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Behavioral Explanation of Tax Asymmetries

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Abstract

This note develops a behavioral explanation for the existence of an asymmetric tax treatment of gains and losses when investors are loss averse. We find that loss offset rules should be more restrictive for investors which are (1) more risk averse in case of gains, (2) less risk seeking in case of losses, or (3) more loss averse. Our findings have important policy implications. Tax authorities often implement identical loss offset rules for different investor clienteles. However, there should be specific loss offset rules for investors who differ in risk attitude as well as in loss aversion.

Keywords: Asymmetric Taxation, Loss Offset Rules, Loss Aversion, Behavioral Economics

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1 Introduction

Tax authorities around the world make distinctions between the taxation of gains and losses: If profits exceed expenditures, investors immediately pay taxes. In contrast, there is no immediate unrestricted tax refund in case of losses. However, there are loss offset rules which allow an offset of losses with past or future profits. For example, in the United States, private investors and corporations can carry forward losses 20 years and back two years.[1] Similar restrictions are applied in many other OECD countries such as Australia, Canada, France, Germany, and Japan. In general, such loss offset restrictions affect risk taking and can result in a distorted demand for risky assets (see Domar and Musgrave, 1944; Richter, 1960; Stiglitz, 1969; Sandmo, 1989).

Many economists thus argue that tax systems require a symmetric taxation of gains and losses to avoid a distortion of investment decisions.[2] In contrast, there are some conditions under which a symmetric treatment of gains and losses is no longer a necessity. For example, Panteghini (2001a,b) show that an asymmetric taxation may be neutral under investment irreversibility and asymmetric effects of uncertainty.[3] Thus, there is no general agreement on whether gains and losses should be taxed symmetrically or asymmetrically.

[1]Empirical evidence from the United States on the importance of loss offset restrictions and the ability of firms to obtain refunds for tax losses is provided by Altshuler and Auerbach (1990) and Shevlin (1990).

[2]Auerbach (1986) shows theoretically that a tax system with a full loss offset, i.e. an immediate tax refund in case of losses, do not distort investment decisions. According to Bonds and Devereux (1995), a neutral business tax must treat profits and losses symmetrically even under uncertainty. In case of capital gains, asymmetric treatment of capital gains and losses "turns the capital gains tax into a discriminatory tax on investment income" (Ball, 1984, p. 480). Furthermore, an asymmetric taxation increases the deadweight loss of taxes as investments are riskier under asymmetric taxation than symmetric treatment of profits and losses (Pirrong, 1995). Using a simulation approach, Majd and Myers (1987) show that tax asymmetries reduce the profitability of risky investment and can be the dominant tax effect for stand-alone projects.

[3]Another dimension affecting the impact of asymmetric taxation is liability of investors when investing in risky projects. Ewert and Niemann (2010) show that full liability as for sole proprietors requires symmetric taxation. In contrast, limited liability as for corporations requires asymmetric taxation of profits and losses.

We contribute to the literature and this discussion in two ways. First, this note provides an explanation for the existence of loss offset restrictions (i.e. an asymmetric taxation of gains and losses) from a behavioral perspective. In a simple model, we show that tax asymmetries can be justified if investors are assumed to be loss averse. Archival and experimental studies provide empirical evidence for this assumption and show that individuals value gains and losses differently (see, for example, Kahneman and Tversky, 1979; Thaler, 1980; Samuelson and Zeckhauser, 1988; Kahneman et al., 1990; Weber and Camerer, 1998; Odean, 1998).

Second, we show that the degree of loss aversion and risk attitude affect the degree of a loss offset restriction. Our model predicts that when investors are (1) more risk averse in case of gains, (2) less risk seeking in case of losses, or (3) more loss averse, loss offset rules should be more restrictive. This finding has important policy implications. Loss offset rules should take into account the substantial heterogeneity in risk attitude and loss aversion across investors. For example, risk attitude and loss aversion differ between income groups, gender (for example Schmidt and Traub, 2002; Brooks and Zank, 2005; Dhar and Zhu, 2006; Calvet et al., 2009a,b; Croson and Gneezy, 2009; Dohmen et al., 2011), and more generally between corporations with limited liability and investors with unlimited liability (Gollier et al., 1997).

From a fiscal perspective, the asymmetric taxation of gains and losses has some desirable effects. Lee and Sung (2007) document that tax revenues in OECD as well as non-OECD countries are pro-cyclical. More specifically, tax authorities collect higher taxes when the economy does well and receive less taxes during economic crises. This pro-cyclicality of tax collections is mitigated if tax authorities only allow loss carry forwards as opposed to giving an immediate tax refund. This effectively lowers budget deficits during economic crises and allows more government spending.

The remainder of this note is organized as follows. In Section 2, we present the theoretical framework. Section 3 discusses the implications of our results for existing tax systems. The final section provides a conclusion.

2 Theoretical framework

In this section, we provide a simple theoretical framework which explains the existence of loss offset restrictions from a behavioral perspective. We consider an investor who invests I in a risky asset with a positive outcome C. The profit from this investment is $\pi = I - C$. Depending on the state of nature, the investor either generates a gain ($I < C$) or a loss ($I > C$). The potential gain $\pi_g = x$ and the potential loss $\pi_l = -x$ ($x > 0$) are assumed to be symmetric. Both state of natures occur with equal probability. The utility function $u(\pi)$ of the investor has three main features (see, for example, Tversky and Kahneman, 1992; Abdellaoui et al., 2007): (1) risk aversion in case of gains, (2) risk seeking in case of losses, and (3) loss aversion, i.e. the utility function is steeper for losses than for gains. Figure 1 illustrates a utility function with these characteristics where $\pi = 0$ ($I = C$) serves as the reference point.

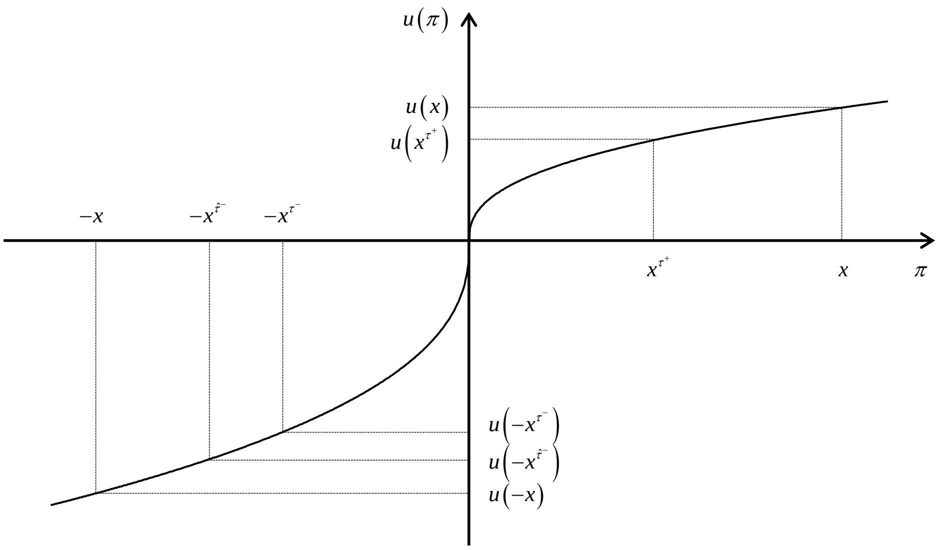

Figure 1: Utility of gains and losses

In the following, we focus on the effect of profit taxation on individual's utility. As our purpose is neither the derivation of a general equilibrium on risky asset markets nor the definition of an optimal taxation, we assume the decision to introduce profit taxes to be exogenous. The motivation of tax authorities to raise taxes is manifold: providing public goods (*fiscal purpose*), introducing or maintaining an income transfer system (*redistribution*), or governing the behavior of taxpayers (*allocation*). In our setting, we use a proportional tax with a potential loss offset restriction. Profits are taxed at the constant rate τ^+. In case of losses a tax refund is granted at the constant rate τ^- with $0 < \tau^+, \tau^- < 1$. The after-tax payoff x^τ in our setting is $(1-\tau^+)x$ in case of a gain and $-(1-\tau^-)x$ in case of a loss.

First, we consider the case of a symmetric taxation of gains and losses ($\tau^+ = \tau^-$), i.e. there is an immediate full loss offset. Profit taxation decreases utility by $u(x) - u\left(x^{\tau^+}\right)$ in case of gains and increases utility by $u\left(-x^{\tau^-}\right) - u(-x)$ in case of losses. In general, loss aversion leads to $u(x) - u\left(x^{\tau^+}\right) < u\left(-x^{\tau^-}\right) - u(-x)$. The increase in utility in case of losses is larger than the decline in utility in case of gains. This implies that a profit tax which treats gains and losses symmetrically is asymmetric in terms of utility.

If we assume that the tax authority intends to treat both situations symmetrically in terms of utility for reasons of anti-discrimination and equality, gains and losses need to be taxed asymmetrically. This assumption justifies that we follow the concept of equal absolute sacrifice (Richter, 1983). To ensure an identical absolute shift in utility in case of gains and losses, the tax authority has two options: (1) increasing τ^+ while keeping τ^- constant or (2) decreasing τ^- while keeping τ^+ constant. Both options effectively restrict the offset of losses. In the following, we focus on the latter option only.[4] To ensure symmetry in terms of utility, the offset of losses should then be restricted to $\hat{\tau}^-$ such that (see also Figure 1)

$$u(x) - u\left(x^{\tau^+}\right) = u\left(-x^{\hat{\tau}^-}\right) - u(-x) \tag{1}$$

To analytically derive values for $\hat{\tau}^-$, we first focus on a utility function with constant relative risk aversion (CRRA) and second on a utility function with constant absolute risk aversion (CARA). We use the two-part power value function of

[4] Our results are qualitatively identical when increasing τ^+ while keeping τ^- constant.

Tversky and Kahneman (1992) as an example for the CRRA function:

$$u(\pi) = \begin{cases} \pi^{\alpha} & \pi \geq 0 \\ -\lambda(-\pi)^{\beta} & \pi < 0 \end{cases} \tag{2}$$

The empirical observation that utility is concave in case of gains and convex in case of losses is characterized by $0 < \alpha, \beta < 1$ (Abdellaoui et al., 2007). As the utility function is usually closer to a linear function for losses than for gains (Köbberling and Wakker, 2005), we constrain our analyses to $\alpha \leq \beta$. If an investor is risk neutral, α and β equal 1. The parameter $\lambda \geq 1$ controls for loss aversion and is greater than unity for a loss averse investor. From Equation (1) and (2), we derive $\hat{\tau}^{-}_{CRRA}$ for the Tversky/Kahneman utility function as:

$$\hat{\tau}^{-}_{CRRA} = 1 - \frac{1}{x}\left[\frac{\lambda x^{\beta} - x^{\alpha} + ((1-\tau^{+}) \cdot x)^{\alpha}}{\lambda}\right]^{\frac{1}{\beta}} \tag{3}$$

As discussed by Köbberling and Wakker (2005), a CRRA utility function entails the existence of $u(x) > |u(-x)|$ when $\alpha \neq \beta$ for small x. Consequently, for small x and λ close to unity, $\hat{\tau}^{-}_{CRRA}$ can exceed τ^{+}. In all other cases which are in line with empirical observations, we find that $\hat{\tau}^{-}_{CRRA} < \tau^{+}$. That is, we should treat gains and losses differently and in our case, the offset of losses should thus be restricted. As the utility function from Equation (2) contradicts empirical evidence of $u(x) < |u(-x)|$ for small x, we additionally analyze an exponential utility function (EUF) with a constant (increasing) absolute (relative) risk aversion:

$$u(\pi) = \begin{cases} \frac{1-e^{-\mu\pi}}{\mu} & \pi \geq 0, \mu \neq 0 \\ \lambda\left(\frac{e^{\nu\pi}-1}{v}\right) & \pi < 0, \nu \neq 0 \end{cases} \tag{4}$$

Similar to the CRRA function, we assume that $0 < \nu \leq \mu$ and $\lambda \geq 1$. Consequently, the utility function from Equation (4) reflects loss aversion ($\lambda \geq 1$) and is concave for gains ($\mu > 0$), convex for losses ($\nu > 0$), and closer to a linear function for losses than for gains ($\nu < \mu$). If μ or ν are very close to zero, the utility function is close to a linear function. The EUF ensures that $u(x) < |u(-x)|$ for all x. From Equation (1) and (4), we derive $\hat{\tau}^{-}_{CARA}$ as:

$$\hat{\tau}^{-}_{CARA} = 1 + \frac{1}{\nu x} \ln \left[\frac{\nu}{\lambda \mu} \left(e^{-\mu \left(1-\tau^{+}\right) x} - e^{-\mu x} \right) + e^{-\nu x} \right] < \tau^{+} \tag{5}$$

Equation (5) and in general cases Equation (3) imply that the tax rate on losses (τ^{-}) is lower than the tax rate on gains (τ^{+}). Hence, tax authorities should tax gains and losses asymmetrically to ensure an identical absolute shift in utility in case of gains and losses. Based on these results, we can formulate:

Proposition 1 *If an investor is risk averse in case of gains, risk seeking in case of losses and loss averse, tax authority should tax gains and losses asymmetrically such that* $\tau^{-} < \tau^{+}$.

This proposition contradicts results of previous studies which demand a symmetric taxation of gains and losses to avoid a distortion of investment decisions (see, for example, Ball, 1984; Auerbach, 1986; Bonds and Devereux, 1995; Pirrong, 1995). However, there are also theoretical papers which show that an asymmetric tax treatment of gains and losses is no longer a necessity under certain conditions such as investment irreversibility, uncertainty, or limited liability (see, for example, Panteghini, 2001a,b; Ewert and Niemann, 2010).

We next analyze how changes in risk attitude and loss aversion affect $\hat{\tau}^{-}$. Following Equation (3) and (5), the extent of loss offset restriction depends on the degree of risk aversion in case of gains, risk seeking in case of losses, and loss aversion for a given x. First, we consider the influence of a lower degree of risk aversion for gains. This implies an increase in α for the CRRA utility function and a decrease in μ for the CARA utility function. The remaining parameters of the utility functions are kept constant. The first derivatives of $\hat{\tau}^-$ with respect to α and μ are:

$$\frac{\partial \hat{\tau}^-_{CRRA}}{\partial \alpha} = -\frac{\vartheta^{\frac{1}{\beta}-1}}{x\beta\lambda}\left[\left(\left(1-\tau^+\right)x\right)^\alpha \ln\left(\left(1-\tau^+\right)x\right) - x^\alpha \ln x\right] \lesseqgtr 0 \tag{6}$$

$$\frac{\partial \hat{\tau}^-_{CARA}}{\partial \mu} = \frac{1}{x\xi\lambda\mu^2}\left[\mu x\left(e^{-\mu x} - \left(1-\tau^+\right)e^{-\mu\left(1-\tau^+\right)x}\right) + e^{-\mu x} - e^{-\mu\left(1-\tau^+\right)x}\right] < 0 \tag{7}$$

where $\vartheta = \frac{\lambda x^\beta - x^\alpha + ((1-\tau^+)\cdot x)^\alpha}{\lambda} > 0$ and $0 < \xi = \frac{\nu}{\lambda\mu}\left(e^{-\mu\left(1-\tau^+\right)x} - e^{-\mu x}\right) + e^{-\nu x} < 1$. As $u(x)$ can exceed $-u(-x)$ for rather small x, $\frac{\partial \hat{\tau}^-_{CRRA}}{\partial \alpha}$ can be below zero. However, $\frac{\partial \hat{\tau}^-_{CRRA}}{\partial \alpha}$ is positive in general cases. Assuming the latter, a lower degree of risk aversion in case of gains leads to an increase of $\hat{\tau}^-$. For the CARA utility function, $\frac{\partial \hat{\tau}^-_{CARA}}{\partial \mu}$ is always negative. Hence, a decline in μ which implies a lower degree of risk aversion leads to an increase of $\hat{\tau}^-$. From Equation (7) and in general cases from Equation (6), we can conclude that if an investor is less risk averse in case of gains, the asymmetry in the taxation of gains and losses should decrease for this investor.

Second, we analyze the influence of a lower degree of risk seeking in case of losses—an increase (decrease) of β (ν) for the CRRA (CARA) utility function—on $\hat{\tau}^-$. The respective derivatives are:

$$\frac{\partial \hat{\tau}^-_{CRRA}}{\partial \beta} = -\frac{\vartheta^{\frac{1}{\beta}-1}}{x\beta^2}\left(x^\beta \ln x^\beta - \vartheta \ln \vartheta\right) \quad \lesseqgtr \quad 0 \tag{8}$$

$$\frac{\partial \hat{\tau}^-_{CARA}}{\partial \nu} = \frac{1}{x\nu^2}\left(1 - \ln \xi - \frac{e^{-\nu x}}{\xi}\left(1+\nu x\right)\right) > 0 \tag{9}$$

The effect of such a change in risk attitude is again ambiguous for the CRRA utility function. However, $\frac{\partial \hat{\tau}^-_{CRRA}}{\partial \beta}$ is below zero in general cases. Hence, $\hat{\tau}^-_{CRRA}$ decreases in the degree of risk seeking. The first derivative of $\hat{\tau}^-_{CARA}$ with respect to ν is above zero. Therefore, a lower degree of risk seeking requires a lower $\hat{\tau}^-$. For both utility functions, we can conclude that if an investor is less risk seeking in case of losses, the asymmetric taxation of gains and losses should increase for this investor.

Finally, we analyze the effect of loss aversion (λ) on $\hat{\tau}^-$. The first derivatives for both utility functions are:

$$\frac{\partial\hat{\tau}^-_{CRRA}}{\partial\lambda} = -\frac{\vartheta}{x\beta\lambda^2}\left[x^\alpha - \left(\left(1-\tau^+\right)x\right)^\alpha\right] < 0 \tag{10}$$

$$\frac{\partial\hat{\tau}^-_{CARA}}{\partial\lambda} = -\frac{1}{x\xi\lambda^2\mu}\left(e^{-\mu\left(1-\tau^+\right)x} - e^{-\mu x}\right) < 0 \tag{11}$$

We find a negative relation between $\hat{\tau}^-$ and λ for both CRRA and CARA utility functions. That is, a lower degree of loss aversion increases $\hat{\tau}^-$. Hence, the degree of asymmetric tax treatment of gains and losses should increase in loss aversion. More (less) loss averse investors should be granted a more (less) restrictive loss offset. This effect points in the same direction as a lower degree of risk aversion in case of gains and in the opposite direction as a lower degree of risk seeking in case of losses.

Although the exact magnitude of each effect is unclear, we can draw some conclusions on the overall effect of a variation in risk attitude and loss aversion. We consider two investors A and B and assume that A's risk preference is closer to risk neutrality than B's. More specifically, investor A is less risk averse in case of gains and less risk seeking in case of losses than B. Furthermore, we assume that A is less loss averse than B. As a change in risk attitude most likely affects risk aversion in case of gains and risk seeking in case of losses to the same extent, the effect of a lower degree of risk aversion in case of gains on the degree of tax asymmetry is approximately identical with the effect of a lower degree of risk seeking in case of losses. Hence, the effect of a variation in risk attitude on the different tax treatment of gains and losses is only marginal. The degree of loss aversion is the dominating effect and justifies a different tax treatment of both investors. As the degree of tax asymmetry of gains and losses increases in the degree of loss aversion, gains and losses of investor A should be taxed less asymmetrically than B's.[5] More specifically,

[5] Even if two investors have identical risk attitudes in case of gains and losses but differ with respect to loss aversion, the tax authority should tax gains and losses of the investor with the lower degree of loss aversion less asymmetrically.

investor A should be granted more generous loss offset provisions than investor B. These arguments lead to our second proposition:

Proposition 2 *If an investor A is closer to risk neutrality in case of gains and losses and less loss averse than an investor B, the tax authority should tax gains and losses of A less asymmetrically than B's.*

3 Implications for Fiscal Policy

We next turn to the implications of our propositions for fiscal policy. In line with Proposition 1, tax authorities around the world make distinctions between gains and losses. In particular, a tax is always levied if taxable income of an investor or a company is positive. In contrast, no tax authority allows an immediate unrestricted loss offset when expenditures are higher than revenues. A few countries allow a carryback of losses which may induce an immediate and full tax refund if profits of preceding years are considerably high to offset current losses. Usually, the use of loss carryback is restricted in time: Germany, Ireland, Netherlands, South Korea, Japan, Singapore, the United Kingdom allow carrybacks for only one year, the United States for two years, and Canada for three years. France allows a carryback for three years but only grants a tax credit and not an immediate tax refund. Remaining losses must be carried forward.

Even if a carryback of losses is not permitted, most countries allow a carry forward of losses to offset current losses against future profits. However, many tax authorities restrict the carry forward to a certain time period, for example five years in Greece or Portugal, seven years in Japan, nine years in the Netherlands, or twenty years in Canada and the United States. Only some countries such as Germany, Ireland, or the United Kingdom allow an unlimited loss carry forward. All these rules lower effective tax rates on losses and result in an asymmetric taxation of gains and losses in accordance with Proposition 1.

However, loss offset rules do not take into account the heterogeneity in risk attitude and loss aversion across investors (Proposition 2). Carryback and carry forward rules are often identical for all investors such as sole proprietors and corporations. For example, the German as well as the Austrian tax authority limits loss carryovers to identical thresholds for personal income tax and corporate tax purposes.[6] According to Proposition 2, the design of loss offset rules should consider the investor's risk attitude as well as the degree of loss aversion. In sum, the refund of losses should be restricted but these limitations should differ with respect to risk attitude and loss aversion. We next discuss three possible dimensions of differences in loss offset restrictions.

First, income and wealth have an influence on both risk attitude and loss aversion. Dhar and Zhu (2006) and Calvet et al. (2009a,b) show that wealthy investors and individuals with higher income exhibit a lower disposition effect. That is, investors tend to hold losing investments too long and sell winning investments too early (see Shefrin and Statman, 1985; Odean, 1998). This finding can be explained by a "S"–shaped value function as in the prospect theory according to which the utility function is steeper for losses than for gains. Consequently, if an investor exhibits the disposition effect to any degree, Proposition 1 holds and he should face an asymmetric tax treatment of gains and losses.

If an investor A exhibits a lower disposition effect than investor B, the difference in absolute values between the utility from a loss and the utility from a gain is lower for investor A than for B, i.e. $|u(-x^A)| - u(x^A) < |u(-x^B)| - u(x^B)$. To put it differently, our conditions for a less asymmetric tax treatment of gains and losses (Proposition 2) are in line with a lower disposition effect of an investor. In our case, loss offset rules should be less restrictive for investor A than for investor B. High income and wealthy investors should thus be taxed less asymmetrically than

[6] More specifically, the German tax authority limits the amount of losses carried back (€ 511,500) and forward (only 60% of profits exceeding € 1,000,000). Austrian investors can only offset losses up to 75% of their gross income in one year. In both countries, these limits are identical for corporations, sole proprietors and private investors.

low income and low wealth investors as the former (latter) exhibit a lower (higher) disposition effect.

Second, demographic characteristics such as gender and age also affect risk attitude and loss aversion. In a recent study, Dohmen et al. (2011) document that women are less willing to take risk than men (see Croson and Gneezy, 2009, for a detailed literature overview). Using experimental settings, Schmidt and Traub (2002) and Brooks and Zank (2005) show that women are additionally more loss averse than men. Empirical evidence thus suggests that the conditions of our Proposition 2 are fulfilled with respect to gender. Consequently, men should be taxed less asymmetrically than women. With respect to age, Dhar and Zhu (2006) find that older individuals exhibit a lower disposition effect. Following the arguments from above, the fiscal authority should thus tax older investors less asymmetrically than younger investors.

Finally, risk taking differs between corporations and private investors. Investors who merge into a corporation are able to diversify their risky positions. The degree of diversification increases in the number of investors participating in a corporation. Thus, a group of investors acts more risk neutral as they have more risk diversification opportunities. In contrast, a sole proprietor without the opportunity to diversify or with a lower ability of risk diversification is more risk averse. Additionally, liability differs between legal organizational forms. Gollier et al. (1997) show that optimal risk exposure is larger under limited (as for corporations) than under full liability (as for sole proprietors). Corporations can thus be seen as more risk neutral in case of gains and losses as well as less loss averse than sole investors. According to Proposition 2, loss offset provisions should be more generous for corporations than for private investors.[7]

[7] A general assumption in a variety of theoretical models is that corporate investors are risk neutral and not loss averse. Under these assumptions, $\hat{\tau}^-$ is equal to τ^+ for both CARA and CRRA utility functions and, thus, the tax authority should grant an immediate unrestricted tax refund in case of losses. Assuming that private investors are not risk neutral but loss averse, τ^+ exceeds $\hat{\tau}^-$. Hence, loss offset should be restricted for sole proprietors, but not for corporate investors.

4 Conclusion

We offer new insights on the existence of asymmetric taxation of gains and losses. From a behavioral perspective, we provide an explanation why tax authorities should restrict loss offsets. We show that if investors are more risk averse (seeking) in case of gains (losses), loss offset rules should be more (less) restrictive. Furthermore, a higher degree of loss aversion has a positive impact on loss offset restrictions. Tax authorities should thus take into careful consideration the differences in risk attitude and loss aversion across investor groups (for example corporations versus private investors, female versus male investors, or low versus high income investors). For example, loss offset rules should be more generous for well diversified investors (corporations or wealthy investors) than for less diversified investors (sole proprietors or low income investors). Our findings have important policy implications as tax authorities in (almost) all countries do not implement such distinctions.

There are several ways of implementing loss offset restrictions: One could (i) introduce investor specific annual loss offset limits, (ii) restrict the use of carrybacks and carry forwards to time periods that differ across investors or (iii) define specific loss offset rules for different income baskets. The asymmetric taxation of gains and losses can further mitigate the pro-cyclical nature of corporate tax revenues (see Lee and Sung, 2007). If firms are not entitled an immediate full loss offset, tax revenues are smoother and less pro-cyclical. This lowers budget deficits during economic crises and increases opportunities for government spending.

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