference-dependent preferences strand extend Tversky and Kahneman's (1991) pioneering model, by endogenising either the *reference point* (as in Köszegi and Rabin, 2006), or the *degree of loss aversion* (as in Loomes et al., 2009). The latter approach uses Sugden's (2003) *reference-dependent subjective expected utility* framework to make the degree of loss aversion contingent on agents' uncertainty about the marginal rate of substitution between goods. Certainty is associated with negligible differences between WTA and WTP, but the gap widens as a preference uncertainty increases. In this context, experience reduces the disparity to the extent that it reduces preference uncertainty. Shaping effects could be explained if subjects reacted to preference uncertainty by using the market price as a signal of the value of the good. However, since the model is not equipped with a specific mechanism relating uncertainty to feedback and repetition, it is not clear why the same experience should have a differential impact on marginal and non-marginal traders, nor there is any reason to expect different auction rules to prompt different valuations.

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[15] Hanemann's (1991) idea that WTA/WTP disparities can be substantial for goods that are difficult to substitute can also, in principle, be extended to incorporate an effect of market experience. For instance, repeated market experience may change subjects' perception of substitution possibilities (e.g. by repeatedly thinking about trading, subjects may become more aware of opportunities to trade). In general, however, substitution effects cannot be the sole factor at work, for, irrespective of substitution possibilities, the observed WTA/WTP ratios require an implausibly large responsiveness of WTP to income changes (Sugden, 1999). In fact, the implied income elasticities of WTP are between three and forty-five times higher than the values obtained by direct measurement (Horowitz and McConnell, 2003).

[16] That people may not have well-formed and readily accessible valuations is also suggested by Ariely et al.'s (2003) finding that irrelevant pieces of information, such as one's social security number, are able to significantly affect how much commodities are valued.

Köszegi and Rabin's (2006) model is the most straightforward extension of Tversky and Kahneman's (1991) idea that the WTA/WTP disparity can be due to loss aversion. Although in their paper Tversky and Kahneman do not explicitly state what the reference point is, in most applications this has been taken to be defined on the same set of dimensions as the alternatives to be evaluated (e.g. current endowment, customary consumption, expected outcome). This is certainly the case in Köszegi and Rabin's model, in which the reference point is agents' *rational expectation* about the outcome of their actions. Individuals are in *Personal Equilibrium* whenever their expectations are correct ex post, that is, when they carry out their anticipated plans. Since there may be several combinations of mutually consistent expectations and behaviours, the personal equilibrium is typically not unique.

How far does this otherwise standard notion of loss aversion fit with the stylised facts? In order to answer this question, consider an application of Köszegi and Rabin's model to a buying auction. It can reasonably be assumed that, after sufficient repetition, the market will settle on an equilibrium in which all agents correctly anticipate the price and behave according to their expectations. In this situation, traders can be partitioned into *equilibrium buyers* and *equilibrium non-buyers*. Equilibrium buyers buy and expect to buy as a result of consistently buying, their equilibrium valuations being higher than the reference-independent value, for not buying the good is now perceived as a loss. Equilibrium non-buyers do not buy and expect not to buy as a consequence of consistently not buying, their valuations being lower than the reference-independent values as they were in the first round of the auction. Due to the fact that in Vickrey auctions the price setter does not trade, the marginal trader is an equilibrium non-buyer. An entirely symmetrical argument shows that in selling auctions *equilibrium sellers'* valuations are lower than the reference-independent value, while *equilibrium non-sellers'* (including the price setter's) valuations stay above the reference-independent value.

The implications of this equilibrium analysis are quite surprising. Despite the fact that each individual a has a unique reference-independent valuation, nobody reports it. In 2^{nd}-price auctions, in which only one person trades, average WTA will only slightly decrease, while average WTP will only slightly increase, with limited impact on the overall disparity. Contrary to Knetsch et al.'s (2001) findings, in a 9^{th}-price auction with ten traders the decrease in average WTA and the increase in average WTP will be substantial, and very likely to lead to a situation in which average WTA is well below average WTP. If the same traders were to participate in both the buying and selling versions of a median auction, WTA and WTP would coincide for everybody *except* the marginal trader, but all valuations would differ from the reference-independent values. These predictions appear to be impossible to reconcile with the stylised facts.

6. CONCLUDING REMARKS

The simple assumptions of price sensitivity and bad-deal aversion used in this paper do a surprisingly good job at reconciling the stylised facts concerning the WTA/WTP disparity. On this account, the disparity itself is a result of bad-deal aversion. Shaping effects and the sensitivity to the auction rules are due to WTA and WTP valuations being increasing in price expectations, which is an implication of price sensitivity. The complete erosion of the disparity at the margin, and its persistence on the aggregate, are the result of the equilibration process following expectation updating.

The notion that prices often act as reference points is far from new in the literature. As Wicksteed noted long ago, whether prices are regarded or cheap or dear can lead to forms of preference reversals like the one illustrated by the following example.

> ‘A man might be willing to give a shilling for a knife because he thought it cheap, and might refuse to give a shilling for a certain pamphlet because he thought it dear, and yet if he had been offered the direct choice between the pamphlet and the knife as a present he might have chosen the pamphlet.’ (Wicksteed, 1910)

Similarly, Thaler shows that individuals are willing to pay more for a beer bought in a fancy hotel than for the same beer coming from a run-down grocery store, because they expect to pay more in the former case than in the latter (Thaler, 1985, p. 206). Putler (1992) – whose theoretical analysis is in many ways similar to the derivation of WTP in the present paper[17] – reports that reference price effects can be found in egg sales data from Southern California. Hu (2007) finds effects of the type predicted by bad-deal aversion in a hypothetical survey study involving products with new attributes.

Price sensitivity and bad-deal aversion seem also intuitively appealing because of their resemblance with the experience of everyday transactions. For instance, the feeling of disappointment in finding out that an item we just bought can be found for a cheaper price a few shops down the road is a rather common experience. Similarly, finding out that we have saved £5 on our new pair of shoes can easily become a matter of pride and satisfaction. These types of behaviour are naturally interpreted in terms of price sensitivity and bad-deal aversion. The increasingly common practice by retailers to offer a lowest price guarantee can also be regarded as a consequence of bad-deal aversion. By offering to refund a multiple of the price difference if the consumer finds the same product at a cheaper price elsewhere, retailers encourage shoppers’ fidelity by ensuring that they will not feel ripped off. And price sensitivity can explain the widespread use of comparative price claims (Kopalle and Lindsey-Mullikin, 2003), and occasional promotional sales, as occasionally low prices look like good deals and boost WTP.

As far as the WTA/WTP disparity is concerned, this paper has shown that the notion of *bad-deal aversion* defined with respect to the expected transaction price appears to be descriptively superior to the idea that preferences are *loss averse* relative to a multi-dimensional reference point, interpreted as either the current endowment (Tversky and Kahneman, 1991), or the customary consumption (Munro and Sugden, 2003), or the expected outcome (Köszegi and Rabin, 2006). On the other hand, loss aversion can explain other findings often regarded as reference-point effects, such as exchange asymmetries (Knetsch, 1989), or the status quo bias (Samuelson and Zeckhauser, 1988), on which, giving the absence of a transaction price, the bad-deal aversion model is silent.

Do these findings suggest that bad-deal aversion is not an interesting phenomenon? To anyone who is searching for a universal notion of reference point they probably could. But since other notions of reference point also struggle to fit the empirical evidence, this may be suggestive that, however theoretically appealing it may be, a universal notion of reference-point may not exist. And indeed, this form of obsession with generality – typical of rational choice thinking – is far from the spirit of behavioural economics (Bruni and Sugden, 2007). Taking a broader perspective, the aversion to feelings of regret (Loomes and Sugden, 1982), or to inequality (Fehr and Schmidt, 1999) may also be regarded as a form of reference-dependence. In fact, these ideas are formalised through some sort of reference point from which positive and

[17] The present analysis extends Putler’s work in three main ways. First, it looks at selling behaviour as well as buying behaviour. Second, it makes the asymmetry between good and bad deals an essential component of the model. Third, it allows the reference point to be endogenous.

negative components are treated asymmetrically or non-linearly. If the range of reference-dependent phenomena is so wide, it should not be surprising if different situations primed different reference points. Rather than asking if there is a universal notion of reference point, a more interesting issue seems to be what features of the context are more salient, and therefore more likely to act as reference points, in particular circumstances. As suggested in this paper, the expected price of the transaction seems to be an appropriate reference point for explaining the WTA/WTP disparity.

References

Adamowicz, W. L., Bhardwaj, V., and Macnab, B. (1993). 'Experiments on the Difference between Willingness-To-Pay and Willingness-To-Accept'. *Land Economics*, 69(4), 416–427.

Ariely, D., Loewenstein, G., and Prelec, D. (2003). 'Coherent Arbitrariness: Stable Demand Curves without Stable Preferences'. *Quarterly Journal of Economics*, 118(1), 73–105.

Bateman, I., Munro, A., Rhodes, B., Starmer, C., and Sugden, R. (1997). 'A Test of the Theory of Reference-Dependent Preferences'. *Quarterly Journal of Economics*, 112(2), 479–505.

Boyce, R. R., Brown, T. C., McClelland, G. H., Peterson, G. L., and Schulze, W. D. (1992). 'An Experimental Examination of Intrinsic Values as a Source of the WTA-WTP Disparity'. *The American Economic Review*, 82(5), 1366–1373.

Braga, J. and Starmer, C. (2005). 'Preference Anomalies, Preference Elicitation and the Discovered Preference Hypothesis'. *Environmental and Resource Economics*, 32(1), 55–89.

Braga, J., Humphrey, S. J., and Starmer, C. (in press). 'Market Experience Eliminates Some Anomalies – and Creates New Ones'. *European Economic Review*.

Brown, T. C. (2005). 'Loss Aversion without the Endowment Effect, and Other Explanations for the WTA-WTP Disparity'. *Journal of Economic Behavior and Organization*, 57(3), 367–379.

Bruni, L. and Sugden, R. (2007). 'The Road Not Taken: How Psychology Was Removed from Economics, and How it Might Be Brought Back'. *The Economic Journal*, 117, 146–173.

Coursey, D. L., Hovis, J. L., and Schulze, W. D. (1987). 'The Disparity between Willingness to Accept and Willingness to Pay Measures of Value'. *Quarterly Journal of Economics*, 102(3), 679–690.

Cox, J. C. and Grether, D. M. (1996). 'The Preference Reversal Phenomenon: Response Mode, Markets and Incentives'. *Economic Theory*, 7(3), 381–405.

Fehr, E. and Schmidt, K. M. (1999). 'A Theory of Fairness, Competition, and Cooperation'. *Quarterly Journal of Economics*, 114(3), 817–868.

Freeman, A. M. (1979). *The Benefits on Environmental Improvement: Theory and Practice*. John Hopkins Press, Baltimore.

Geanakoplos, J., Pearce, D., and Stacchetti, E. (1989). 'Psychological Games and Sequential Rationality'. *Games and Economic Behavior*, 1, 60-79.

Hammack, J. and Brown, G. (1974). *Waterfowl and Wetland: Toward Bioeconomic Analysis*. John Hopkins Press, Baltimore.

Hanemann, W. M. (1991). 'Willingness to Pay and Willingness to Accept – How Much Can They Differ?' *The American Economic Review*, 81(3), 635–647.

Harless, D. W. (1989). 'More Laboratory Evidence on the Disparity between Willingness to Pay and Compensation Demanded'. *Journal of Economic Behavior and Organization*, 11(3), 359–379.

Horowitz, J. K. and McConnell, K. E. (2002). 'A Review of WTA/WTP Studies'. *Journal of Environmental Economics and Management*, 44(3), 426–447.

Horowitz, J. K. and McConnell, K. E. (2003). 'Willingness to Accept, Willingness to Pay and the Income Effect'. *Journal of Economic Behavior and Organization*, 51(4), 537–545.
Hu, W. (2007). 'Bargains or Rip-offs? Reference Price Effects in Cojoint Stated Demand'. *Journal of Agricultural and Resource Economics*, 32(2), 256-272.
Huck, S., Kirchsteiger, G., and Oechssler, J. (2005). 'Learning to Like What You Have – Explaining the Endowment Effect'. *The Economic Journal*, 115, 689–702.
Kahneman, D., Knetsch, J. L., and Thaler, R. H. (1990). 'Experimental Tests of the Endowment Effect and the Coase Theorem'. *Journal of Political Economy*, 98(6), 1325–1348.
Knetsch, J. L. (1989). 'The Endowment Effect and Evidence of Non-Reversible Indifference Curves'. *The American Economic Review*, 79(5), 1277–1284.
Knetsch, J. L. and Sinden, J. A. (1984). 'Willingness to Pay and Compensation Demanded – Experimental Evidence of an Unexpected Disparity in Measures of Value'. *Quarterly Journal of Economics*, 99(3), 507–521.
Knetsch, J. L., Tang, F. F., and Thaler, R. (2001). 'The Endowment Effect and Repeated Market Trials: Is the Vickrey Auction Demand Revealing?' *Experimental Economics*, 4, 257–69.
Kolstad, C. D. and Guzman, R. M. (1999). 'Information and the Divergence between Willingness to Accept and Willingness to Pay'. *Journal of Environmental Economics and Management*, 38(1), 68–80.
Kopalle, P. K. and Lindsey-Mullikin, J. (2003) 'The Impact of External referene Price on consumer Price Expectations'. *Journal of Retailing*, 79, 225-236.
Köszegi, B. and Rabin, M. (2006). 'A Model of Reference-Dependent Preferences'. *Quarterly Journal of Economics*, 121(4), 1133–1165.
List, J. A. (2003). 'Does Market Experience Eliminate Market Anomalies?' *Quarterly Journal of Economics*, 118, 41–71.
List, J. A. (2004). 'Neoclassical Theory Versus Prospect Theory: Evidence from the Market Place'. *Econometrica*, 72(2), 615–25.
Loomes, G. and Sugden, R. (1982). 'Regret Theory: An Alternative Theory of Rational Choice under Uncertainty'. *The Economic Journal*, 92(368), 805–824.
Loomes, G., Starmer, C., and Sugden, R. (2003). 'Do Anomalies Disappear in Repeated Markets? *The Economic Journal*, 113(486), C153–C166.
Loomes, G., Orr, S., and Sugden, R. (in press). 'Preference Uncertainty and Status quo Effects in Consumer Choice'. *Journal of Risk and Uncertainty*.
Mandler, M. (2004). 'Status Quo Maintenance Reconsidered: Changing or Incomplete Preferences? *The Economic Journal*, 114(499), F518–F535.
Milgrom, P. R. and Weber, R. J. (1982). 'A Theory of Auctions and Competitive Bidding'. *Econometrica*, 50(5), 1089–1122.
Munro, A. and Sugden, R. (2003). 'On the Theory of Reference-Dependent Preferences'. *Journal of Economic Behavior and Organization*, 50(4), 407–428.
Plott, C. R. (1996). 'Rational Individual Behaviour in Markets and Social Choice Processes: The Discovered Preference Hypothesis'. In K. Arrow, E. Colombatto, M. Perleman, and C. Schmidt, editors, *Rational Foundations of Economic Behavior*, pages 225–250. Macmillan, London.
Plott, C. R. and Zeiler, K. (2005). The Willingness to Pay-Willingness to Accept Gap, the "Endowment Effect", Subject Misconceptions, and Experimental Procedures for Eliciting Valuations. *The American Economic Review*, 95(3), 530–545.
Putler, D. S. (1992). 'Incorporating Reference Price Effects into a Theory of Consumer Choice'. *Marketing Science*, 11, 287–309.
Randall, A. and Stoll, J. R. (1980). 'Consumer's Surplus in Commodity Space'. *The American Economic Review*, 70(3), 449–455.

Rowe, R. D., D'Arge, R. C., and Brookshire, D. S. (1980). 'An Experiment on the Economic Value of Visibility'. *Journal of Environmental Economics and Management*, 7(1), 1–19.
Samuelson, W. and Zeckhauser, R. (1988). 'Status Quo Bias in Decision Making'*. Journal of Risk and Uncertainty*, 1, 7–59.
Schulze, W. D., D'Arge, R. C., and Brookshire, D. S. (1981). 'Valuing Environmental Commodities: Some Recent Experiments'. *Land Economics*, 57(2), 151–172.
Shogren, J. F., Shin, S. Y., Hayes, D. J., and Kliebenstein, J. B. (1994). 'Resolving Differences in Willingness to Pay and Willingness to Accept'. *The American Economic Review*, 84(1), 255–270.
Shogren, J. F., Cho, S., Koo, C., List, J., Park, C., Polo, P., and Wilhelmi, R. (2001). 'Auction Mechanisms and the Measurement of WTP and WTA'. *Resource and Energy Economics*, 23, 97–109.
Sugden, R. (1999). 'Alternatives to the Neo-Classical Theory of Choice'. In I. J. Bateman and K. G. Willis, editors, *Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the US, EU and Developing Countries*, pages 152–180. Oxford University Press.
Sugden, R. (2003). 'Reference-Dependent Subjective Expected Utility'. *Journal of Economic Theory*, 111(2), 172–191.
Thaler, R. (1980). 'Toward a Positive Theory of Consumer Choice. *Journal of Economic Behavior and Organization*, 1(1), 39–60.
Thaler, R. (1985). 'Mental Accounting and Consumer Choice'. *Marketing Science*, 4, 199–214.
Tversky, A. and Kahneman, D. (1991). 'Loss Aversion in Riskless Choice: A Reference-Dependent Model'. *Quarterly Journal of Economics*, 106(4), 1039–1061.
Vickrey, W. (1961). 'Counterspeculation, Auctions, and Competitive Sealed Tenders'. *Journal of Finance*, 16(1), 8–37.
Wicksteed, P. (1910). *The common sense of political economy*, Volume I. Routledge, London.
Willig, R. D. (1976). 'Consumer's Surplus without Apology'. *The American Economic Review*, 66(4), 589–597.