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Amedeo Piolatto and Matthew D. Rablen

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Amedeo Piolatto
Barcelona Institute of Economics (IEB)

Matthew D. Rablen[y]
Brunel University

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Abstract

The standard expected utility model of tax evasion predicts that evasion is decreasing in the marginal tax rate (the Yitzhaki puzzle). The existing literature disagrees on whether prospect theory overturns the $puzzle$. We disentangle four distinct elements of prospect theory and …nd loss aversion and probability weighting to be redundant in respect of the $puzzle$. Prospect theory fails to reverse the $puzzle$ for various classes of endogenous speci…cation of the reference level. These classes include, as special cases, the most common speci…cations in the literature. New speci…cations of the reference level are needed, we conclude.

JEL Classi…cation: H26; D81; K42

Keywords: prospect theory, tax evasion, Yitzhaki puzzle, stigma, diminishing sensitivity, reference dependence, endogenous audit probability, endogenous reference level.

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1 Introduction

If …nes are imposed on the evaded tax, and if taxpayers' preferences satisfy the (theoretically and empirically plausible) assumption of decreasing absolute risk aversion (DARA), then the Expected Utility Theory (EUT) model of tax evasion predicts a negative relationship between tax rates and evasion (Yitzhaki, 1974).[1] Much empirical and experimental evidence, however, …nds a positive relationship between evasion and the tax rate (see, e.g., Bernasconi *et al.*, in press, and the references therein).[2] Owing to its lack of empirical support, and its counter-intuitive nature, the negative relationship between tax rates and evasion predicted by the EUT model has sometimes been termed the "Yitzhaki paradox" or "Yitzhaki puzzle".

Prospect Theory (PT) has become standard in behavioural economics, for it is able to resolve many puzzles associated with EUT and provides a better …t to much empirical data (Bruhin *et al.*, 2010).[3] Our study seeks to (re)-examine the role of PT in reversing the Yitzhaki puzzle. In recent years a number of papers have claimed that applying the insights of PT to the tax evasion problem solves the Yitzhaki puzzle. Dhami and al-Nowaihi (2007: 171) claim to "...show that prospect theory provides a much more satisfactory account of tax evasion including an explanation of the Yitzhaki puzzle." Similar sentiments are also found in Trotin (2012), Bernasconi and Zanardi (2004) and Yaniv (1999). In their recent review of this literature, however, Hashimzade *et al.* (in press: 16) conclude (on the basis of several examples) that "Prospect theory does not necessarily reverse the direction of the tax e¤ect: our examples show that certain choices of the reference level can a¤ect the direction of the tax e¤ect in some situations, but none of the examples is compelling." We investigate this dichotomy.

We analyse the tax evasion decision with variants of a Reference-Dependent (RD) model (which includes PT as a special case) in which we vary (i) the elements of PT that are assumed to hold; (ii) the properties of the reference level, which may (or may not) depend on the marginal tax rate and/or on the taxpayer's income declaration; and (iii) the properties of the probability of audit, which we allow to be …xed exogenously or to be a function of the taxpayer's declaration. In particular, we decompose PT into four distinct elements. The …rst, reference dependence, assumes outcomes to be judged relative to a reference level of

wealth .[4] The second, diminishing sensitivity, assumes that marginal utility is diminishing in distance from the reference level, which implies concave preferences over outcomes above the reference level and convex preferences over outcomes below the reference level. The third, loss aversion, is the property that the disutility of a loss exceeds the utility of a gain of equal magnitude. The …nal element, probability weighting, transforms objective probabilities into decision weights. Decomposing PT in this way allows us, unlike the existing literature, to clarify the elements which allow it to overturn the Yitzhaki puzzle or otherwise.

Our results in some cases extend, and in others contrast, with the existing literature. When both the audit probability and the reference level are treated as exogenously …xed, we …nd that the introduction of reference dependence does not, on its own, reverse the Yitzhaki puzzle. The combination of reference dependence and diminishing sensitivity, however, unambiguously reverses the Yitzhaki puzzle when, at the interior maximum, the payo¤ if caught lies below the reference level. Throughout the analysis, loss aversion and probability weighting are found to play no role in determining the ability of the RD model to overturn the puzzle.[5]

Allowing the reference level to be a decreasing function of the tax rate has curious e¤ects. If the reference level is su¢ ciently $sensitive$ to the tax rate, then simply the assumption of reference dependence is su¢ cient to reverse Yitzhaki's puzzle. On the other hand, if reference dependence and diminishing sensitivity are assumed, Yitzhaki's puzzle is reversed only if the reference level is su¢ ciently $insensitive$ to the tax rate. We show that there exists a set of speci…cations of the reference level that are insu¢ ciently sensitive to the tax rate for reference dependence alone to reverse the Yitzhaki puzzle, but that are too sensitive to the tax rate for reference dependence combined with diminishing sensitivity to reverse the Yitzhaki puzzle. Importantly, the speci…cation of the reference level as the taxpayer's post-tax wealth if they do not evade – which is argued as the most plausible speci…cation of the reference level by several authors – belongs to this set. In these cases, whether utility is assumed to be globally concave, or to display diminishing sensitivity, the RD model cannot reverse the Yitzhaki puzzle. These results are shown to be robust to a class of speci…cations of the reference level (which includes, for instance, the expected value of the tax gamble) that also allow for a dependency on the taxpayer's declaration.

[4] In their development of PT, Kahneman and Tversky (1979) assume the reference level $\boldsymbol{R}$ to be an exogenous parameter, although in many economic applications it is assumed endogenous to the parameters of the model. We consider alternative assumptions for the setting of the reference level, therefore.

[5] Consistent with this …nding, Eide (2001) shows that introducing (rank-dependent) probability weighting into the standard tax evasion model changes none of the qualitative comparative statics results.

where n =

Reference dependence can be introduced into the EUT model independently of the remaining elements of PT. This is performed by writing the taxpayers' objective function in (1) as:[6]

$$R = \quad (\quad ^{c} \quad) + [1 \quad] \quad (\quad ^{n} \quad). \tag{7}$$

Diminishing sensitivity

Diminishing sensitivity cannot meaningfully be introduced into the EUT model independ-

Henceforth, when analysing the RD model with diminishing sensitivity, we proceed under the maintained assumption that indeed the …rst order condition describes a unique, and genuinely optimal, interior choice for the taxpayer. Under this assumption equations (9) and (10) together imply that the interior maximum satis..es [

Proposition 2 *Assume* $_t$ 0 *and* $_x = 0$. *Then:*
(i) assuming DARA, there exists a threshold level e_t *such that, at an interior maximum,* 0 *for* $_t$ e_t *and* 0 *for* $_t$ e_t.
(ii) assuming diminishing sensitivity, there exists a threshold level $e_{t;DS}$ *such that, at an interior maximum,* 0 *for*

portable across contexts, that the reference level should re‡ect the expected outcome of the lottery. If, accordingly, the reference level is set as the expected value of the tax gamble,

$$= \quad ^{c} + [1 \quad] \quad ^{n} = \quad [1 \quad] + \quad [\quad 1], \qquad (15)$$

proof proceeds by establishing that equations (16) and (17) have identical roots to (13) and (14). Hence, it remains the case that, for any reference level such that $_t$ 2 e_t $e_{t;DS}$, the RD model is unable to reverse Yitzhaki's puzzle whether or not diminishing sensitivity is assumed. Is this …nding germane to the speci…cation of the reference level as the expected value of the tax gamble, or as = [1] ?

Corollary 2 *If is the expected value of the gamble, or if = [1] as in Hashimzade et al. (in press), then 0 whether or not diminishing sensitivity is assumed.*

According to Corollary 2 neither of these speci…cations of the reference level can overturn the Yitzhaki puzzle in any variant of the RD model. Together, the results of sections 3.2.1 and 3.2.2 imply that the RD model does not reverse the Yitzhaki puzzle for any of the endogenous speci…cations of the reference level we observe in the literature.

3.3 Endogenous Audit Probability

Suppose now that the probability of audit is not exogenous, but instead depends on declared income.[15] Consistent with the literature on optimal auditing (e.g., Reinganum and Wilde, 1986) we assume that higher income declarations are less likely to be audited (0). The models discussed so far are for the special case of this assumption in which = 0. Under this new assumption the analysis becomes more complex and few, if any, general results are possible. We therefore follow Dhami and al-Nowaihi (2007) who, citing Tversky and Kahneman (1992), analyse a model in which is homogeneous of degree 2 [0 1].[16] In this framework, equation (1) becomes

$$_p = (^c) + [1] (^n), \tag{18}$$

where now = ( ). By homogeneity, equation (18) becomes

$$_p = [ ] \; h \; h \; i \; i \; [1] + 1 \; (1) \; . \tag{19}$$

The …rst order condition corresponding to (19) is

$$[ ] \; h \; h \; i \; h \; i \; i \; [1] + 1 \; ^0(1) + [1] \; 1 \; ^0 (1) = 0. \tag{20}$$

The next proposition characterises how the introduction of an endogenous audit probability alter the predictions of the RD model, under the assumption of homogeneity.

[15] Hashimzade *et al.* (in press) discuss this version of the RD model only cursorily in their footnote 5.

[16] The homogeneous form is standard in applications of PT, and is axiomatised under PT by al-Nowaihi *et al.* (2008).

Proposition 4 *Assume endogenous reference dependence, with* = [1], *homogeneous of degree*

the idea that stigma can overturn the Yitzhaki puzzle in the EUT model is not. Variations of this idea, but under di¤erent assumptions over how stigma enters the taxpayer's objective function are found in, e.g., al-Nowaihi and Pyle (2000), Dell'Anno (2009), Gordon (1989) and Kim (2003).

Proposition 5 appears of roughly equal generality to Dhami and al-Nowaihi's Proposition 4. In particular, the latter proposition need no longer hold for su¢ cient deviations from the assumption of homogeneity, while the former need no longer hold for su¢ cient deviations from risk neutrality. Overall, therefore, we ..nd no evidence to suggest that the RD model systematically improves upon the predictions of the EUT model in respect of the Yitzhaki puzzle in this case.

Although any positive level of stigma is su¢ cient to overturn the Yitzhaki puzzle in the EUT model of Proposition 5, much larger levels of stigma must be assumed to resolve a further di¢ culty with the EUT model: it predicts far more tax evasion than is empirically observed.[18] By contrast –as loss aversion and probability weighting help reduce predicted evasion levels –PT is shown by Dhami and al-Nowaihi (2007) to be able to match empirically observed levels of evasion for much more moderate levels of the parameter . Thus, it can be argued, the PT model should be preferred to the EUT model on these grounds.[19] We recognise this argument, but note two points. First, its validity or otherwise is orthogonal to our analysis, which is concerned solely with the ability of models to resolve the Yitzhaki puzzle. Second, it is equally possible to resolve the levels puzzle without resort to either PT or stigma costs. For instance, PT assumes that taxpayers observe the true audit probability

4 Conclusion

Albeit with limitations, (see, e.g., Levy and Levy, 2002; List, 2003), PT is widely viewed as the best available description of how people behave in risky settings. Barberis (2013: 73) notes, however, that there are "few well-known and broadly accepted applications of prospect theory in economics." The reason, Barberis argues, is that PT is not straightforward to apply: in particular, the most appropriate choice of the reference level is often unclear.[20]

inability to do so when the reference level is a decreasing function of the tax rate.

We …nd that loss aversion and probability weighting are irrelevant in respect of the predictions of the RD model for the sign of . Invoking Occam's razor, we believe that results relating to the Yitzhaki puzzle that have been attributed to "prospect theory" may more properly be interpreted as being attributable to simpler RD models that contain only a subset of the elements of PT.

We do not take our …ndings to imply that PT is unimportant for the tax evasion decision.

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Appendix

Proof of Proposition 1. (i) Under DARA (n) (c) 0, hence [ ] 0.

(ii) We may rearrange (12) to obtain

$$\frac{}{} = \frac{1}{} \frac{[\quad] \_(\quad c \quad) \quad [\ (\quad n \quad) \quad \_(\quad c \quad)]}{[\quad 1] \_(\quad c \quad) + \ (\quad n \quad)} \quad 0. \qquad \text{(A.1)}$$

Proof of Proposition 5. The objective function under risk neutrality (( ) =) is given by = [^{c} [ ]] + [1] [^{n}], from which we obtain the …rst order condition

$$^{0}[\quad] + \quad 1 = \frac{[\,^{0}[\quad] \quad]}{\quad}. \tag{A.2}$$

The derivative of with respect to is

$$\frac{\quad}{\quad} = \frac{^{0}[\quad] + \quad 1}{\quad}, \tag{A.3}$$

where = 0. Using (A.2) into (A.3), we obtain

$$\frac{\quad}{\quad} = \frac{[\,^{0}[\quad] \quad]}{\quad} = \frac{\quad}{[\ .}$$