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Article

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Suggested Citation: Chen, Kuo-Shing; Tsai, Huolien (2018) : Taxing the rich policy, evasion behavior, and portfolio choice: A sustainability perspective, Cogent Business & Management, ISSN 2331-1975, Taylor & Francis, Abingdon, Vol. 5, https://doi.org/10.1080/23311975.2018.1526362

This Version is available at:
https://hdl.handle.net/10419/206120

Chen & Tsai, *Cogent Business & Management* (2018), 5: 1526362
https://doi.org/10.1080/23311975.2018.1526362

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BANKING & FINANCE | RESEARCH ARTICLE

Taxing the rich policy, evasion behavior, and portfolio choice: A sustainability perspective

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Received: 05 May 2018
Accepted: 14 September 2018
First Published: 09 October 2018

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Reviewing editor:
David McMillan, University of Stirling, USA

Additional information is available at the end of the article

Abstract: In the spring of 2016, the tax-evasion revelations from the Panama Papers regarding the international clients of Mossack Fonseca shook the financial world. This article sheds light on whether taxing the rich will generate the tax-evasion effect, if the evasion behavior will affect the portfolio choice, and finally, the broader economic impacts of such tax evasion. The main insights are: (1) the evidence from the Panama Papers demonstrates that the supply of tax evasion services explains that evasion behavior rises steeply with wealth; (2) we also affirm that higher tax rates induce greater tax evasion activity and explain why the taxation system introduced by Hollande, which levied high tax on millionaires, failed in France; and (3) the primary components of billionaires' asset allocation involve adequately weighting long-term stock holdings. Finally, these findings provide some evidence on the sustainability of taxing the rich and the sustainable investing behavior of the ultra-wealthy.

Subjects: Economic Psychology; Macroeconomics; Public Finance; Business, Management and Accounting

Keywords: asset allocation; CGARCH model; prospect theory; Panama papers; tax evasion

ABOUT THE AUTHORS

Kuo-Shing Chen received his PhD degree in Finance from National Sun Yat-sen University. Currently he is working as an adjunct assistant professor at Shih Chien University, Kaohsiung Campus, where he taught Financial Management and Financial Statement Analysis. He had received several research awards e.g. the 2011 Taiwan Conference on Business and Information (TBI), and the Excellent Doctoral Paper of 2016 TSC Thesis Symposium. His main research fields are the Public Finance, FinTech, and Management Accounting. His academic papers on reverse mortgages and tax reform have appeared in the Real Estate Economics (SSCI), Journal of Risk Model Validation (SSCI), Journal of Applied Banking and Finance(EconLit/AEA), and Journal of Housing Study(TSSCI), among others.

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PUBLIC INTEREST STATEMENT

The tax-avoidance revelations from the Panama Papers regarding the international clients of Mossack Fonseca recently shook the financial world. Our findings show wealthy individuals' tax evasion channels and give more insight about offshore wealth from the Panama Papers. The study also highlights the issues surrounding taxation of the wealthy and evasion behavior and portfolio choice by the wealthy. This article also presents that an increase in the tax rate will increase the taxpayer's level of tax evasion. Moreover, the net worth of the world's billionaires has not obviously contributed to their country's revenue, and the evidence further shows the invalid policy of millionaires' taxes in France. Overall, the article suggests sustainable reforms in three important areas and contains original theoretical, applied, and empirical work which makes a substantial contribution to the taxing the rich and tax evasion subject and is of broad interest to researchers and readers.

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Subjects: E62; G11; H10; H26

1. Introduction

Forbes publishes a list of the world's billionaires. The list is published each year and reveals each individual's net worth and business background. The list contains individuals from all economic industries, including software production (Bill Gates), value investing strategies (Warren Buffet), and computer hardware (Michael Dell), along with real estate, diversified industries, communication, retailing, and many other sectors. Therefore, to include class of high-income individuals, the paper additionally considers using "The World's Billionaires" rank (Forbes, 2015). The list of billionaires offers excellent insights into both wealth concentration and global wealth inequality. The wealth of billionaires is on the economic scale of some countries' economies. Oxfam's claim that by 2016 the richest 1% could control as much as or more than the bottom 99% is not wildly implausible. The effect of direct and indirect taxes have an impact on inequality. How much tax should top income earners pay? Piketty and Saez (2013) provide empirical evidence that the interval of the optimal top tax rate can range from 57% to 82%, a rate that depends on the elasticity of standard supply side channels. These findings may have some constructive policy implications for authorities. However, the measure considered to be François Hollande's most famous election promise regarding taxes, the famous 75% rate for people with incomes over €1 million, was ended in January 2015 by France's Constitutional Council. The implementation of France's 75% "millionaire tax" lasted only two years. In brief, progressive taxation is a political decision. Furthermore, taxation can be ineffective in reducing inequality if progressive taxation is constrained to individual incomes, and top income earners cannot only hold individual companies to profit from lower corporate taxes, but also either shift their tax residence to tax havens or search for other methods to reduce taxation (Goolsbee et al., 2010). For example, Harris (1993) also note that some U.S. companies migrate their benefit incomes to low-tax countries. Landier and Plantin (2016) also identified the similar result of high migrations of wealth, focusing especially on millionaire migration activities related to tax flight. A notable link here is to Young and Varner (2011); Young, Varner, Lurie Ithai, & Prisinzano (2016), who examine millionaires' migration decisions in the presence of tax evasion.

Is wealth inequality hidden in a shadow economy? Previous studies offered reliable insights into the hidden global wealth held in tax havens and found that a rapidly growing share of equities are being managed offshore in several countries (Zucman, 2014; Alstadsæter, Johannesen, & Zucman, 2017). U.S. corporations' international profits are also increasingly flowing into tax havens. Due to the different evasion technologies available for various skills in tax collection activities, the empirical and experimental evidence showed that obligatory advance tax payments reduce tax evasion under risk and uncertainty, a fact that can be entirely captured by prospect theory (PT) but not by expected utility theory (EUT). This is because PT can resolve many puzzles related to EUT and significantly outperforms EUT by providing a better fit to much of the empirical data (see, e.g. Bruhin, Fehr-Duda, & Epper, 2010; Yaniv, 1999). In addition, the cost of risk to the taxpayer's decisions related to risk-avoidance or risk seeking from the risky activity of evasion behavior needs an explicit model (Dhami and al-Nowaihi, 2010). In particular, obligatory advance tax payments can be regarded as purchasing a safe asset, while tax aggressiveness is analogous to purchasing a risky asset. This article sets flight capital in the context of portfolio choice, focusing on whether rich individuals' wealth is capital flight via tax havens to hide their wealth and assets, or stays in the home country as private capital. Thus, the tax evasion decision facing a wealthy individual essentially becomes a portfolio selection problem.

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evasion techniques available for various kinds of tax collection activities, the empirical and experimental evidence showed that obligatory advance tax payments reduce tax evasion under risk and uncertainty, a fact that can be entirely captured by the prospect theory (PT) but not by the expected utility theory (EUT). This is because PT resolves many puzzles related to EUT and significantly outperforms EUT by providing a better fit to much of the empirical data (e.g. Bruhin et al., 2010; Yaniv, 1999). In addition, the cost of risk to the taxpayer's decisions related to risk-avoidance or risk seeking behavior from the risky activity of evasion behavior needs an explicit model (Dhami and al-Nowaihi, 2010). In particular, obligatory advance tax payments can be regarded as purchasing a safe asset, while tax aggressiveness is analogous to purchasing a risky asset. This article sets flight capital in the context of portfolio choice, focusing on whether rich individuals hide their wealth and assets in tax havens via capital flight, or retain their wealth in the home country as private capital. Thus, the tax-evasion decision facing a wealthy individual essentially becomes a portfolio selection problem.

In the optimal allocation strategy problem, the most significant hurdle faced by wealthy investors in the financial markets is the effect of taxation on investment choice. The wealthy investors recognize that tax considerations are important for their portfolio management and their trading decisions. Indeed, the rich may migrate their investments to nearby tax havens and hide their wealth in offshore accounts because taxes have first-order impacts on investor behavior. Top executives in particular consider these factors to minimize tax payments. The timing of realization of stock payments and stock-option exercises is very important so that top executives in the U.S. can regulate the timing of realization of capital gains (Goolsbee, 2000). In portfolio choice and stock market participation issue, due to the cost of participation, stock ownership is concentrated in the wealthy, making them even wealthier, and their portfolio choice comprises an even larger share of stocks. Stock market participants are, on an average, richer and benefit disproportionately from a stock market boom. When wealthy individuals choose to hold more stock in their portfolio, the middle and lower classes own significantly less, thus decreasing their participation rate, as the stock of capital is finite (Favilukis, 2013). The net result is a rise in wealth at the top of the wealth spectrum and an increase in wealth disparity. Kushnirovich (2016) also discussed portfolio choices among immigrant and native-born investors. This work discusses the claim that taxing the rich leads to representative governance, and while referencing both past and current applications, highlights some vague theories found in this argument. The rich investor plays a decisive role in the financial market, and herding behavior has a substantial influence on investors.

The review of earlier literatures focuses on the findings, shows the taxation of wealthy individuals, and demonstrates approaches to analyze the tax evasion channel (Dell'Anno, 2009; Zucman, 2014).However, the study suffers from a drawback. The effects of the net wealth of global billionaires on their country's revenue collection are not taken into account. This study, therefore, sought to fill this research gap by answering this question: What is the relationship between the government revenue and the net worth of the billionaires of the world?

This article contributes to the existing literature in several ways. First, in contrast to the contributions of the existing literature, which the standard model ignores, our first and arguably the most important contribution is that our study provides the evidence to interpret the reasons why taxing wealthy individuals often fails, especially in France and the net worth of the billionaires of the world have not obviously contributed to the revenues of their country. Second, our findings show wealthy individuals' tax evasion channels and give more insight about offshore wealth from the Panama Papers. Finally, this study also contributes toward establishing a tax evasion model for taxation of wealthy individuals, which might determine the optimal proportion of risky assets in the portfolio choice under this taxation policy.

The main focus of the paper is to provide conclusive evidence that, for modeling evasion behavior, understanding the financial behavior of millionaires will help policy-makers facilitate the shifting of wealth due to millionaires' migration, and thus establish anti-evasion mechanisms to prevent tax evasion activity.

This study is the first attempt of its kind to analyze billionaires' net worth (across countries) and their equity portfolio management under the taxation system for the wealthy. For that reason, it is subject to several caveats. First, the paper discusses the expected rate of return on the wealth in the form of tax evaded and exposes how the wealthy have hidden their wealth offshore, e.g. via tax evasion. Furthermore, we confirm our findings using a component Generalized AutoRegressive Conditional Heteroskedasticity (GARCH) estimator that focuses on a specific mechanism through which the log return of the S&P500 affects growth in billionaires' net worth. To present both theoretical and empirical research on taxation for the wealthy, the framework for analyzing the determinants of the modes of financial behavior of wealthy investors and millionaires' tax effects are based on the risk aversion theory of millionaire migration (see Table A1 in the Appendix A). The table also schematically represents alternative approaches to measuring the behavior of wealthy investors under the millionaire tax system.

The outline of this paper is as follows: In Section 2, we describe aggressive tax evasion and provide the findings of the determinants of tax evasion behavior by the very wealthy. Unsurprisingly, the wealthy increasingly experience risk aversion as their wealth increases. In Section 3, we study a few of the major features consistent with net worth of billionaires and their links with macroeconomic variables, such as Gross Domestic Product (GDP), stock market returns, government revenue, and other variables. Section 4 analyzes the empirical results and discusses the results presented in the relevant literature. In Section 5, we conclude this work with policy suggestions and limitations of the research.

2. The economy model

2.1. Tax evasion decisions based on prospect theory

Based the prospect theory (Kahneman & Tversky, 1979), suppose the wealthy individual's taxable wealth is W, and whose declared wealth to the tax administration for d, $d \in [0, W]$, hidden wealth for h, $d = W - \mathrm{h}$. If a taxpayer evades, then $0 \leqq d < W$. The government levies a tax on declared wealth at the tax rate τ, $0 < \tau < 1$, and the probability he was being seized is $p(d) \in [0,1]$. Here it is assumed that $p(d)$ is continuous, and $p'(d) \leqq 0$, and it audited with the exogenous probability p; $0 < p < 1$: if he is caught cheating, the taxpayer must pay the evaded tax $\tau(W - d)$ and a fine $f\tau(W - d)$; where $f > 0$ is the penalty rate on evaded taxes. The net wealth of the taxpayer without and with auditing are denote by M and N, respectively:

$$M = W - \tau d \tag{1}$$

$$N = W - \tau d - (1 + f)\tau(W - \mathrm{d}) \tag{2}$$

Following Dhami and Al-Nowaihi (2007), the legal after-tax wealth is taken as the reference point:

$$R = (1 - \tau)W \tag{3}$$

From Equations (1)–(3), the wealth relative to the reference point without and with auditing are:

$$m = M - R = \tau(W - \mathrm{d}) \tag{4}$$

$$n = N - R = -f\tau(W - d) \tag{5}$$

Without auditing, $m \geqq 0$, the outcome of the taxpayer is above the reference point, and taxpayers are in the domain of gains. With auditing, $n \leqq 0$, the outcome of the taxpayers are below the reference point, and taxpayers are in the domain of losses. The probability weighting function π is a continuous function in [0,1], strictly increasing from [0,1]. The probability to be audited being low, $\pi(p) < p$ for gains and $\pi(p) > p$ for losses. The taxpayer maximizes the following subjective utility of his declared wealth:

$$U = \pi(1 - p)u(m) + \pi(p)u(n) \tag{6}$$

The utility U is a continuous function in the interval [0, W] and is associated with an outcome that is assumed to vanish to zero and to be increasing, concave for gains, and convex for losses. In the general case, we assume here that the second derivative could vanish when reaching its maximum at only one point, denoted by d^*. For the sake of simplicity, and without loss of generality, the first- and second-order conditions associated with this maximization solution are, respectively:

$$\frac{\partial U}{\partial d}(d^*) = -\pi(1-p)\tau u'(m) + \pi(p)f\tau u'(n) = 0 \tag{7}$$

$$\frac{\partial^2 U}{\partial d^2}(\,d^*) = \pi(1-p)\tau^2 u''(m) + \pi(p)f^2\tau^2 u''(n) < 0 \tag{8}$$

Since U is a continuous function on $\mathbb{R}$, twice continuously differentiable on $\mathbb{R}^*$, such that $u' > 0$ on $\mathbb{R}^*$, $u'' < 0$ on $\mathbb{R}^*_+$. Therefore, we provide Proposition 1 as follows:

Proposition 1: *Whereas the wealth declared by the taxpayer is interior* ($0 < d^* < W$), *an increase in the tax rate will increase the taxpayer's level of tax evasion.*

Proof. See the Appendix B.

The relationship between tax rates and less declaring wealth, for example, tax rate increase, $\frac{\partial^2 U}{\partial d^2}$ will be strictly negative, that is, under-reported wealth will permit taxpayers to increase the utility function. Therefore, tax evasion will increase and there is a positive association with the tax rate, which is the primary difference with the conventional A-S model. This explains, in reality, why tax evasion is widespread in high-net-worth individuals. More importantly, Propostion1 serves as specific evidence to the failure of Hollande's high tax on millionaires in France.

2.2. Taxing the rich policy and evasion behavior

There are stochastic shocks to the returns that take on the form of a Brownian motion. The basics of such models are analytically treated in Dang and Forsyth (2016) and Vigna (2014). A compounded effect on this state of affairs describes the non-intuitive property that the Geometric Brownian Motion (GBM) of agent ensembles, and leads to a tenet of stochastic studies of wealth distributions. Similar models can be found in Benisty (2017); Dang, Forsyth and Vetzal (2017). Therefore, the Wiener process in the wealth equation can be written as a function of the Wiener processes for the risky and risk-return, with the same framework as in Forsyth and Vetzal (2017). Given the previous considerations, we assume the wealth evolution accumulation process satisfies the geometric Brownian motion (GBM), with the following specification:

$$dW(t) = \left\{ \begin{array}{c} \alpha_w W(t)dt + \sigma_w W(t) {dB_t}^w \; W(t) \geq W(r) \\ 0 \; W(t), < W(r) \end{array} \right\} \tag{9}$$

where $W(r)$ is the wealth threshold to be considered rich, α_w is the return on assets, σ is the volatility of risky assets, ${dB_t}^w$ is the Wiener increment, and $W(t)$ is the wealth taken into account of the wealthy taxpayers.

In this section, the stochastic portfolio optimization problem is solved in continuous time and to employ a stochastic control approach to find the optimal portfolio value by maximizing the utility of wealth when the wealth function is subjected to income tax and capital gains tax with two investment possibilities:

A risk-free asset with its price evolving as:

$$dN(t) = \rho N(t)dt, \; N(0) = 1 \tag{10}$$

and risky asset allocations at time t can be described dynamically by the geometric mean-reversion model:

$$dX(t) = \kappa[\ \mu - lnX(t)]X(t)dt + \sigma X(t)dB_t \tag{11}$$

where μ, κ, σ are positive constant parameters such that μ denotes the long-term mean equilibrium, i.e. that for such values around which the future trajectories are expected to converge in the long-run, κ is the speed of that convergence, and σ is the degree of volatility. Suppose the risky asset pays continuous proportional dividends at a continuous rate that is proportional to the stock value at a constant rate *D*, which is known as the dividend yield. This dividend, when paid in the time interval, can be expressed as *DXdt*. When an investor pays income tax on the dividend or capital gains of the risky asset, the stochastic equation becomes:

$$dX(t) = \kappa[(1-\tau\ )D + \mu - lnX(t)]X(t)dt + \sigma X(t)dB(t) \tag{12}$$

where τ denotes the tax rate of the wealthy. The representative tax code τ, and increased capital gains and dividend taxes on the classified "rich", serve as ending preferential treatment for top earners, and refining the tax code would decrease incentives to amass extreme amounts of wealth, as many others that have discussed elsewhere.[1] A billionaire's wealth $W(t)$ is represented as:

$$W(t) = X(t) + N(t) \tag{13}$$

It is useful to use Bellman's principle of optimality and Hamilton-Jacobi-Bellman (HJB) to solve the stochastic control. To solve the optimal utility and investment problem, the approach of stochastic dynamic optimization is considered. The optimal strategy $\pi^*(w)$ with respect to exponential utility can be expressed in the following equation:

$$\pi^*(w) = \frac{\kappa[(1-\tau\ )\mathcal{D} + \mu - lnw] - r_f}{\sigma^2 w\ \gamma} \tag{14}$$

We only give a sketch of the proof; please refer to Chen (2015) for the more detailed version.

The optimal strategy is (unanimously) similarly found in closed form for a class of utility functions. This paper describes utility function chosen for risk aversion functions based on (under) the optimal strategies. The risk attitude of evasions as expressed by their utility function plays an important role in the determination of what is considered optimization from an evasion behavior perspective. Evasion behavior, such as capital flight and tax evasion, are significant developmental problems that require urgent attention. In general, taxes on wealth and commodities are exposed to tax evasion. This paper highlights key issues related to tax evasion and capital flight via tax havens. Defining U as the utility function and W as wealth, these are the utility functions, which are also defined the same as in Equation (14):

$$U(w) = \frac{\kappa[\ \mu + (1-\tau\ )\mathcal{D} - lnw] - r_f}{\sigma^2 w\ \gamma} \tag{15}$$

Most importantly, a relative risk aversion measure is adapted to losses in prospect theory. When the relative risk aversion of the wealthy taxpayer is high enough, the rich evade less when the tax rate increases because their expected penalty payment rises more than their marginal benefit to cheat. The first-order condition for an interior maximum of Equation (15) can then be written as:

$$U'(w) = \frac{-\kappa\frac{\sigma^2 w\gamma}{w} - \sigma^2\gamma\{\kappa[\ \mu + (1-\tau\ )\mathcal{D} - lnw] - r_f\}}{\sigma^4 w^2\ \gamma^2} = \frac{-\kappa\{1 + [\ \mu + (1-\tau\ )\mathcal{D} - lnw]\} - r_f}{\sigma^2 w^2\gamma} \tag{16}$$

The second-order condition is:

$$\begin{aligned} U''(w) &= \frac{\kappa\frac{\sigma^2 w^2\gamma}{w} + 2w\sigma^2\gamma * \kappa\{1 + [\ \mu + (1-\tau\ )\mathcal{D} - lnw]\} - r_f}{\sigma^4 w^4\gamma^2} \\ &= \frac{\kappa + 2\kappa\{1 + [\ \mu + (1-\tau\ )\mathcal{D} - lnw]\} - r_f}{\sigma^2 w^3\gamma} \end{aligned} \tag{17}$$

We use the well-known Arrow-Pratt risk aversion measures to evaluate our results. These are the absolute and the relative risk aversion functions, defined as follows:

$$R(w) = \frac{-U''(w)}{U'(w)} \text{ or } R(w) = \frac{-wU''(w)}{U'(w)} = \frac{\frac{\kappa + 2\kappa\{1+[\mu+(1-\tau)\mathcal{D}-lnw]\}-r_f}{\sigma^2 w^3 \gamma}}{\frac{\kappa\{1+[\mu+(1-\tau)\mathcal{D}-lnw]\}+r_f}{\sigma^2 w^2 \gamma}} \tag{18}$$

$$= \frac{\kappa + 2\kappa\{1+[\mu+(1-\tau)\mathcal{D}-lnw]\}-r_f}{w\kappa\{1+[\mu+(1-\tau)\mathcal{D}-lnw]\}+wr_f}$$

The reduced form is written as follows:

$$\frac{\kappa + 2\kappa\,\Omega - r_f}{w(\kappa\,\Omega + r_f)} \tag{19}$$

Let:

$$1 + [\,\mu + (1-\tau)\mathcal{D} - lnw] = \Omega \tag{20}$$

which can be written in an implicit form as follows:

$$\Omega(\mu, \tau, \mathcal{D}, lnw)$$

Assuming the risk-free interest r_f, is exogenously given, regarded as a constant and known by the taxpayer under the risk aversion measure. For brevity, the reduced form Equation (29) can be written alternatively as:

$$R(w) = \frac{1+2\Omega}{w\Omega} \tag{21}$$

The result for increasing absolute risk aversion is expressed as follows:

$$R(w) > 0 \tag{22}$$

This result is shown as the billionaires' financial behavior in the presence of risk aversion. Which, as in Equation (21) and rearranged, implies:

$$\Omega = \frac{1}{R(w)w - 2} \tag{23}$$

Incorporating Equation (20) into Equation (21), we obtain:

$$\frac{1}{R(w)w-2} = 1 + [\,\mu + (1-\tau)\mathcal{D} - lnw] \tag{24}$$

The absolute risk aversion $R(w)$ exists in relation to variables τ, lnw, and μ. It is intuitively appealing, however, to speculate that higher tax rates will encourage, instead of repress, evasion. Previous studies (e.g. Alm, Martinez-Vazquez, & McClellan, 2016; Lin & Yang, 2001; among others) typically find that higher tax rates are associated with greater tax evasion, and the tax rate on declared income linked to the costs of evasion. Lin and Yang (2001) have shown that whereas higher tax rates repress tax evasion in the static model, they encourage tax evasion in the dynamic model. The above analysis strongly emphasizes that the *lnw* is the presence of a negative relationship with $R(w)$, but w shows the existence of relational uncertainty with $R(w)$. Therefore, the following discussion should be conducted: Differentiating Equation (21) with respect to w and solving for $\frac{\partial R(w)}{\partial w}$, from $\frac{\partial R(w)}{\partial w} > 0$ indicates that the greater the risk aversion with the increasing wealth function w of the billionaires, the greater the risk aversion of the wealthy person as their wealth increases. Further evidence supporting this key finding is also discussed in Section 4.1.

It follows that the condition derived in Proposition 2 below for an increase in risk aversion preferences can be stated as follows:

Proposition 2

Under $[\mu + (1-\tau)\mathcal{D} - lnw] > 0$ *or* $-2 < [\mu + (1-\tau)\mathcal{D} - lnw] < \frac{-1}{2}$, *there is a positive degree of risk aversion associated with wealth (defined as* $\frac{\partial R(w)}{\partial w} > 0$*), whereas there is increasing growth in billionaires' wealth, which leads to the greater risk aversion. It is also known that tax evasion will occur, an inequality that is considered to be satisfied here.*

Proof: See Appendix C.

To gain more insights into the meaning of the necessary condition in Proposition 2, consider the case in which the increase in background risk increases the derived risk aversion of agents. The first term is positive whenever *w* is declining and convex. If $\frac{\partial R(w)}{\partial w} > 0$, then the following condition must be satisfied:

$$[\mu + (1-\tau)\mathcal{D} - lnw] > 0 \text{ or } -2 < [\mu + (1-\tau)\mathcal{D} - lnw] < \frac{-1}{2} \tag{25}$$

Under this condition, the latter term of Equation (25) can be computed intuitively. For example, considering *lnw* is exogenously given, and the calculated (plausible) values of the term $\mu + (1-\tau)\mathcal{D}$ at τ = 0.2 are greater than at τ = 0.5 (i.e. the larger values of $R(w)$). The result accurately reflects that evaded tax appears to be positively influenced by the tax rate.[2] Under this scenario, at higher tax rates, however, the extent of tax evasion becomes more significant, according to Proposition 2. The positive effect of tax evasion on growth eventually overruns the negative effect of taxation as the tax rate progressively increases. Moreover, the absolute risk aversion depends on the μ, τ, and $\mathcal{D}$ variables, which are the taxpayer's decision variables for individual behavior .

2.3. The shadow economy

Considering Equation (25) holds, the cost of unsuccessful evasion includes not only additional taxes and penalties, but also a return on assets and interest charges, then, other things being equal, higher interest or tax rates increase the cost of unsuccessful evasion and, ignoring risk considerations, should cause evasion to decrease. Conversely, higher tax rates increase tax evasion. The individual's actual response depends on which of these three effects dominates, along with his/her attitude towards risk.

Where the term $\mu + (1-\tau)\mathcal{D}$ represents the expected rate of return on the wealth of evaded tax, i.e. billionaires' tax evasion, consider that the factor of the expected rate of return on wealth and after-tax capital is without loss of generality in this case. Therefore, if offshore holdings provide a higher than expected rate of return and an after-tax capital increase, there is an incentive for tax evasion, thus restricting the analysis to deterministic mechanisms. Recently, the leaks from Panama Papers[3] reveal millions of wealthy individuals' leaked documents, exposing how the rich and powerful have hidden their wealth. The following financial services merely provide the channel for the rich to tax evasion. Offshore financial centers essentially provide asset protection, trusts, fund management, and corporate planning; additionally, they offer sophisticated, but legal, tax planning. As depicted in Figure 1 presents that offshore wealth is distributed very similarly in the two scenarios: The wealthiest 0.1% has owned about 80% of it, and approximately 50% belongs to the 0.01% richest people. In other word, the shadow economy may incorporate many of these insights in the top income group and its tax rate (Schneider and Enste (2013). In addition, the centers provide the following implications (advantages):

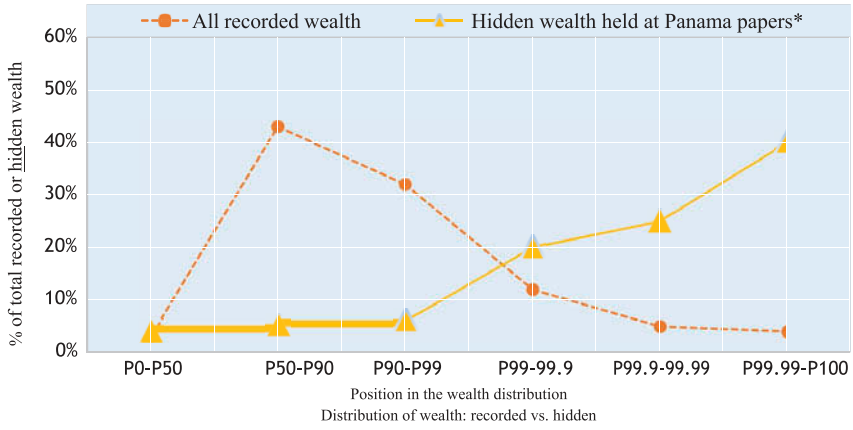

Figure 1. Offshore wealth and its impact on the size of tax evasion.

Source: The International Consortium of Investigative Journalists (ICIJ) database (https://offshoreleaks.icij.org/pages/database).
Notes: The asterisk * is applicable in estimated results

(1) An offshore center provides strict bank secrecy to its investors; and

(2) Tax evasion reduces the onshore country's tax revenue through tax havens.

Overcoming these advantages remains an urgent priority that requires the creation of an incentive structure to remove bank secrecy and tax information sharing with onshore countries. Nevertheless, the need to solve problems must provide incentives created by an economy's institutional structure.

3. Research design and empirical strategy access to portfolio choice

To comprehend the impact of the tax-the-wealthy policy on the asset-allocation strategies of the macroeconomy, we first consider the major factors and analytical framework as follows:

(1) What is significant for government revenue measures and macroeconomic factor measures of responsiveness, persistence, and discretion? To consider taxation on the rich, it is necessary to deeply investigate billionaires' wealth associated with government revenue and the macroeconomic factors impacting tax revenue, particularly responsiveness, persistence, and discretion. The empirical results are presented in Section 4.4.

(2) This research is important for studying the portfolio allocations of billionaires in the representative stock market for risky assets and measuring the wealth volatility spillover for daily stock market returns to billionaires. More importantly, distribution of earnings as dividends to entrepreneurs is always a major factor and generally has the most dominant impact on getting rich in the equity market.

The component GARCH (CGARCH) econometric technique is employed to identify these problems. Christoffersen, Jacobs, and Wang (2008) have learned that distinguishing between short-run and long-run components further enables the CGARCH model to capture volatility dynamics better than the standard GARCH model.[4] Samouilhan (2007) also confirms the usefulness of this approach and states that it is a technique used to understand the behavior of the second moments of equities. Accordingly, it is a major improvement on the standard GARCH estimation.

3.1. Hypothesis testing

Based on prior research in this field, we will examine whether the relationship between wealthy investors and their portfolio choice is evident in a novel GARCH model using the following hypothesis:

H1: The billionaires' wealth has substantial components of long-term fluctuations in stock returns.

Next, using tax revenue as our measure of the tax consequences among high-net-worth (HNW) individuals, we will use regressions to test the following hypothesis that can be tested with

macro data. Based on the view of evaded taxes, the work is intuitively expected to show that the net worth of the world's billionaires has significant impacts on their country's revenue as following:

H2: The net worth of the world's billionaires has a positive impact on aggregate government revenue.

3.2. Methodology

The main task of this empirical model is to verify the assumptions about the factors underlying the wealth-evolution process as discussed in the Merton portfolio problem (1976) developed in previous studies. Ideally, in the regressions analysis, the dependent variable should be expressed by macroeconomic indicators for different countries, which can be calculated for each country from a reliable sample of wealthy individuals. To do this, the study adopted the Forbes (2015) list of "The World's Billionaires." To test Hypothesis 1, the CGARCH model is applied in this study, in which the assumption of stationary volatility is violated. The encompassing model is a C-GARCH model[5] for the S&P500 returns, with mean and volatility equations. Suppose the log returns are defined as $\mathbb{R}_t = \log(p_t/p_{t-1})$, where p_t is the time t price of the asset.

To verify the existence of asymmetric volatility in stock returns, we employ the CGARCH model proposed by Engle and Lee (1999) that captures both long- and short-run volatility. The model allows a slow mean reverting component of conditional variance and a more volatile short-run component. By distinguishing between the short- and long-run components of volatility, the CGARCH model provides a better description of volatility dynamics relative to the GARCH model (Guo & Neely, 2008). Considering the CGARCH process:

$$\sigma_t^2 = \omega + \alpha\left(\epsilon_{t-1}^2 - \omega\right) + \beta(\sigma_{t-1}^2 - \omega) \tag{26}$$

where ω represents the unconditional variance, α represents the coefficient of the ARCH process, and β represents the coefficient of the GARCH process.

A more detailed analysis of index volatility could be provided in the framework of a *Component GARCH* model. It should be noticed that the conditional variance in the simplest GARCH model, which precedes Equation (26), indicates that this specification imposes mean reversion to ω, which is a constant. In comparison, the component model that allows mean reversion to a varying level q_t, with the model is described as follows:

$$q_t = \omega + \rho(q_{t-1} - \omega) + \varphi\left(\epsilon_{t-1}^2 - \sigma_{t-1}^2\right) \tag{27}$$

$$\sigma_t^2 - q_t = \alpha\left(\epsilon_{t-1}^2 - q_{t-1}\right) + \beta\left(\sigma_{t-1}^2 - q_{t-1}\right) \tag{28}$$

where σ_t^2 is still the volatility, whereas q_t takes the place of ω and is the time-varying long-run volatility. Equation (27) represents the long-run component q_t. ρ, thus, provides a measure of the long-run persistence. Equation (28) explains the transitory component, $\sigma_t^2 - q_t$, which converges to "zero" with powers of ($\alpha + \beta$).

To test Hypothesis 2, thus, Equation (29) provides a broader picture to examine the relation between government revenue and macroeconomic variables. The regression model for estimating government revenue is characterized as follows:

$$logGR_i = c + b_1 logW_i + b_2 logGDP_i + b_3 log\mathbb{I}_i + b_4 logMI_i + \epsilon_i \tag{29}$$

where i is a billionaire's country of citizenship, *GR* denotes the general government revenue, *W* denotes net worth, and *GDP* represents Gross Domestic Product. $\mathbb{I}$ denotes the ratio of total investment divided by *GDP* and *MI* represents a macroeconomic indicator that is proxied by the ratio of government revenue divided by *GDP*(*GR*/*GDP*). Since the changes of all of the variables enter the logarithm transfer equation, ϵ_i is the error term with a mean of zero and assumed *i.i.d.*

To address the issue of extreme values caused by economic wealth inequality, let the conditional distribution of $\mathcal{Y}$ be linearly associated and allowing for regressor $\mathcal{X}$ so that the following equation is obtained:

$$Q_n(\theta|\ \mathcal{X}_i, b(\theta)) = \mathcal{X}_i' b(\theta) \tag{30}$$

where $b(\theta)$ expresses the parameters to be estimated. Equation (30) determines the linear specification between vector $\mathcal{X}$ and the θth conditional quantile of the response variable $\mathcal{Y}$ .By minimizing weighted deviations from the conditional quantile, we obtain

$$\hat{b}_\theta = argminE\left[I_\theta\left(\mathcal{Y}_i - \mathcal{X}_i' b\right)\right] \tag{31}$$

where the conditional distribution of the dependent variable $\mathcal{Y}_i$ is characterized by various θth quantiles given $\mathcal{X}_i$, and I_θ is a check function that weights positive and negative residuals asymmetrically for any θ□ (0, 1). The indicator function is defined as follows:

$$I_\theta(\xi_i) = \left\{ \begin{array}{c} \theta\xi_i \ if\ \xi_i \geq 0 \\ (1-\theta)\xi_i \ if\ \xi_i < 0 \end{array} \right\} \tag{32}$$

where $\xi_i = \mathcal{Y}_i - \mathcal{X}_i' b$

Equations (31) and (32) imply that

$$\begin{aligned} \hat{b}_\theta &= argmin\left(\sum_{\mathcal{Y}_i > \mathcal{X}_i' b} \theta|\mathcal{Y}_i - \mathcal{X}_i' b| + \sum_{\mathcal{Y}_i < \mathcal{X}_i' b} (1-\theta)|\mathcal{Y}_i - \mathcal{X}_i' b| \right) \\ &= argmin\left\{ \sum_i I_\theta\left[\mathcal{Y}_i - \mathcal{X}_i' b(\theta)\right] \right\} \end{aligned} \tag{33}$$

Expression (33) illustrates that the quantile regression[6] estimators can be expressed in the form of a simple optimization problem by minimizing the sum of weighted absolute errors, where the weights are dependent on the various quantile values.

3.3. Sample selection

Now that we have characterized the distribution of "The World's Billionaires" data, we turn to investigating whether these featured distributions have something in common with real-world economics. As key variables that can be associated with wealth, we employed the GDP and daily stock market returns on the Standard and Poor's 500 Composite Index (S&P500). The data cover the period from January 2013 to Dec 2014 and are collected from http://www.cboe.com/SPX S&P500® data. In the quantile regression model, we apply numerous financial and macroeconomic factors that have been found by the relevant literature to be important for return variance. The macroeconomic data are collected from the International Monetary Fund, World Economic Outlook Database (International Monetary Fund, 2015) for April 2015. See Appendix D: Table A2 for more details about the dataset. In the empirical applications, one is confronted with the problem of developing the regression models for estimation using macroeconomic variables observed at different frequencies. Therefore, our approach to estimating models allows us not only to forecast volatility with data sample at various frequencies but also to address a large number of such forecasts to observe whether the continuous asymptotic arguments as discussed by Merton (1980) are also found in practice.[7]

4. Empirical analysis and discussion of findings

4.1. Tax evasion offshore wealth by the wealthy: evidence from leaks

Despite some limitations,[8] by our estimate, the supply of services to offshore tax evasion explains that tax evasion rises steeply with wealth, according to the leaks from Panama Papers. As shown in Figure 2, the probability of owning a Mossack Fonseca offshore shell company reaches 1.3% in

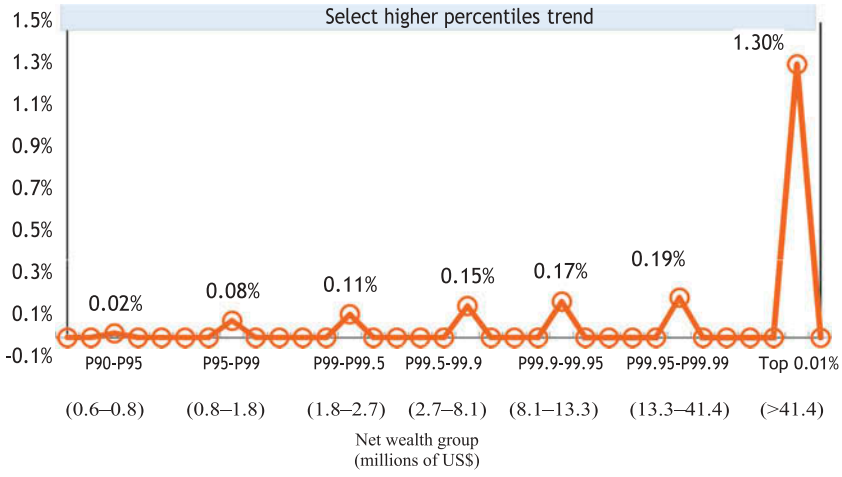

Figure 2. Panama papers individuals by wealth group.

Source: ICIJ database (https://offshoreleaks.icij.org/pages/database) . Notes: The figure shows the probability to appear in the "Panama Papers" by wealth group (shareholders of shell companies created by Mossack Fonseca).

the top 0.01% of the wealth distribution, against less than 0.2% for all groups below the top 0.01%. Therefore, this finding indicates that tax evasion rises very sharply with wealth, thus demonstrating a phenomenon that evasion appears to be rising around the 95th percentile position of the wealth, and stabilizes within the top 5%. Along this scope, Figure 2 also describes that with the rise in wealth past the 95th percentile position, the probability to hide wealth offshore rises very steeply within the top 0.01%, similar results were also found by Alstadsæter et al. (2017).Broadly speaking, as shown in Figure 1–2, the wealth in offshore tax havens is highly concentrated in the top 0.1 percent of the wealthy and has important implications for measured wealth inequality. Globally, an extended inequality measure should be considered accordingly, the share of comprehensive wealth owned by the wealthiest one percent.

4.2. Descriptive statistics and analysis results

Figure 3 displays a pattern in the stationary exponential shape (semi concave-shaped). As expected, the distribution is well fit by the exponential function. The smooth lines are similar to the exponential cumulative distribution. Similar distributions were also found by Yakovenko and Rosser (2009).

The empirical data also display outstanding agreement with a power-law or Pareto exponent wealth distribution. Wealth inequality and the temporal variation in its distribution inequality have been studied in many previous works. Wolff (2010) and Piketty, Postel-Vinay, and Rosenthal (2004) have examined wealth distribution throughout the economy. In contrast, this paper investigates the Pareto exponent distribution, which is appropriate for studying the wealth distribution at high wealth levels. The result reflects that inequality is a confirmed global phenomenon in the world.

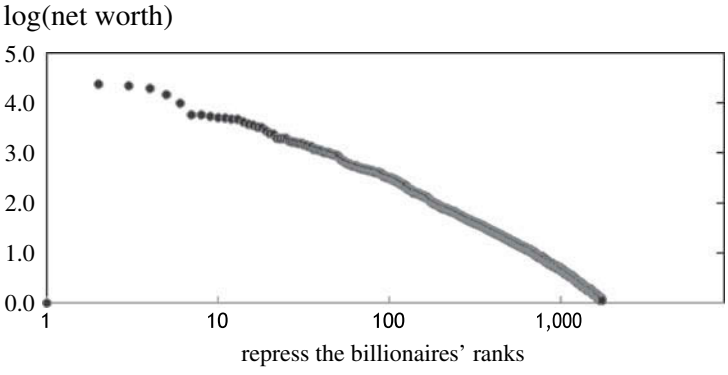

Figure 3. Zipf plot of the wealth (W) of the investors in the *Forbes* global billionaires of 2015 vs. their ranks r_a.

Table 1. Summary statistics for macroeconomic variables

Moment statistics	GR(Billion $)	Net worth (Billion $)	GDP per capita	Investment (%)	MI (%)	SPX1
Mean	2352.584	3.876155	7442.300	24.590	32.408	1787.588
Median	1503.667	2.100000	2945.100	19.867	31.434	1805.450
Maximum	5475.457	79.20000	17,418.90	46.852	70.828	2090.570
Minimum	1.342656	1.00	3.70	10.575	9.772	1457.150
Std. Dev.	2224.361	5.979064	7182.868	9.012	8.523	169.7327
Skewness	0.483338	6.155923	0.474033	1.682	0.565	−0.147976
Kurtosis	1.510116	56.73774	1.440084	4.574	3.779	1.893959
Sum	4,135,842.	6814.280	13,083,564	43,229.22	56,974.50	90,0944.1
Sum Sq. Dev.	8.69E+ 09	62,811.36	9.06E+ 10	142,713.5	127,642.9	14,491,019
Observations	1758	1758	1758	1758	1758	504

Notes: 1. The skewness and kurtosis statistics are significantly different from zero for a normal distribution. Furthermore, these statistics and Jarque-Bera statistics give a preliminary indication of the non-normality of net worth and these macroeconomic variables; 2. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively; 3. *GR* represents general government revenue, and SPX1 denotes the S&P500.

Table 1 provides summary statistics on the main variables for each of the macroeconomic factors. As is also obvious from the data from Forbes (2015), accounting for 1,758 observations, the distributions of the wealth data is extremely skewed at 6.15. The countries in which the wealthiest people reside are repress the billionaires' ranks are also the countries with the most volatile GDP, even higher than the S&P500 market volatility. The standard deviations of the countries' GDPs and the S&P500 are 7,182.86 and 169.73, respectively. Is that reasonable? This is why we need to use quantile regression to capture extreme properties caused by inequality. The net worth (wealth) display in Table 1 shows that the mean (3.87) is very different from the median (2.1), and they also report a large difference between the maximum and minimum values of net worth, 79.2 and 1, respectively. These episodes are also reflected in the numbers of the other macroeconomic variable in Table 1. Additionally, Table 2 also presents some outcomes of policy implications. Apparently, the main result reveals that government revenue is related to a country's GDP. More importantly, Table 2 shows the correlation matrix for the variables, that is, the coefficients of GR which are 0.086, 0.332, −0.251, and 0.107, respectively for the models with Net worth, GDP, I and MI. Moreover, all correlation coefficients among these variables in Equation (29) are relatively low, which supports ignoring the possibility of multilinearity[9] between independent variables in the regression model. As we investigate in particular the impact of the reviewed

Table 2. Correlation matrix

	GR	Net worth	GDP	I	MI
GR	**1.00**				
Net worth	0.086	**1.00**			
GDP	(0.0003)*** 0.332	0.081	**1.00**		
I	(0.000)*** −0.251	(0.0008)*** −0.1389	−0.216	**1.00**	
MI	(0.000)*** 0.107	(0.000)*** 0.067	(0.000)*** 0.0192	−0.55	**1.00**
	(0.000)***	(0.005)***	(0.419)	(0.000)***	

Note: 1. *p*-values are in parentheses; 2. ***, **and * denote significance at the 1%, 5%, and 10% levels, respectively; 3. The table shows the correlation between observations of the macroeconomic variables. The macroeconomic variables are total government revenue (GR), billionaire's net worth, and gross domestic product (GDP), where *I* is the ratio of total investment to GDP (*I/GDP*), and *MI,* i.e. the macroeconomic indicator denoted by the total government revenue dividend to GDP (*GR/GDP*).

factors on government revenue, we will not disregard any of the variables, and we also perform the quantile not OLS (ordinary least squares) regressions in our test.

4.3. Portfolio choice of the rich

The extended CGARCH approach introduced by Ding and Granger (1996) and Engle and Lee (1999) can capture the high persistence in volatilities. More specifically, the two-component GARCH model is decomposed into one component that captures the short-run innovation effect and a second component that captures the long-run impact of an innovation. The component GARCH model estimated results are displayed in Tables 3 and 4. According to the implications of the variance equation as depicted in Tables 3 and 4, billionaires' wealth has a significant impact on long-term fluctuations (ω) of stock returns (both p-values< 1); thus, the result supports the hypothesis (H1). The short-term fluctuations (α) are insignificant under the CGARCH and student's t-test (p-value = 0.2845). The insignificant coefficient also illustrates the weak relation between return and conditional volatility, which is also found by Li, Yang, Hsiao, and Chang (2005) for U.S. stock markets. The asset allocation in the stock holdings of the rich trend more towards long-term holding, and any trend toward either short-term trades or temporary holding phenomena is not obvious. This finding also implies that predicting stock market returns can become a difficult task because the deviation of that series from the evolution of billionaires' wealth increases in the short run. In this case, effective policy formulation could also be difficult in the short run. The long-run half-lives of permanent components appear to be longer than 180 days. The short-run component half-life decay is shorter than one day, indicating full decay of the response to the transitory components within a few days. The permanent component and the transitory component are both covariance stationary, satisfying the requirement of $\rho < 1$ and $(\alpha + \beta) < 1$. Consequently, in Tables 3 and 4 the CGARCH model has high values of log likelihood for both estimated models, expression as 1,815.56 and 1,814.21, respectively. This reveals that the two GARCH-type models fit the data well.

Table 3. Component GARCH model (GED) estimated result

Dependent Variable: dlog(SPX1)

$q_t = \omega + \rho(q_{t-1} - \omega) + \varphi(\epsilon^2_{t-1} - \sigma^2_{t-1})$
$\sigma^2_t = q_t + \alpha(\epsilon^2_{t-1} - q_{t-1}) + \beta(\sigma^2_{t-1} - q_{t-1})$

Variable	Coefficient	Std. Error	z-Statistic	Prob.
dlog(Net worth)	0.000495	0.016937	0.029247	0.9767
C	0.000968	0.000283	3.414855	0.0006
	Variance Equation			
Permanent component	**Long-run half-lives: 180 day**			
ω	5.72E-05	1.14E-05	5.035915	0.0000***
ρ	0.681130	0.063548	10.71829	0.0000***
φ	0.685928	0.088294	7.768693	0.0000***
Transitory component	**Short-run half-lives: 0.63day**			
α	-0.543473	0.091970	-5.909245	0.0000***
β	0.877663	0.060426	14.52456	0.0000***
$\alpha + \beta$	0.33419			
GED PARAMETER	**1.430**	**0.140493**	**10.18271**	**0.0000*** **
R-squared	-0.001616	Mean dependent var		0.000680
Sum squared resid	0.024603	Durbin-Watson stat		2.085580
Log likelihood	1815.560	Akaike info criterion		-7.187115

Notes: 1. ***, **and * denote significance at the 1%, 5%, and 10% levels, respectively; 2. Convergence achieved after 27 iterations; 3. Method: ML: ARCH (Marquardt); generalized error distribution (GED); 4. The appropriate computation of the long-run and short-run half-lives are measured using the following $L_{HL}(\rho) = \ln(0.5)/\ln(\rho)\%$ and $S_{HL}(\alpha + \beta) = \ln(0.5)/\ln(\alpha + \beta)$.

Table 4. Component GARCH model (Student's t) estimated result

Dependent Variable: dlog(SPX1)

$q_t = \omega + \rho(q_{t-1} - \omega) + \varphi(\epsilon^2_{t-1} - \sigma^2_{t-1})$
$\sigma^2_t = q_t + \alpha(\epsilon^2_{t-1} - q_{t-1}) + \beta(\sigma^2_{t-1} - q_{t-1})$

Method: ML—ARCH (Marquardt)—Student's t distribution

Variable	**Coefficient**	**Std. Error**	***z*-Statistic**	Prob.
dlog(Net worth)	0.00447	0.01647	0.27131	0.7862
C	0.00108	0.00029	3.73405	0.0002
	Variance Equation			
Permanent component	**Long-run half-lives: 327day**			
ω	5.51E−05	1.54E−05	3.58149	0.0003***
ρ	0.809186	0.112852	7.17034	0.0000***
φ	0.288396	0.133070	2.16724	0.0302***
Transitory component	**Short-run half-lives: 0.3day**			
α	−0.140735	0.131498	−1.07024	0.2845
β	0.238267	0.794458	0.29991	0.7642
$\alpha + \beta$	0.0975			
GED PARAMETER	**6.578426**	**2.402715**	**2.737916**	**0.0062**
R-squared	−0.00262	Mean dependent var		0.00068
Sum squared resid	0.02463	Durbin-Watson stat		2.08084
Log likelihood	1814.217	Akaike info criterion		−7.1877

Notes: 1. The results in Table 1 demonstrate that poverty-level net worth is positively skewed and that the returns are negatively skewed for the S&P500. Kurtosis coefficients of net worth are larger than 3, indicating a fat tailed empirical distribution of the returns over time. Jarque-Bera test Hypothesis: { H_0: Normal distribution $p < 0.05$, reject H_0 }; 2. A J. B. test-based skewness and kurtosis coefficient rejects at any reasonable level the null hypothesis distributed normally in all countries. The result showed that the return series illustrated some excess kurtosis; 3. Convergence achieved after 69 iterations. Presample variance: backcast (parameter = 0.7).

Overall, the analysis reveals key findings that the wealthy (entrepreneurs) hold long-term equity investment strategies by increasing access to capital accumulation and its income gains. Thus, the result is consistent with the hypothesis (H1). As stock returns rise, the capital income gains are disproportionately distributed among the wealthy.

To quantify the precise relation, we regressed the log of government revenue on the log of the net wealth for each country in which a global billionaire resides, including macroeconomic variables. The main results are shown in Table 5. The regression line is the least accurate in the upper tail of the distribution; for an explanation of this result, see the argument on the appropriate estimators in Castaldi and Milakovic (2007). For this study, however, the quantile estimate of the regression line will suffice. For present purposes, it also suffices to note that the R^2 values of the regression line are all very close to 1; thus, the fit is very good. We also found that the global billionaires' distributions approximately follow a power law. It is noted that the greater the slope of the line of absolute inequality, the larger the wealth inequality nexus in the sense that the wealth difference between the top values and the bottom values is greater.

4.4. Evidence of the billionaires' net worth impact on revenue

It is important to note that taxes are the main source of government revenue. To estimate the composition of government revenue, it is suggested and assumed that government revenue comes from general taxes, which is practical for most countries. When government revenue comes from other sources, such as the sale of resources or other national assets, the issue becomes how or whether to allocate such revenue to households. The natural logarithm of

Table 5. Quantile regression and coefficient estimates. *Dependent Variable* $logGR_i$

Variable	0.25	t-Statistic	0.5	t-Statistic	0.75	t-Statistic
ln Net worth	2.72E−8	5.27E−4	1.62E−6	1.97E−4	3.35E−6	1.12E−7
ln GDP	0.314	468.46***	0.310	974.292***	0.3025	152.059***
ln I	−10.226	−50.705***	−11.254	−100.151***	−12.011	−59.598***
ln MI	9.384	9.154***	10.462	11.209***	21.84	5.94***
C	−98.64	−2.68***	−35.342	−1.17	−2.44.115	−2.940***
Pseudo R-squared	0.9637		0.971		0.967	
R-squared	0.9636		0.971		0.966	
Quasi-LR statistic	175,778.08		461,304.8		145,757.9	
Prob(Quasi-LR stat)	< 0.01		< 0.01		< 0.01	

Notes: 1. We use ***, ** and * to denote significance at the 1%, 5%, and 10% levels, respectively; 2. The table presents the 0.25, 0.50, and 0.75 quantile regression coefficient estimates and t-statistic value; 3. The final 3, 4 columns give the R^2 for each of the regressions, and the fit is clearly quite high.

billionaires' net worth (ln *Net worth*) is significantly uncorrelated to the government revenue ($lnGR_i$) component across the quantiles (0.25, 0.5, and 0.75) in Table 5, with *p*-values > 0.2. Therefore, our results do not support the hypothesis (Hypothesis 2). The effects of Billionaires' net worth on government revenue *(GR)* appear to be non-positive and insignificant, and support the existence of the "tax evasion" phenomenon. The net worth of the world's billionaires has not obviously contributed to their country's revenue, and the evidence further shows the invalid policy of millionaires' taxes in France.

Any assessment of this impact depends on cautious consideration of the type of tax evasion practiced. Billionaires use tax-haven operations to establish their corporations as multinational ones and take advantage of effective tax rates that are lower than those imposed on domestic companies.

4.5. Evidence of millionaire tax from France[10]

The French President Francois Hollande had argued for a 75% tax rate on household incomes above €1.3 million. Thus, it can be treated as evidence to assess the effectiveness of taxing the rich in isolation. We use monthly data on tax collections of government revenues in France adapted from the National Institute of Statistics and Economic Studies for the period January 2009 to September 2017. From Table 6 it can be observed that taxes on income, profits, and capital gains constitute the most important sources of total tax revenue (excluding social security contributions), whereas taxes on goods and services are the major sources of revenue (approximately 41.8%) in France. Government revenues, as depicted in Table 6, indicate that aggregate revenues are accurately captured by tax and display the most representative variable for tax revenue. Two year after the implementation of this tax, the government has not collected more than the expected revenues as depicted in panel A of Table 7. Moreover, panel B of Table 7 shows the results of the tax regime estimating changes in revenue among pre-millionaire tax (2009–2012), post-millionaire tax (2013–2014), and the tax that was implemented after adjusting for the millionaire tax abolishment (2015–2017). We found no evidence of significant differences in either the execution time compared to the pre-tax period (d.f. = 69, t = —1.225, $p = 0.224$) or compared to the abolishing time zones (d.f. = 55, t = 0.426, $p = 0.6719$). The computed *p*-values exceed the significance level (0.05) value, so the null hypothesis cannot be rejected. This test has not provided statistically significant evidence that millionaire tax scheme access to revenue is collected more than non-millionaire tax. Overall, those findings explain the reason why Hollande's high tax on millionaires ended in failure in France[11] (Business Insider, 2014).

4.6. Discussion of the finding results

Our study advances the frontiers of knowledge in the tax evasion literature. Slemrod and Yitzhaki (2002) have done a detailed study on the implications of taxpayers' noncompliance with the tax

Table 6. Share of major taxes in aggregate revenue (general government)

(In millions of *Euros*)	2009	2010	2011	2012	2013	2014	2015	2016
Revenue	886,152	1,050,945	1,071,580	1,085,572	1,119,891	1,141,797	1,166,276	1,192,546
Taxes	530,102	557,005	578,398	586,045	608,609	617,840	634,523	648,815
Taxes on income, profits, and capital gains	195,604	210,478	227,016	233,583	246,222	246,414	249,996	255,627
Taxes on payroll and workforce	27,138	28,256	28,893	30,578	34,127	35,074	35,340	36,136
Taxes on property	84,693	90,146	87,590	83,727	85,701	88,121	92,036	94,109
Taxes on goods and services	221,639	227,209	233,407	236,609	240,469	246,110	255,381	261,133
Taxes on international trade and transactions	503	392	483	481	589	552	553	565
Other taxes	525	524	1,009	1,067	1,501	1,569	1,217	1,244
Social contributions	303,576	361,122	375,424	387,117	398,881	408,804	412,814	422,113
Other revenue (e.g. Grants)	52,474	132,818	117,758	112,410	112,401	115,153	118,939	121,618

1. Tax bases and revenues in France. The data from this study is also captured and integrated in the IMF database.
2. Source: Compiled from the IMF (2009–2016) and the National Institute of Statistics and Economic Studies

Table 7. Revenues and its change between pre- and post-implementation of the millionaire tax in France

Panel A Descriptive statistics (million Euros)

Variable	Tax regime	Obs.	Mean	Std. Dev.	
REVENUE1	(2009–2012)	47	137,071.7	76,681.71	11,185.18
REVENUE2	(2013–2014)	24	162,160.5	90,578.47	18,489.25
REVENUE3	(2015–2017*)	33	152,282.8	83,397.55	14,517.65
All		104	156,441.8	85,838.63	11,369.60

Panel B. Test for equality of means between revenue series

	d.f.	Value	Probability	d.f.	Value	Probability
t-test	69	−1.225	0.2244	55	0.426	0.6719
Satterthwaite-Welch *t*-test*	40.22	−1.161	0.2525	47.206	0.421	0.6763
Anova F-test	(1, 69)	1.502	0.2244	(1, 55)	0.181	0.6719
Welch F-test*	(1, 40.22)	1.348	0.2525	(1, 47.206)	0.177	0.6763

* up to September 2017. The execution time of millionaire tax (2013–2014).
The significant level at 5%.
Reference group tax period Jan.2013–Dec.2014.
Source: National Institute of Statistics and Economic Studies. https://www.insee.fr/en/statistiques/serie/001717257
In statistical hypothesis, assuming μ_1 represent the population mean for the pre-tax period group (Revenue1) and μ_2 represent the population mean for the implementation tax group (Revenue2), μ_3 represent the elimination tax group (Revenue3).

regulations and also focused on developed economies. The study provided results that support prior research on tax evasion, and the findings showed that increases in tax rates and penalty for tax non-compliance (collectively known as classical factors)

Null hypothesis: H_0: $\mu_1 = \mu_2$ versus **alternative hypothesis**: H_a: $\mu_1 \neq \mu_2$,

Null hypothesis: H_0: $\mu_2 = \mu_3$ versus **alternative hypothesis**: H_a: $\mu_2 \neq \mu_3$

may induce evasion behavior from the above Proposition 1. The evidence is in line with Ali, Cecil, and Knoblett (2001) who captured the notion that tax rates play a significant role in mediating the relationship between penalty for tax noncompliance and tax evasion. Therefore, there have been some previous studies examining the relationship between these predictors and tax evasion (Dell'Anno, 2009; Dhami & Al-Nowaihi, 2007; Slemrod & Yitzhaki, 2002). The findings of this study for portfolio choice are contained in our hypothesized model from the existing literature.

5. Conclusion and future research

There is a long string of studies on the wealthy and the top earners. However, there has been very little work on global insights into the rich, although future research will likely address the potential importance of the issue, and there are some obvious signs that a non-negligible part of the wealth or income of the rich crosses national borders. We do not find any significant relationship between net worth composition and government revenue structure and regulatory policies, a finding that casts doubt on the ability of taxation policy-makers to influence the net worth composition of billionaires. Our findings have important policy implications. In particular, we show that tax from a billionaire should not be taken for granted. A majority of billionaires are limited "transitory billionaires." Nevertheless, the size of this tax obligation varies according to time and place and is subject to political negotiation and unanticipated consequences, such as tax migration, which provides a platform to help policymakers decide whether to collect more tax revenue from wealthy investors. Overall, the article suggests sustainable reforms in three important areas:

(1) Design and implementation to construct anti-evasion provisions: the evidence in this study suggests reforms to anti-evasion laws to combat tax evasion by multinationals operating in a global environment, especially via offshore finance centers. The government must establish efficient anti-evasion schemes.[12]

(2) Ensure adequate tax rates on wealthy individuals: from this, the risk aversion preferences can be seen from the above Proposition 2. Sustainable tax revenues will be collected via adequate taxation of wealthy individuals based on tax evasion behavior, with the tax rate on declared income linked to the costs of evasion.

(3) Implementation of tax amnesty, capital flight, and political implications: tax amnesty aims to repatriate assets held abroad, broaden the tax base, and generate additional revenues. Arguably, frequently initiated tax amnesties are often used not only to improve tax compliance and to increase tax revenue, but also address the problem of capital flight. For example, in 2016, the market really welcomed the tax amnesty policy in Indonesia. In addition, targeting wealthy individuals is politically attractive, and may have a role in securing public finances. However, raising substantially more fiscal taxation through taxes on millionaires and ensuring relatively sustainable revenues may require a much wider tax base.

Finally, the shocking scale of the industry aimed at minimizing the tax bills of the wealthy is laid bare by the Panama Papers leak. This story is now global, and the leaks suggest that some governments must establish efficient anti-evasion schemes that apply to those who are merely rich.

This study has extended and expanded our knowledge in the area of taxing the rich and tax evasion, but not without limitations. However, unfortunately, some key tax information data are not available to analyze groups of countries with common characteristics (high versus low top tax rate, high versus low compliance and so on) but we leave the deeper empirical analysis of this issue to future researchers.

Acknowledgements
We are especially grateful for the constructive comments and helpful suggestions from the two anonymous referees to improve our paper, and we also benefited from the discussions of the participants in the 2017 Taiwan Finance Association (TFA) Annual Conference held in Hualien, Taiwan, in May, 2017. Of course, all errors remain our own.

Funding
The authors received no direct funding for this research.

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Citation information
Cite this article as: Taxing the rich policy, evasion behavior, and portfolio choice: A sustainability perspective, Kuo-Shing Chen & Huolien Tsai, *Cogent Business & Management* (2018), 5: 1526362.

Notes

1. Stiglitz (2014) suggested a 5% increase to the tax rate of the top 1% of income earners—a reform that he said would raise as much as $1.5 trillion revenue over 10 years. He also called for a "fair tax," which would eliminate preferential tax treatment for income earned from capital gains and dividends—benefits enjoyed mainly by those who can afford to possess a large amount of stock.
2. However, Dhami and Al-Nowaihi (2007) document that PT might be a better alternative to EUT models and find an unambiguous positive association between tax evaded and its rates.
3. The Panama Papers in Perspective: International tax evasion is happening around the world and can be solved effectively only through international measures. The UK is living proof of the requirements for a global response. The Panama leak claims to expose the offshore holdings, showing how easily wealthy individuals have been able to adopt Panamanian bank secrecy laws to "conceal" their wealth. In a global economy, powerlessness increases. When the global super-rich elite exploit the power to avoid paying their fair share of taxes, elected rulers become even more constrained. Retrieved from http://www.independent.co.uk/news/world/americas/millions-of-leaked-documents-reveal-how-world-s-rich-and-powerful-have-hid-money-a6966921.html.
4. Noticeably, several authors have examined the generalized two component normal mixture. GARCH (1, 1) models performs better and forecast more accurately than the symmetric and skewed Student's t-GARCH models (Alexander & Lazar, 2006; Colacito, Engle, & Ghysels, 2011). Moreover, Engle and Lee (1999) find the relative outperformance of this new specification over the classical GARCH (single component) model employing two stock indices, the S&P 500 and the NIKKEI 225, and their arguments are supported in subsequent

research for many stock indices (Christoffersen et al., 2008; Deo, Hurvich, & Lu, 2006).

5. A GARCH type model process is given by:

$$\mathbb{R}_{\approx} = \alpha_0 + \sum_{i=1}^{k} \mathfrak{B}_i \mathbb{X}_i + \in_t$$
$$\text{where} \in_t | \Omega_{t-1} N(0, h_t), \text{and } h_t = \alpha$$
$$+ \sum_{i=1}^{p} \beta_i h_{t-i} + \sum_{j=1}^{q} \gamma_i \in_{t-j}{}^2, \text{where}$$
$$h_t = \sigma_t^2 | \Omega_{t-1}$$

(conditional variance dependent on the information set Ω_{t-1}). With the following conditions:ϵ_t is the residual of the mean equation, $\mathbb{R}_t$ denotes the return of the asset at time t and $\mathbb{X}'s$ are explanatory variables.

6. EVIEWS 7.1 is adopted in this study to estimate the conditional quantile $\hat{b}_\theta$, which is based on a modified version of Koenker and D'Orey (1987).
7. Similar work has been conducted by Ghysels, Santa-Clara, and Valkanov (2006) who propose mixed data sampling (MIDAS) regression models to predict volatility using equity return data. The financial variables, e.g. various interest rates, investment returns, or stock prices, are used in many contemporary macroeconomic models. However, the empirical data on macroeconomic indicators, e.g. the gross domestic product, many important macroeconomic indicators are not sampled at the same frequency. For example, gross domestic product (GDP) and government revenue data are sampled quarterly, investment data are sampled monthly, and most stock prices data are sampled daily.
8. In practice, it is difficult to assess the net worth of the world's super-rich in current research and to acquire data on the hidden wealth and evaded income tax, excluding reported measure of income and wealth referring to declared amounts. Moreover, other factors which are not accurately estimated from information disclosure (i.e. declared amounts) may also influence the amount of tax evasion.
9. We thank a referee for pointing this out for our empirical analysis. In addressing the effect of multicollinearity, Table 2 presents the pairwise correlation matrix showing the multi-collinearity test results of the independent variables. It can be observed that some relationships with other variables such as GDP and share of government revenue in GDP ratio, show correlation coefficient (the magnitude of 0.33) less than ceiling value 0.6. In addition, according to Gujarati (2003), the significant correlations are a sufficient but not a necessary condition for the existence of multicollinearity. Moreover, in Table 2, it can exist even though the correlations are comparatively low say, with absolute values less than 0.6. Finally, the correlations between the independent variables indicate that multicollinearity is not a potential problem in the model.
10. Obviously, empirical findings also indicate that the average bill paid by high-income taxpayers at the revenues did not increase after the millionaire tax was implemented.
11. **Hollande's 75% Super-Tax Ends As A Failure**. In 2012, Hollande campaigned on the fact that he wanted to institute a 75% tax on those making a million Euros or more, as a means of reversing France's growing debt. Hollande accomplished passage of that tax through the French legislature in December 2013. Overall, France's two-year experiment was a failure, and Thomas Piketty's high taxes on the rich were revealed as an economic fraud. Source http://www.businessinsider.com/r-france-waves-discreet-goodbye-to-75-percent-super-tax-2014-12.
12. More importantly, from 2018 global tax transparency will improve as a result of the OECD's Common Reporting Standard (CRS). Over 100 countries will start to share bank account information regarding tax transparency with each other. To enhance this incentive, many countries have originated (introduced) the prompted voluntary disclosure forms often incorporated with a tax amnesty, or penalty tax reduction, for taxpayers with disclosing unpaid or underpaid taxes. For more information, see https://www.pwc.com/gx/en/about/assets/voluntary-disclosures-and-amnesties-by-various-national-institutions-on-tax.pdf.

References

Alexander, C., & Lazar, E. (2006). Normal mixture GARCH(1,1): Applications to exchange modelling. *Journal of Applied Econometrics*, *21*, 307–336. doi:10.1002/jae.849

Ali, M. M., Cecil, H. W., & Knoblett, J. A. (2001). The effects of tax rates and enforcement policies on taxpayer compliance: A study of self-employed taxpayers. *Atlantic Economic Journal*, *29*(2), 186–202. doi:10.1007/BF02299137

Alm, J., Martinez-Vazquez, J., & McClellan, C. (2016). Corruption and firm tax evasion. *Journal of Economic Behavior and Organization*, *124*, 146–163. doi:10.1016/j.jebo.2015.10.006

Alstadsæter, A., Johannesen, N., & Zucman, G. (2017).Tax evasion and inequality. *NBER Working Paper*, No. 23772, September.

Benisty, H. (2017).Simple wealth distribution model causing inequality-induced crisis without external shocks. *Physical Review E*, *95*. doi:10.1103/PhysRevE.95.052307

Bruhin, A., Fehr-Duda, H., & Epper, T. (2010). Risk and rationality: Uncovering heterogeneity in probability distortion. *Econometrica*, *78*(4), 1375–1412. doi:10.3982/ECTA7139

Bussiness Insider, 2014. Hollande's 75% Super-Tax Ends As A Failure. Retervied May 25, 2015 from, http://www.businessinsider.com/r-france-waves-discreet-goodbye-to-75-percent-super-tax-2014-12.

Castaldi, C., & Milakovic, M. (2007). Turnover activity in wealth portfolios. *Journal of Economic Behavior & Organization*, *63*, 537–552. doi:10.1016/j.jebo.2005.06.008

Chen, K. S. (2015). Essays on asset allocation strategy under taxing billionaires and housing endowment innovation, *PhD dissertation*, National Sun Yat-sen University.

Christoffersen, P. F., Jacobs, K., & Wang, Y. (2008). Option valuation with long-run and short-run volatility components. *Journal of Financial Economics*, *90*, 272–297. doi:10.1016/j.jfineco.2007.12.003

Colacito, R., Engle, R., & Ghysels, E. (2011). A component model for dynamic correlations. *Journal of Econometrics*, *164*, 45–59. doi:10.1016/j.jeconom.2011.02.013

Dang, D. M., & Forsyth, P. A. (2016). Better than pre-commitment mean-variance portfolio al location strategies: A semi-self-financing Hamilton-Jacobi-Bellman approach. *European Journal of Operational Research*,*250*, 827–884. doi:10.1016/j.ejor.2015.10.015

Dang, D. M., Forsyth, P. A., & Vetzal, K. R. (2017). The 4% strategy revisited: A pre-commitment optimal mean-

variance approach to wealth management. *Quantitative Finance*, *17*, 335–351. doi:10.1080/14697688.2016.1205211

Dell'Anno, R. (2009). Tax evasion, tax morale and policy makers effectiveness. *The Journal of Socio-Economics*, *38*, 988–997. doi:10.1016/j.socec.2009.06.005

Deo, R., Hurvich, C., & Lu, Y. (2006). Forecasting realized volatility using a long-memory stochastic volatility model: Estimation, prediction and seasonal adjustment. *Journal of Econometrics*, *131*(1), 29–58. doi:10.1016/j.jeconom.2005.01.003

Dhami, S., & al-Nowaihi, A. (2010). Optimal taxation in the presence of tax evasion: Expected utility versus prospect theory. *Journal of Economic Behavior & Organization*, *75*(2), 313-337. doi:10.1016/j.jebo.2010.03.004

Dhami, S., & Al-Nowaihi, A. (2007). Why do people pay taxes? Prospect theory versus expected utility theory. *Journal of Economic Behavior and Organization*, *64*(1), 171–192. doi:10.1016/j.jebo.2006.08.006

Ding, Z., & Granger, C. W. J. (1996). Modeling volatility persistence of speculative returns: A new approach. *Journal of Econometrics*, *73*, 185–215. doi:10.1016/0304-4076(95)01737-2

Engle, R. F., & Lee, G. G. J. (1999). A permanent and transitory component model of stock return volatility. In R. F. Engle & H. White (Eds.), *Cointegration, causality, and forecasting: A Festschrift in honour of clive W. J. Granger* (pp. 475–497). Oxford: Oxford University Press.

Favilukis, J. (2013). Inequality, stock market participation, and the equity premium. *Journal of Financial Economics*, *107*(3), 740–759. doi:10.1016/j.jfineco.2012.10.008

Forbes, (2015). The world's billionaires. Retervied May 09, 2015,from, http://www.forbes.com/billionaires .

Forsyth, P., & Vetzal, K. (2017). Robust asset allocation for long-term target-based investing. *International Journal of Theoretical and Applied Finance*, *20*, 3. doi:10.1142/S0219024917500170

Ghysels, E., Santa-Clara, P., & Valkanov, R. (2006). Predicting volatility: Getting the most out of return data sampled at different frequencies. *Journal of Econometrics*, *131*, 59–95. doi:10.1016/j.jeconom.2005.01.004

Goolsbee, A. (2000). What happens when you tax the rich? Evidence from executive compensation. *Journal of Political Economy*, *108*(2), 352–378. doi:10.1086/262122

Goolsbee, A., Lovenheim, M., & Slemrod, J. (2010). Playing with fire: cigarettes, taxes, and competition from the internet. *American Economic Journal: Economic Policy*, *2*(1), 131-154. Retrieved from http://www.jstor.org/stable/25760054

Gujarati, D. N. (2003). *Basic econometrics* (4th ed.). New York, NY: McGraw-Hill.

Guo, H., & Neely, C. (2008). Investigating the intertemporal risk-return relation in international stock markets with the component GARCH model. *Economics Letters*, *99*, 371–374. doi:10.1016/j.econlet.2007.09.001

Hanlon, M., Maydew, E. L., & Thornock, J. R. (2015). Taking the long way home: u.s. tax evasion and offshore investments in U.S. equity and debt markets. *The Journal of Finance*, *70*(1), 257–287. doi: 10.1111/jofi.12120

Harris, D. G. (1993). The impact of U.S. Tax law revision on multinational corporations capital location and income-shifting decisions. *Journal of Accounting Research*, *31*(3), 111–140. doi:10.2307/2491167

International Monetary Fund. (2015).World Economic Outlook Database. Retervied June 18, 2015 from, http://www.imf.org/external/pubs/ft/weo/2015/weodata/weoselser.aspx .

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, *47*, 263–291. doi:10.2307/1914185

Koenker, R., & D'Orey, V. (1987). Algorithm AS 229: Computing regression quantiles. *Applied Statistics*, *36* (3), 383–393. doi:10.2307/2347802

Kushnirovich, N. (2016). Immigrant investors in financial markets: Modes of financial behavior. *Journal of Business Economics and Management*, *17*(6), 992–1006. doi:10.3846/16111699.2016.1171253

Landier, A., & Plantin, G. (2016, June 27). Taxing the rich. *Review of Economic Studies*. doi:10.1093/restud/rdw033

Li, Q., Yang, J., Hsiao, C., & Chang, Y. J. (2005). The relationship between stock returns and volatility in international stock markets. *Journal of Empirical Finance*, *12*, 650–665. doi:10.1016/j.jempfin.2005.03.001

Lin, W. Z., & Yang, C. C. (2001). A dynamic portfolio choice model of tax evasion: Comparative statics of tax rates and its implication for economic growth. *Journal of Economic Dynamics and Control*, *25*, 1827–1840. doi:10.1016/S0165-1889(99)00081-0

Merton, R. C. (1976). Option pricing when the underlying stock returns are discontinuous. *Journal of Financial Economics*, *3*, 125–144. doi:10.1016/0304-405X(76)90022-2

Merton, R. C. (1980). On estimating the expected return on the market: An exploratory investigation. *Journal of Financial Economics*, *8*, 323–361. doi:10.1016/0304-405X(80)90007-0

Piketty, T., Postel-Vinay, G., & Rosenthal, J.-L. (2004). Wealth concentration in a developing economy: Paris and France, 1807–1994. Discussion Paper, 4631. Center for Economic Policy Research (CEPR).

Piketty, T., & Saez, E. (2013). A theory of optimal inheritance taxation. *Econometrica*, *81*(5), 1851–1886. doi:10.3982/ECTA10712

Samouilhan, N. (2007). The persistence of SA equity volatility: A Component ARCH perspective. *Journal of the Study of Economics and Econometrics*, *31*(1), 99–117.

Schneider, F., & Enste, D. H. (2013). *The shadow economy: An international survey*. New York, NY: Cambridge University Press.

Slemrod, J., & Yitzhaki, S. (2002). Tax avoidance, evasion, and administration. In A. Auerbach & M. Feldstein (Eds.), *Handbook of public economics* (Vol. 3, pp. 1423–1470). Amsterdam: Elsevier Science.

Stiglitz, J. E. (2014). Reforming tax to promote growth and equity. Roosevelt Institute, Working Paper Retervied from http://www.rooseveltinstitute.org/reforming-taxation-promote-growth-and-equity

Vigna, E. (2014). On the efficiency of mean-variance based portfolio selection in defined contribution pension schemes. *Quantitative Finance*, *14*, 237–258. doi:10.1080/14697688.2012.708778

Wolff, E. (2010). Recent trends in household wealth in the United States: Rising debt and the middle-class squeeze—An Update to 2007, Working Paper, 589. Levy Economics Institute.

Yakovenko, V. M., & Rosser, J. B. (2009). Colloquium: Statistical mechanics of money, wealth, and income. *Reviews of Modern Physics*, *81*, 1703–1725. doi:10.1103/RevModPhys.81.1703

Yaniv, G. (1999). Tax compliance and advance tax payments: A prospect theory analysis. *National Tax Journal*, *52*(4), 753–764.

Young, C., & Varner, C. (2011). Millionaire migration and state taxation of top incomes: Evidence from a

natural experiment. *National Tax Journal*, *64*(2), 255–283. doi:10.17310/ntj.2011.2.02

Young, C., Varner, C., Lurie Ithai, Z., & Prisinzano, R. (2016). Millionaire migration and taxation of the elite: Evidence from administrative data. *American Sociological Review*,*81*, (3), 421–446. doi:10.1177/0003122416639625

Zucman, G. (2014). Tax evasion on offshore profits and wealth. *Journal of Economic Perspectives*, *28*(4), 121–148. doi:10.1257/jep.28.4.121

Appendix A

Appendix B

Table A1. Framework to analyze determinants of financial behavior modes of the wealthy under the millionaire tax system

	Existing theories		Theme in the study
Class and features of research	**Theoretical and empirical approaches to taxing wealthy individuals**	**Relevant issue and literature**	
Key representative factors (key aspects)			
Millionaire Migration and Taxation of Wealthy Individuals	Macroeconomic indicators such as Government revenue. Tax revenue indicators that provide a snapshot of structural taxation of the wealthy.	Risk taking (Landier & Plantin, 2016); Tax flight (Young et al., 2016) ; Millionaire tax and migration effects (Young & Varner, 2011).	Derived from the effects of millionaire tax in Section 2. Prior empirical research methods in Section 3 and empirical results in Section 4.4–4.5.
Evasion behavior	Objective ability for risk Aversion	Tax Evasion (Alm et al., 2016); Prospect Theory framework (Dhami and al-Nowaihi, 2010), Risk aversion (Lin & Yang, 2001);Tax havens (Zucman, 2014)	Derived from tax evasion in Section 2.
Financial portfolio choice	Macroeconomic indicators such as Government revenue. Tax revenue indicators that provide a snapshot of structural taxation of the wealthy.	Stock market participation framework (Favilukis, 2013); Portfolio selection (Kushnirovich, 2016)	Empirical research has been done by academics method in Section 3.The implications of empirical results analyze in Section 4.3

Proof of Proposition 1.

With the notation $\mathcal{L}(d,\tau) = U(d)$ from equation (6), thus, by applying the Implicit Function Theorem to $\mathcal{L}$,

$$\frac{\partial d^*}{\partial \tau} = -\frac{\partial \mathcal{L}/\partial \tau}{\partial \mathcal{L}/\partial d}(d^*,\ \tau)$$

The sign of $\frac{\partial d^*}{\partial \tau}$ is then the same as the one of $\frac{\partial \mathcal{L}}{\partial \tau}(d^*,\tau)$. Therefore,

$$\frac{\partial \mathcal{L}}{\partial \tau} = -\pi(1-p)\tau u'(m) - \pi(1-p)\tau(W-d)u''(n) + \pi(p)fu'(n) - \pi(p)f^2\tau\ (W-d)u''(n). \quad \text{(A1)}$$

Next, substituting (7) into (A1) and rearranging yields

$$\frac{\partial \mathcal{L}}{\partial \tau} = -\tau(W-d)\ \left[\pi(1-p)u''(m)+\pi(p)f^2u''(n)\right] \tag{A2}$$

Hence, by *sgn*(equation 8) < 0, then gives $sgn\left(\frac{\partial \mathcal{L}}{\partial \tau}\right) > 0, sgn\left(\frac{\partial d^*}{\partial \tau}\right) > 0$, and this completes the proof of Proposition 1.

Appendix C

Recalling $R(w) = \frac{1+2\Omega}{w\Omega}$ Differentiating (21) with respect to *w* and solving for $\frac{\partial R(w)}{\partial w}$,we obtain the first -order condition

$$\frac{-\frac{2}{w}w\Omega-(1+2\Omega)(w\Omega'+w'\Omega)}{w^2\Omega^2} = \frac{-\frac{2}{w}w\Omega-(1+2\Omega)\left(-\frac{1}{w}w+\Omega^2\right)}{w^2\Omega^2}$$
$$= \frac{-2\Omega-(1+2\Omega)\left(\Omega^2-1\right)}{w^2\Omega^2} = \frac{1-\Omega^2-2\Omega^3}{w^2\Omega^2} \tag{A3}$$

Take into account the term $\frac{\partial R(w)}{\partial w} > 0$.These conditions can be rewritten as

$$1-\Omega^2-2\Omega^3 \cong (1+\Omega)\left(1-\Omega-2\Omega^2\right) > 0 \tag{A4}$$

Moreover, this mechanism is feasible because using the quadratic formula, we then have

$$\Omega > -1 \text{ and } \Omega > \frac{1\pm\sqrt{1-4\times(-2)}}{-4} = 1 \text{ or } \frac{1}{2} \tag{A5}$$

or alternatively,

$$1+[\mu-(1-\tau)\mathcal{D}-lnw] > -1 \text{ and } 1 \text{ or } \frac{1}{2} \tag{A6}$$

$\frac{\partial R(w)}{\partial w} > 0$, indicates the increasing risk aversion of the rich (billionaires) while *w* improves. Accordingly, with increased wealth, the wealthy person possesses a greater degree of risk aversion. This scenario is in the tradition of the portfolio-choice model of tax evasion. The intuition behind this finding is expressed as *Proposition 2*.

Appendix D

Table A2. *Variable Sources, Definitions and Billionaires' rankings by County* The number of observations, sample period, and variable sources

Variable	Definition	The number of observations	Source	Sample period
GR	The general government revenue	1,758	World Economic Outlook Database (International Monetary Fund, 2015)	2015
W_i	The billionaire's net worth, *i* is a billionaire's country of citizenship	1,758	Forbes list	2015
GDP	GDP in constant U.S. dollars	1,758	World Economic Outlook Database	2015
$\mathbb{I}_i$	The ratio of total investment divide by *GDP*, total investment/GDP	1,758	World Economic Outlook Database	2015

(*Continued*)

TableA2. (*Continued*)

Variable	Definition	The number of observations	Source	Sample period
MI	A macroeconomic indicator that is proxied by the ratio of government revenue divide by *GDP*(*GR*/*GDP*).	1,758	World Economic Outlook Database	2015
SPX1	Standard and Poor's 500 Composite Index (S&P 500)	504	Cboe Options Exchange (Cboe)	Jan.2013 to Dec. 2014
Revenue1	Revenues in the pre-millionaire tax (2009–2012)	47	National Institute of Statistics and Economic Studies	Jan.2009 to Dec. 2012
Revenue2	Revenues in the execution time of millionaire tax (2013–2014)	24	National Institute of Statistics and Economic Studies	Jan.2013 to Dec. 2014
Revenue3	Revenues in the millionaire tax abolishment(2015–2017)	33	National Institute of Statistics and Economic Studies	Jan.2015 to Sep. 2017

The World's Billionaires' rankings by County (2015 *Forbes list*)

Rank	Countries	No. of Obs.	Rank	Countries	No. of Obs.	Rank	Countries	No. of Obs.
1	United States	536	25	Chile	12	48	Colombia	3
2	China	213	25	Malaysia	12	48	Greece	3
3	Germany	103	27	Philippines	11	48	Monaco	3
4	India	90	28	Norway	10	48	Morocco	3
5	Russia	88	28	Saudi Arabia	10	48	Portugal	3
6	Hong Kong	55	30	Netherlands	9	48	Venezuela	3
7	Brazil	54	31	Egypt	8	55	New Zealand	2
8	United Kingdom	53	32	Austria	7	55	Oman	2
9	France	47	32	Lebanon	7	55	Romania	2
10	Canada	39	32	South Africa	7	55	Tanzania	2
10	Italy	39	35	Peru	6	59	Algeria	1
12	Taiwan	33	36	Argentina	5	59	Angola	1
13	Turkey	32	36	Cyprus	5	59	Georgia	1
14	South Korea	30	36	Czech Republic	5	59	Guatemala	1
15	Switzerland	29	36	Denmark	5	59	Guernsey	1
16	Australia	27	36	Finland	5	59	Iceland	1
17	Japan	24	36	Ireland	5	59	Lithuania	1
18	Indonesia	23	36	Kazakhstan	5	59	Nepal	1
19	Sweden	23	36	Kuwait	5	59	St. Kitts and Nevis	1
20	Spain	21	36	Nigeria	5	59	Swaziland	1
21	Singapore	19	36	Poland	5	59	Uganda	1
22	Israel	17	36	Ukraine	5	59	Vietnam	1
23	Mexico	16	47	United Arab Emirates	4			
23	Thailand	16	48	Belgium	3			

Cogent Business & Management **(ISSN: 2331-1975) is published by Cogent OA, part of Taylor & Francis Group.**