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Rebuttal of Hashimzade, Myles and Tran-Nam (2009) "New Approaches to the Economics of Tax Evasion"

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Abstract

In a recent, 58 page, paper, Hashimzade, Myles and Tran-Nam (2009) "New Approaches to the Economics of Tax Evasion" survey alternative approaches to tax evasion. Their central conclusion is, in their own words (p. 56): "*What they* [the non-expected utility models] *do not do is change the relationship between the tax rate and the level of evasion*." We show that their central conclusion is incorrect. We also show that their representation of our work [(2007) "Why Do People Pay Taxes? Prospect Theory Versus Expected Utility Theory", Journal of Economic Behavior and Organization, 64: 171–192] is highly misleading, and incorrect.

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"*Great is the power of steady misrepresentation; but the history of science shows that fortunately this power does not long endure.*" Charles Darwin, in the sixth edition of the Origin of Species, p. 421:

1. Introduction

Hashimzade, Myles and Tran-Nam (2009) (henceforth, **HMT**) provide a recent survey of the alternative approaches to tax evasion, a topic of great importance, in it's magnitude and in it's welfare implications. HMT's conclusions, in full (p. 56) are as follows: "*The conclusion is simple. The non-expected utility models can change the cut-off probability for evading and hence the proportion of evaders. They also change the amount declared. What they do not do is change the relationship between the tax rate and the level of evasion. This can only be changed by altering the structure of payoffs. A number of ways in which this can be achieved have been noted.*" We have no problems with the first two sentences (they are correct). However, we show that the central conclusion, mentioned in the third sentence (*What they do not do is change the relationship between the tax rate and the level of evasion*), is incorrect.

Dhami and al-Nowaihi (2007) (henceforth, **DaN**) provide the solution to an outstanding puzzle in tax evasion, the *Yitzhaki puzzle* (due to Yitzhaki, 1974) among other contributions.[1] Under expected utility (EU) and under reasonable attitudes to risk (non-increasing absolute risk aversion) Yitzhaki (1974) showed that the taxpayer evades less as the tax rate goes up. So, to eliminate evasion completely, the government should levy a 100% tax on income! Understandably, this absurd and counterintuitive conclusion is rejected by the bulk of experimental and field data (see DaN for the references). DaN show that if the taxpayer uses Tversky and Kahneman's (1992) cumulative prospect theory (CP) then tax evasion increases as the tax rate increases, in conformity with the evidence. Hence, DaN's solution to the Yitzhaki puzzle is in direct conflict with the central conclusion of HMT.

DaN are cited four times in the HMT paper; indeed section 4.2.1 is devote to their work. While severe criticism is welcome and proper, misrepresentation is not. However, DaN's work is very badly misrepresented, and it is inaccurately, incompletely, and ambiguously cited and described in HMT.

Our initial response was to write to all three authors (on 31 October 2009) with a detailed 8 page letter, painstakingly describing the problems with HMT and requesting a correction.[2] There was no reply or acknowledgement. We then sent a second email (on 10

[1] DaN also show in a calibrated model that cumulative prospect theory explains well, the tax evasion data while expected utility is wrong by a factor of about 100! The framework of DaN can also the explain the effect of obligatory advance tax payments but this has already been done by Yaniv (1999).

[2] Here is an extract of what we wrote: "Of course, severe criticism is welcome and proper. But misrepresentation is not. We are sure this misrepresentation was unintended, and we hope it will be

December 2009) which suggested a public rebuttal.[3] But our second email too met with an identical fate. We then waited another 3 weeks and finally decided to formally publish a rebuttal of the work of HMT.

Section 2 describes the basics of the model in DaN and section 3 collects some of their results. Section 4 gives our serious disagreements with HMT's work which puts into doubt their entire enterprise.

2. The model in DaN

The basic model in DaN is simply the well known Allingham-Sandmo-Yitzaki model in which decision makers use cumulative prospect theory (CP) instead of expected utility (EU).

A taxpayer has exogenous taxable income $Y > 0$ and can choose to declare some amount $D \in [0, Y]$. The government levies a tax on declared income at the constant marginal rate t, $0 < t < 1$. If the taxpayer evades ($0 \leq D < Y$), then he is caught with probability $p(D) \in [0, 1]$.[4] DaN assume that $p(D)$ is continuously differentiable and $p'(D) \leq 0$ (i.e. the taxpayer is more likely to be caught if he evades more). That the probability of detection may depend on the amount evaded is quite familiar from the tax evasion literature within the EUT framework; see, for example, Slemrod and Yitzhaki (2002). However, to the best of our knowledge, this is the first paper in the prospect theory literature to allow the probability of detection to depend on amount evaded.

If caught, the dishonest taxpayer must pay the outstanding tax liabilities $t(Y - D)$, a penalty $\theta t(Y - D)$ where $\theta > 0$ is the penalty rate on evaded taxes and also suffers some stigma $s(Y - D)$ where s is the stigma rate on evaded income[5]. There is a continuum of individuals with stigma rates $s \in [\underline{s}, \overline{s}]$ with density $\phi(s)$ and distribution function $\Phi(s)$.

corrected. This is not merely a gripe at the mistreatment of our paper. As the result of misunderstanding our work, a central conclusion of your survey is mistaken."

[3] Here is an extract from the second email in which Sanjit Dhami wrote: "The misrepresentation of our paper in your survey is a very serious matter and is a cause of great concern and anguish to us. Reluctantly me and Ali are leaning towards publishing a full rebuttal of the mistreatment of our paper. Just thought that I should let you know.."

[4] There are two issues regarding $p(D)$. First, the audits carried out by the tax authorities need not be random. Andreoni et al. mention that for the US, the IRS assigns each tax return a "score" based on a "discriminant function". However, because the score and the discriminant function are strictly private information to the IRS, thus, from the perspective of the taxpayer, her return is randomly audited. Second, for a significant percentage of the population, income taxes are withheld at source, so tax evasion is not an option for them. Suppose, for the sake of argument, that this applies to half the population. In that case the effective probability of audit doubles for taxpayers whose income is not withheld at source.

[5] As in Gordon (1989) and Besley and Coate (1992), such stigma enters linearly, as a monetary equivalent, into the payoff in that state of the world. Stigma costs could arise from factors such as social sanctions and the effect on one's current and future earnings arising from being a tax evader. In their paper, DaN discuss issues about the magnitude of stigma, a more general formulation of stigma, and also "guilt" that might arise from the act of evasion.

Denoting by Y_C and Y_{NC}, respectively, the income of the taxpayer when he is "caught" and when he is "not caught",

$$Y_{NC} = Y - tD, \tag{2.1}$$

$$Y_C = (1-t)\,Y - (s+\theta t)\,(Y-D). \tag{2.2}$$

2.1. Sequence of Moves

The government moves first, making an announcement of p and θ. The taxpayer then makes the decision to either fully report his or her income or evade a fraction of it. Finally, the government audits a fraction p of the returns and dishonest taxpayers are required to give up a fraction $t\,(1+\theta)$ of their unreported income in addition to suffering stigma at the rate of s for each dollar of tax evaded.

2.2. Utility of an outcome under prospect theory

Denote the reference income of the taxpayer as R and the income relative to the reference point as

$$X_i = Y_i - R, i = C, NC. \tag{2.3}$$

As in Kahneman and Tversky (1979) and Tversky and Kahneman (1992), the utility associated with any outcome X_i is defined as $v(X_i)$, and

$$v(X_i) = \begin{cases} X_i^{\beta} & if \quad X_i \geq 0 \\ -\gamma(-X_i)^{\beta} & if \quad X_i < 0 \end{cases} \tag{2.4}$$

where $\beta \in [0,1]$ and $\gamma > 1$ are preference parameters. The functional form in (2.4) arises from the axiom of *preference homogeneity*.[6] The parameter γ is the *parameter of loss aversion*; it encapsulates the basic idea that a loss of x dollars bites more that the pleasure that is derived from a gain of x dollars. Based on experimental evidence, Kahneman and Tversky (1979) and Tversky and Kahneman (1992) suggests that $\beta \approxeq 0.88$ while $\gamma \approxeq 2.25$. Figure 2.1 shows the utility function under prospect theory for $\beta = 0.5$.

2.3. The reference point under prospect theory

Although prospect theory does not provide sufficient guidance to determine the reference point in each possible situation, in several cases there can be a plausible candidate for a reference point. Indeed, specifying a suitable reference point is often essential for a successful application of prospect theory.

[6]For the axiomatic foundations, see al-Nowaihi, Bradley and Dhami (2009).

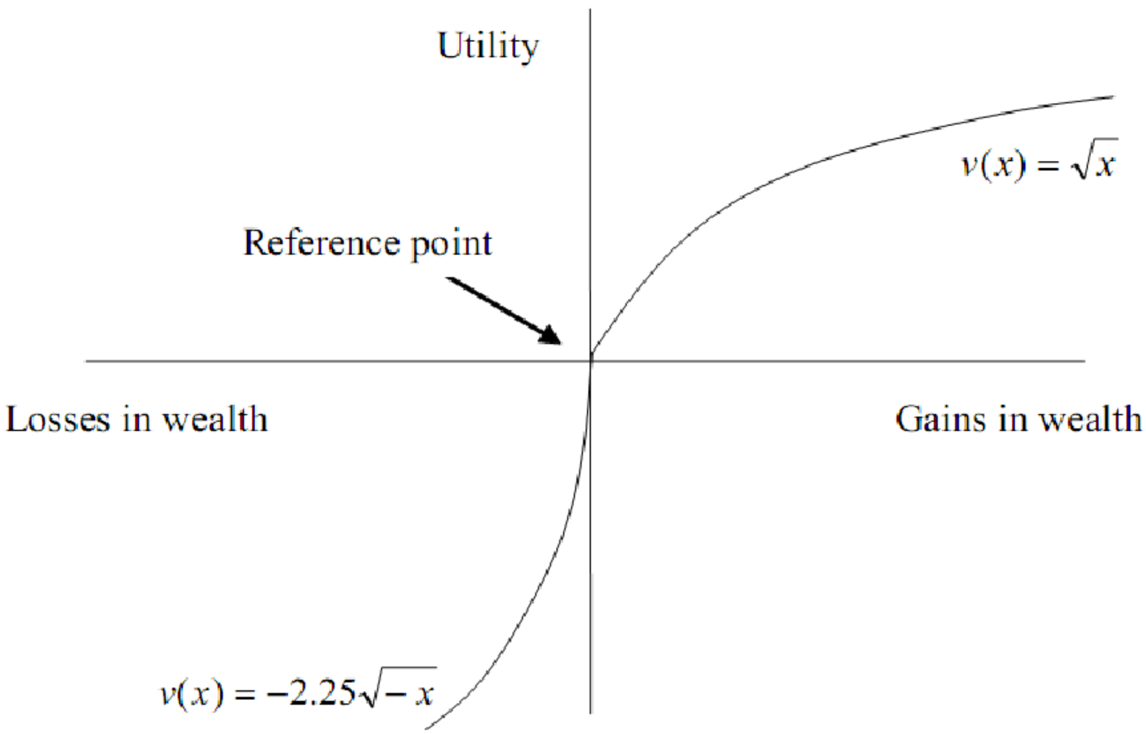

Figure 2.1: Utility function under prospect theory

DaN take the legal after-tax income as the reference point in their paper, so

$$R = (1 - t)Y. \tag{2.5}$$

This has the implication that if the taxpayer evades but is not caught, then she finds herself in the domain of gains. On the other hand, if she evades and is caught, then she finds herself in the domain of losses.

DaN justify (2.5) as follows. If the taxpayer is always in the domain of gains or always in the domain of losses, then CP reduces to RDEU. But Eide (2001) showed that the paradoxical comparative static results of the Allingham-Sandmo-Yitzhaki model carry over to RDEU. Therefore, the only interesting case is that in which the tax payer is in the domain of gains if not caught but in the domain of losses if caught. Proposition 1 from DaN, below, shows that this will be the case if, and only if, the reference point is the legal after tax income (2.5).

Proposition 1 *Suppose that for all levels of declared income, $D \in [0, Y]$, a tax payer is in the domain of gains if not caught, $X_{NC} \geq 0$, but in the domain of losses if caught, $X_C \leq 0$. Then the reference point must, necessarily, be $R = (1 - t)Y$.*

2.4. The probability weighting function

There is considerable empirical evidence that people overweight low probabilities but underweight high probabilities; see, for example, Kahneman and Tversky (1979), Tversky and Kahneman (1992) and Starmer (2000). We take a probability weighting function to be a strictly increasing function, $f(p)$, from $[0, 1]$ onto $[0, 1]$. Hence $f(p)$ is continuous with $f(0) = 0$, $f(1) = 1$. We assume that $f(p)$ is differentiable on $(0, 1)$. At a general level, the probability weighting function for gains, $f^+(p)$, need not be the same as that for losses, $f^-(p)$. We illustrate in Figure 2.2 an example of a specific weighting function, due to Prelec (1998) that takes the form $f(p) = \exp(-(-\ln p)^\alpha)$ for $\alpha = 0.35$. Such a function is identical for gains and losses, so $f^+(p) = f^-(p) = f(p)$.

2.5. Value function under prospect theory

Recall that our reference income is legal after-tax income (2.5): $R = (1 - t)Y$. Hence, from (2.3), $X_{NC} = Y_{NC} - (1 - t)Y$ and $X_C = Y_C - (1 - t)Y$. Then, using (2.1), (2.2) and recalling that $0 \leq D \leq Y$, we get

$$X_{NC} = t(Y - D) \geq 0, \tag{2.6}$$

$$X_C = -(s + \theta t)(Y - D) \leq 0. \tag{2.7}$$

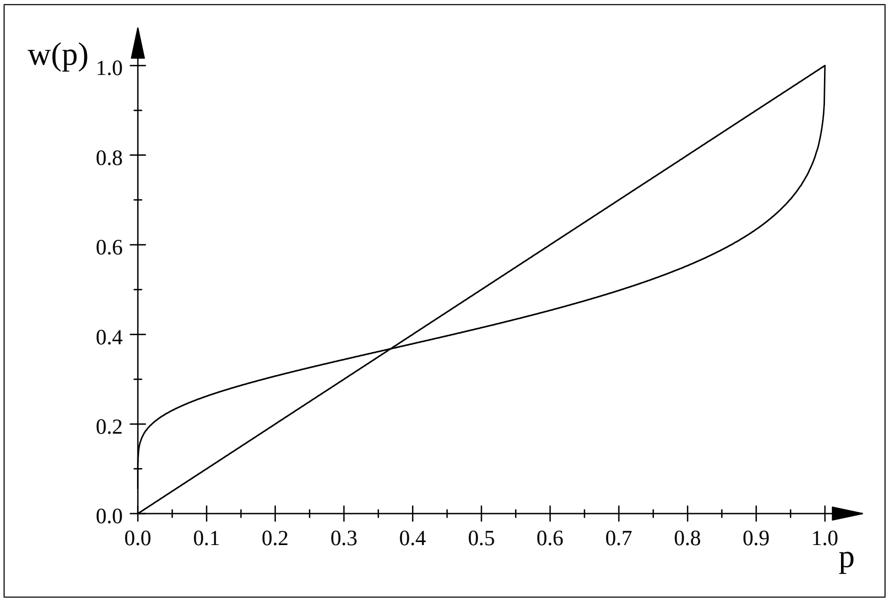

Figure 2.2: A Prelec (1998) probability weighting function.

Hence, the taxpayer is in the *domain of losses* if caught but in the *domain of gains* if not caught. Let v be the taxpayer's value function and f^+, f^- be her probability weighting function for the domains of gains and losses, respectively. Then, according to cumulative prospect theory, the taxpayer maximizes

$$V(D,t) = f^-[p(D)]\,v(X_C) + f^+[1-p(D)]\,v(X_{NC}). \tag{2.8}$$

Comparing (2.8) with the analogous expression for expected utility theory, we see the following differences. First, the carriers of utility in prospect theory are gains and losses relative to some reference point rather than levels. Second, one uses decision weights in prospect theory to aggregate outcomes while one uses objective probabilities under expected utility theory. From (2.4), (2.6), (2.7) and (2.8) we get that for the power form of the utility function:

$$V(D,t) = f^+[1-p(D)]\,[t(Y-D)]^\beta - f^-[p(D)]\,\gamma\,[(s+\theta t)(Y-D)]^\beta. \tag{2.9}$$

For any general utility function $v(.)$, $v' > 0, v'' < 0$ under prospect theory we get instead:

$$V(D,t) = f^+[1-p(D)]\,v(t(Y-D)) - f^-[p(D)]\,v((s+\theta t)(Y-D)) \tag{2.10}$$

3. Main results of DaN

DaN first prove the Yitzhaki result; see Proposition 2 below.

Proposition 2 *Assume that the probability of detection is independent of the amount evaded, so $p'(D) = 0$. Also assume no stigma $(s = 0)$ and non-increasing absolute risk aversion. Under these conditions, EUT predicts:*

(a) At an interior optimum an increase in the tax rate, t, causes a reduction in tax evaded.

(b) At an optimum on the boundary ($D^* = 0$ or $D^* = Y$), tax evasion is non-increasing in the tax rate, t.

The main result in DaN when taxpayers use cumulative prospect theory with an endogenous probability of detection $p(D)$ is contained in proposition 3. This Proposition also states in part (b) the resolution of the Yitzhaki puzzle using cumulative prospect theory.

Proposition 3 *Under prospect theory,*

(a) At a regular interior optimum, tax evasion is strictly decreasing in the punishment rate, θ, the stigma rate, s, and the coefficient of loss aversion, γ. However, tax evasion is strictly increasing in the tax rate, t.

(b) At an optimum on the boundary ($D^* = 0$ or $D^* = Y$), tax evasion is non-increasing in the punishment rate, θ, the stigma rate, s, and the coefficient of loss aversion, γ. However, tax evasion is non-decreasing in the tax rate, t.

3.1. Some results from DaN in the special case of a fixed exogenous probability of detection $p'(D) = 0$.

Suppose that we have the special case of an exogenous probability of detection i.e.

$$p(D) = p \text{ for all } D \geq 0.$$

In this case we highlight the following propositions from DaN:

Proposition 4 *: Suppose that the utility function under CP is of the (empirically supported) power form as in (2.4). Then the optimal solution D^* is the bang-bang solution i.e. we have either one of the two corner solutions $D^* = 0$ or $D^* = Y$.*

DaN argue (based on evidence) that tax evasion often takes the form of either hiding certain sources of income fully or fully reporting them.

Proposition 5 *: Suppose that the utility function under CP is of the (empirically supported) power form as in (2.4). Ceteris-paribus: (1) $\exists\ \theta = \theta_c \geq 0$, such that, when $\theta > \theta_c$, the taxpayer declares the full amount of income, while in the complementary case, all income is evaded. (2) $\exists\ p = p_c \in [0, 1]$, such that, when $p > p_c$, the taxpayer declares the full amount of income, while in the complementary case, all income is evaded. (3) $\exists\ s = s_c \in \left[\underline{s}, \bar{s}\right]$, such that, when $s > s_c$, the taxpayer declares the full amount of income, while in the complementary case, all income is evaded.*

Proposition 6 *: For realistic magnitudes of tax evasion (approximately 30 percent) and audit probabilities (1 to 3 percent), the penalty rate predicted by Prospect theory is 0.66 to 1.21 while that predicted by EUT is 31 to 98. The penalty rate predicted by Prospect theory is consistent with observed rates.*

From (2.10), Since V is a continuous function of declared income, D, on the compact set, $[0, Y]$, it attains a global maximum at, say, $D^* \in [0, Y]$. If D^* is an interior point ($0 < D^* < Y$), if V is twice continuously differentiable in a neighborhood of D^* and if $\left[\frac{\partial^2 V}{\partial D^2}\right]_{D^*} \neq 0$ (hence, $\left[\frac{\partial^2 V}{\partial D^2}\right]_{D^*} < 0$), then

$$\left[\frac{\partial D}{\partial t}\right]_{D^*} = -\left[\frac{\frac{\partial^2 V}{\partial D \partial t}}{\frac{\partial^2 V}{\partial D^2}}\right]_{D^*}. \tag{3.1}$$

Since p is constant, thus, $f^{\pm}$ are constant[7]. Using $\left[\frac{\partial V}{\partial D}\right]_{D=D^*} = 0$, and the value for $\frac{\partial^2 V}{\partial D^2}$, (3.1) gives

$$\left[\frac{\partial D}{\partial t}\right]_{D^*} = \frac{Y - D^*}{t} + s\left[\frac{f^-}{t\frac{\partial^2 V}{\partial D^2}}\left[v' - (s + \theta t)(Y - D) v''\right]\right]_{-(s+\theta t)(Y-D)} \gtrless 0 \tag{3.2}$$

Setting s (stigma) $= 0$, gives

$$\left[\frac{\partial D}{\partial t}\right]_{D^*} = \frac{Y - D^*}{t} > 0, \tag{3.3}$$

which is equation (53), p26 in HMT.

Remark 1 *: Note that we need a whole host of assumptions to get (3.3). In particular, we need ALL three of the following assumptions:*
(1) No stigma, $s = 0$.
(2) Exogenous probability of detection i.e. $p(D) = p$ for all $D \geq 0$.
(3) Interior solution.
Clearly, ALL three assumptions in conjunction is a very restrictive assumption. From Proposition 4, we cannot get an interior solution for the case of (i) $p(D) = p$, and (ii) the empirically and axiomatically supported power form of utility under prospect theory. It is this power form of the utility function that gives Proposition 6, which, therefore, is crucial to get a match with the data. It is remarkable that a match with the data is found by using parameters from independent and generic situations of risk (when taxpayers follow

[7] Incidentally, setting $f^-(p) = q$ and $f^+(p) = 1-q$, as HMT do, is only valid for $f^-(p) = 1-f^+(1-p)$. To quote from Prelec (1998), last line of Appendix A: "Cumulative prospect theory reduces to rank dependent utility if $f^-(p) = 1 - f^+(1-p)$. Empirically, however, one observes $f^-(p) = f^+(p)$" (we have changed Prelec's w to HMT's f).

prospect theory). Thus, if one abandons the power form of utility in order to justify an interior solution (but nevertheless requiring $s = 0$, and $p(D) = p$) then one has to find another form of the utility function that qualitatively and quantitatively explains the puzzles as in DaN. We are very skeptical of this possibility but would welcome it if someone came up with such a utility function.

Remark 2 : ***It is remarkable and ludicrous, in light of Remark 1 that HMT use (3.3) as the basis of their central conclusion on p. 56: "What they [non-expected utility models] do not do is change the relationship between the tax rate and the level of evasion."***

We discuss remark 2 in greater detail below.

4. Our disagreements with HMT

Dhami and al-Nowaihi (2007) is first mentioned in the last but one paragraph on p18 (subsection 4.2). This is then discussed in more detail towards the end of p25, p26, top of p27 and then in the first paragraph on p28. In total about $1\frac{1}{2}$ pages, a fair amount to devote to any one paper on tax evasion in a 58 page survey. So, no complaints at all here. However consider the following.

4.1. Main Disagreement: HMT's main conclusion is incorrect

At the bottom of page 26, HMT write their main result for prospect theory, namely, the effect of the tax rate, t, on declared income, D. This is equation (53) in HMT and is written as:

$$\frac{\partial D}{\partial t} = \frac{Y - D}{t} > 0 \tag{4.1}$$

Note well, that this is simply our equation (3.3), above and keep in mind Remarks 1 and 2. Following this equation, in the first paragraph, p27, HMT state: "The result is clear: counter to the suggestion [by DaN] that prospect theory can reverse the tax effect this model actually delivers an even stronger result than Allingham-Sandmo. As the tax rate increases so does the declared level of income. There is no need to make any assumption about absolute risk aversion. The conclusion is that prospect theory alone cannot reverse the tax effect.". **Every claim made here is wrong (as we show below)!**

DaN do not merely suggest that prospect theory can reverse the tax effect, they prove it. Furthermore, they prove this in a standard model of prospect theory that is corroborated by a large amount of empirical evidence, as shown in detail in DaN but completely ignored by HMT.

The result of HMT in their equation (53) (reported above as (4.1) and (3.3)) is conditional on the following three assumptions (see Remark 1). These assumptions are obvious from section 3 and (3.3) above.

A1. No stigma i.e. $s = 0$.

A2. The probability of an audit is exogenous to the taxpayer i.e. $p(D) = p$ for all $D \geq 0$.

A3. The maximum is an interior point.

All three of these assumptions are (of course) explicitly stated in HMT when their equation (53) is derived. But are ignored elsewhere. They are ignored in the quote given above, in the abstract, in the conclusion (Section 6, p56) and elsewhere. This thereby gives the reader the misleading impression that HMT's (53) is valid without restriction and, by implication, that DaN's results (in section 3 above) are merely erroneous conjectures.

In DaN's Section 4, the probability of an audit, $p(D)$, is allowed to depend on declared income, D. In Proposition 4 of DaN (which is reproduced as Proposition 3 in section 3 above), it is clear that the Yitzhaki puzzle can be explained using prospect theory. DaN proved this result using exactly the same method as in HMT! This result of DaN (in Proposition 3, section 3 above) is only referred to obliquely in HMT's first paragraph, p26, and not at all in their subsection 4.2.2 "Varying Probability of Audit". There is no inconsistency between DaN's result (reported in Proposition 3 above) and HMT's (53), since DaN assume positive stigma ($s > 0$) and endogenous probability of detection $p(D)$ which is in direct contrast to two of the restrictive assumptions behind HMT's (53) i.e. (i) no stigma and, (ii) p constant.

DaN did not pursue an endogenous probability of detection $p(D)$ for their calibration results or robustness checks because they did not have empirical evidence on the shape of $p(D)$. DaN argued (based on evidence) that the taxpayer is also unlikely to have such information. So, in their Section 5 "Model calibration" and Section 6 "Robustness analysis" they assume an exogenous probability of detection i.e. $p(D) = p$, a constant. For the power function form of the utility function as in (2.4) above (HMT's (48)) DaN show that the optimum will always be on the boundary (see Proposition 4 in section 3 above). There will be a critical level of stigma, s_c, such that $D^* = 0$ for $s < s_c$ but $D^* = Y$ for $s \geq s_c$ (see DaN's (5.11) and (5.12)) (see, also Proposition 5 in section 3 above). DaN interpret this to mean that some sources of income are hidden completely while others are revealed fully. In their discussion that follows their equation (5.11) DaN argued that this bang-bang nature is consistent with the available empirical evidence. As t increases so will s_c and, hence, some taxpayers will switch from compliance to evasion. DaN's result is barely mentioned in the first paragraph on HMT's p26 and nowhere else in their survey. In DaN's special case of exogenous probability of detection ($p(D) = p$), because the maximum is always on the boundary (and stigma is present), this result does not conflict with HMT's (53) because the latter requires assumption 3 above, i.e. the maximum is an interior point!

One should note well that the power form of the utility function in prospect theory is not an ad-hoc simplification. It accords with the empirical evidence (see Tversky and Kahneman, 1992) and it has been axiomatized (see al-Nowaihi, Bradley and Dhami, 2008). Furthermore, using the power form of utility, prospect theory is able to explain the data arising from tax evasion in a very satisfactory manner while expected utility fails badly (see Proposition 6 in section 3 above). As Proposition 4 in section 3, above, clearly shows, when the probability of detection is exogenous, and the utility function is of the power form, then one cannot get an interior solution.

However, an interior solution is one of the three assumptions (assumption 3) that HMT need to get their (53) (which is reported as (4.1) above). It must, therefore, be the case that they reject the power form of the utility function which is consistent with the evidence and has an axiomatic foundation. Hence, HMT must have another utility function in mind, but which? The onus is on them, then, to give at least one example of a utility function (other than the power form) that can explain all the tax evasion puzzles (qualitative and quantitative) that DaN explain. If HMT cannot come up with such a utility function then their equation (53) (which is reported as (4.1) above)) is vacuous.

Thus, in a nutshell, all there assumptions A1, A2, A3, simultaneously, are required to get HMT's result in (4.1) above. In none of the models reported in DaN are all three assumptions in A1, A2, A3 simultaneously made. Furthermore, the results in DaN, which are in close conformity with the quantitative and qualitative evidence require that assumptions A1, A2, A3 never be simultaneously made.

4.2. Other Disagreements

1. Nowhere is the model of DaN specified, so the reader is unable to judge for him/herself.[8] Equation (49) in HMT, which is a special case of equation (4.6) in DaN (this is equation (2.10) above), is presented as that of HMT, or at least this is what readers may surmise. Equation (49) in HMT only holds if the reference point is the '*legal after tax income*', which is what DaN specify. This reference point is not arbitrary. If the taxpayer is always in the domain of gains or always in the domain of losses, then cumulative prospect theory reduces to rank dependent utility. However, Eide (2001) showed that the paradoxical comparative static results of the Allingham-Sandmo-

[8] Parts of the paper dealing with DaN's work appear as unintelligible or simply misleading. See, for instance, the paragraph beginning at the end of page 25 and continuing well into the top of page 26.

Yitzhaki model carry over to rank dependent utility. Hence, the only interesting case is that in which the taxpayer is in the domain of gains if not caught but in the domain of losses if caught. Proposition 3 of DaN, reported above as Proposition 1, shows that this will be the case *if, and only if, the reference point is the 'legal after-tax income'*.

2. Nowhere are the actual results of DaN given, or even summarized. HMT simply claim that the results of DaN are erroneous without ever formally stating them. Hence, we have felt it important to include the material in sections 2 and 3 above.

3. At the end of the third paragraph, p26, HMT say "our point is that even when there is an interior maximum and comparative statics can be applied the claims made [by DaN] for prospect theory do not hold up." **Both assertions here are wrong**. Comparative static analysis can also be carried out for maxima on the boundary as well as the interior. We have rechecked our results, several times, since reading the HMT survey. All the results in Dhami and al-Nowaihi, far from not holding up, are correct and rigorously established.

4.3. A methodological disagreement with HMT

On p29, central paragraph, lines 3-5, HMT say: "prospect theory alone is not sufficient to deliver the conclusion that an increase in tax rate raises the amount of evasion"

This is certainly correct. But it is also correct of *all* theories. In particular, DaN never claimed that "prospect theory alone can reverse the tax effect". On the contrary, we believe that *no* empirical result can be derived from a theory without an empirical input (as well as simplifying assumptions and auxiliary hypotheses, etc.).

What DaN do claim is that a simple model of tax evasion within a standard prospect theory framework can easily explain both the qualitative and quantitative aspects of tax evasion while a comparably simple model within a standard expected utility framework cannot. Moreover, in applying prospect theory DaN did not fix the parameter values of their model to fit the evidence on tax evasion. Quite the contrary, DaN used parameter values that are well corroborated by evidence unrelated to the tax evasion problem. When such parameter values were unavailable, DaN undertook robustness analyses. Hence, the nature of DaN's contribution is described in a highly misleading manner in HMT's review.

Maybe there is a confusion here. Consider, for example, the neoclassical theory of consumer behavior. This theory imposes *no* restrictions other than *adding-up*, *homogeneity*, *symmetry* and *negativity*. To get the theory to work, we may start with a flexible functional form (translog etc.) but then we have to impose extra conditions (to be tested empirically). For example, if we are modelling goods whose demands are clearly downward sloping, we have to impose a condition that excludes Giffen goods.

4.4. Disagreement with HMT's evaluation of prospect theory

On p26, central paragraph, last two lines, HMT say: "Prospect theory is not a simple solution to the problem of the tax rate effect"

Assume, for argument's sake that this is true (it is not). All the elements of prospect theory, including the power function form of the utility function (HMT's (48)), have received strong empirical support both from experiments and field studies. See, for example, Tversky and Kahneman (1992), Kliger and Levy (2009) and Gurevich, Kliger and Levy (2009). But this is not the case for expected utility theory. Hence, given a choice between expected utility theory and prospect theory, we would argue that it is incumbent upon us to use the later, even if it were more complex. However, DaN[9] show that prospect theory provides a much simpler solution than expected utility theory. This part of DaN's work (the main part), is totally ignored in HMT.

In section 6 of HMT titled "Conclusions", p56 (similar statements can be found in HMT's Abstract and elsewhere), HMT state: "What they [non-expected utility models] do not do is change the relationship between the tax rate and the level of evasion" We strongly disagree, as shown in Dhami and al-Nowaihi (2007, 2010) and explained in detail above.

HMT also say: "The non-expected utility models can change the cut-off probability for evading and hence the proportion of evaders. They also change the amount declared" We fully agree. Nevertheless, we cannot help but feel disappointed that DaN's paper, which gives strong support to this conclusion, is not found worthy of mentioning in this respect.

DaN's main point is that a simple model of tax evasion within a standard prospect theory framework can explain the evidence on tax evasion far better than a comparably simple model based on expected utility. In fact, DaN's simple model, despite its simplifying assumptions, predicts the empirically correct directions and magnitudes. By contrast, a comparably simple model based on expected utility predicts the wrong direction of change of evasion in response to a tax increase and predicts magnitudes that are wildly wrong, by a factor of 100 in some cases. This suggests, and contrary to HMT's conclusion, that prospect theory can provide a better framework for modelling and understanding tax evasion.

[9] See also the follow-up paper from Dhami and al-Nowaihi (2007), which is Dhami and al-Nowaihi (2010).

5. References

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