Brains or Muscles?

A Political Economy of Offshore Tax Evasion

Arduino Tomasi
University of Chicago

Alberto Parmigiani
London School of Economics

Abstract

A wealthy citizen wants to get away with offshore tax evasion. To reduce the chances of being financially audited, he can sophisticate his evasion scheme through a "brains" type of investment. In our framework, an audit does not directly lead to sanctions: evidence needs to be uncovered by a tax investigator, in the shadow of retaliation by the wealthy through a "muscles" investment. We show that there exists a threshold in the quality of institutions below which brains and muscles are positively correlated, and above which the correlation becomes negative. The empirical implication of our theoretical model suggests that estimates of offshore tax evasion have an inverse U-shaped relationship with institutional strength. We build a panel dataset of offshore wealth by individuals for thirty-seven countries between 2002 and 2006, and we show robust evidence in support of the theoretical prediction by utilizing an array of parametric and nonparametric-based methods.

Introduction

From "The Panama Papers" to "The Pandora Papers", citizens all over the world learned about the intricate schemes used by the very wealthy to avoid billions of dollars from being duly taxed. The salience of both scandals, which also involved world leaders, brought to the public discussion the fact that global offshore wealth has been substantially (yet surreptitiously) increasing over the last forty years. Since the near entirety of this form of evasion comes from those at the very top of the wealth distribution (Alstadsæter, Johannesen and Zucman 2019; Johannesen et al. 2023), it seems unlikely that these two scandals are isolated cases.[1] But then, how can the very wealthy systematically get away with such punishable financial offenses, in spite of the institutions in place to prevent it?

We address this important question with a novel theoretical framework that enables a wealthy citizen to employ concealment and retaliatory tools to get away with his evasion of taxes. The choice of a concealment tool is tantamount to the sophistication of the evasion scheme, which curbs fiscal institutions from detecting accounting discrepancies and, thereby, starting a financial audit against him. As such, we refer to it as a "brains" type of investment by the wealthy citizen. In contrast with the existing and canonical literature (see Yitzhaki 1987; Cremer and Gahvari 1994), we assume that an audit does not directly lead to pecuniary sanctions. For the latter to occur, a tax investigator needs to substantiate with hard evidence the case against the wealthy who, in turn, chooses retaliatory measures to be inflicted against her as a form of retribution. In consequence, we refer to such tool as a "muscles" type of investment.

Following Dal Bó and Di Tella (2003), retaliation can go from legal harassment to the deliberate use of violence. Indeed, exposing the financial offenses by the wealthy may not

[1] In the United States, evidence shows that "more than 60% of the individuals in the top 0.01% of the income distribution own foreign accounts, the vast majority in tax havens" (Johannesen et al. 2023, 4).

come without a cost. For example, Finckenauer and Voronin (2001, 22) have argued that "blackmail, threats, violence, and corruption involving tax inspectors and the tax police are commonplace throughout Russia" by the hand of criminal organizations that operate with businessmen. In Europe, the exposure of local corrupt businessmen and politicians through "The Panama Papers" data has allegedly been one of the potential causes of the tragic assassination of the Maltese journalist Daphne Caruana Galizia (Pace 2017).

We demonstrate the existence of a unique threshold in the quality of (fiscal and legal) institutions that, in equilibrium, determines the direction of the correlation between brains and muscles. Below this threshold, the frailty of the institutions in place to protect the investigator creates incentives for wealthy evaders to capitalize on the forcefulness of muscles to design less intricate (and thus less costly) evasion schemes. They would invest in brains to push slight down an already low probability of being audited because, even in the event of an audit, muscles are all set to deter the incentives to uncover hard evidence, thereby decreasing the probability of facing pecuniary sanctions. Thus, the equilibrium investments in brains and muscles are positively correlated when institutions are weak enough. However, the marginal returns from capitalizing on muscles start to decrease gradually (yet firmly) along improvements in the institutional protections that surround the investigator, which creates incentives for the wealthy to trade-off muscles for more sophisticated (and thus more costly) evasion schemes. Hence, strong enough institutions render the optimal investments in brains and muscles negatively correlated.

But these findings above are not just theoretical. We show how the equilibrium use of concealment and retaliatory means yields an empirically testable prediction: the expected estimates of tax evasion should display an inverse U-shaped relationship along measures of institutional quality. Building a panel dataset that features estimates of offshore wealth by individuals for thirty-seven countries from 2002 to 2016, we find empirical evidence in support of our theoretical prediction using different parametric specifications and a battery of controls. Finally, we provide further evidence by implementing an algorithm (Simonsohn 2018) that pivots on non-parametric methods to test the validity of (inverse) U-shaped relationships without making functional-form assumptions.

The Model

We study a game between a wealthy tax evader ("he") and an investigator ("she"). The evader wants to evade a unit of taxable money, which is a risky practice that can trigger a financial audit. Letting $a \in \{0, 1\}$ denote whether an audit is triggered $(a = 1)$ or not, we assume that $\Pr\big(a = 1\big) = \lambda\,(1 - b) \equiv f_a(b)$, where $\lambda \in (0, 1)$ stands for the quality of institutions. The wealthy can manipulate this probability by sophisticating his evasion scheme, which we denote by $b \in [0, 1]$ and denominate a "brains" type of investment.

An audit does not lead directly to sanctions; the investigator needs produce hard evidence. Letting $\sigma \in \{\varnothing, 1\}$ denote whether evidence was uncovered $(\sigma = 1)$ or not, we assume that $\Pr(\sigma = 1) = e \equiv f_\sigma(e)$, where $e \in [0, 1]$ is the effort that she exerts. The tax evader can distort the discovery process via retaliatory means in the form of a retribution against the investigator, which is equal to $(1 - \lambda)\, m \equiv f_e(m)$ and where $m \in [0, 1]$ is a "muscles" investment that is inflicted in the event that evidence is uncovered.

The wealthy wants to elude sanctions. His expected utility is equal to

$$U_E(b, e, m) = 1 - \Big(\, f_a(b)\, f_\sigma(e)\, \tau + \kappa(b, m) \Big)$$

where $\tau \in (0, 1)$ is a penalty tax rate (or sanction) and where $\kappa(\cdot)$ is an additively-separable quadratic cost function which is the same for all players. In turn, the investigator wants to expose financial offenses. Her expected utility is equal to

$$U_I(e,m) = f_\sigma(e) - \Big(f_\sigma(e)\, f_e(m) + \kappa(e) \Big)$$

The game proceeds as follows: (1) The tax evader makes his investments in brains and muscles; (2) Nature determines whether an audit will take place: if it does not, payoffs are realized and the game ends; otherwise, it moves to the next stage; and (3) The investigator exerts effort to uncover hard evidence. Payoffs are realized and the game ends.

The structure of the game is common knowledge. The solution concept is Subgame Perfect Nash Equilibrium, in which (1) the investigator optimally chooses her effort level, given the wealthy citizen's investment in muscles; and (2) the citizen optimally invests in brains and muscles, in anticipation of the investigator's effort.

Analysis

Backwardly, the investigator's optimal effort balances the returns from exposing unlawful behaviour with the cost of effort. Fixing a level of muscles, better institutional protections ($\lambda \uparrow 1$) increase her incentives to exert effort ($e \uparrow 1$) via the attenuation of the harm imposed by retaliations.[2] And fixing protections, an increase in muscles ($m \uparrow 1$) reduces her effort ($e \downarrow 1$) because it decreases her gains from exposing him. Anticipating the investigator's incentives structure, the tax evader makes his investment choices.

Lemma 1. *There exists a unique* $\lambda^\dagger(\tau) \in (0,1)$*, decreasing in* $\tau \in (0,1)$*, such that if* $\lambda \leq \lambda^\dagger(\tau)$*, then* $\partial b^*/\partial\lambda > 0$ *and* $\partial m^*/\partial\lambda > 0$*; otherwise,* $\partial b^*/\partial\lambda > 0$ *and* $\partial m^*/\partial\lambda < 0$*.*

The above lemma tells us that when institutions are frail enough ($\lambda \downarrow \lambda^\dagger$), the wealthy citizen finds it optimal to invest in both means. Indeed, brains diminish an already low

[2] We utilize the notation $a \uparrow b$ for "a moves towards b", and $a \downarrow b$ for "a moves away from b".

audit probability $\left(f_a(b^*) \downarrow 1\right)$ and, as a safeguard, the forcefulness of muscles further shrinks the probability of being sanctioned $\left(f_\sigma(e\,(m^*)) \downarrow 1\right)$ by deterring the investigator from exerting effort. In this sense, brains and muscles are positively correlated.

But the correlation becomes negative once institutions become good enough ($\lambda \uparrow \lambda^\dagger$), after which muscles are traded off for brains ($m^* \downarrow 1$ and $b^* \uparrow 1$) because the former is then impotent to significantly distort the evidence discovery process. In addition, Lemma 1 tells us that the higher the penalty tax rate, the quicker this substitution arises: he prefers to keep as remote as possible the very event of a financial inquiry and, thereby, he has incentives to increase brains and reduce muscles.

Lemma 2. *In equilibrium,* $e^* = \left(1 - f_e(m^*)\right)$ *and* $\partial^2 e^*/\partial\lambda^2 = -\partial^2 f_e(m^*)/\partial\lambda^2 > 0$.

Returning to the investigator's problem, Lemma 2 conveys the key insight her optimal effort moves in the opposite direction of muscles as stated in Lemma 1. Intuitively, overly frail institutional protections decreases her incentives to exert effort ($e^* \downarrow 1$) even as these become better over time since, by Lemma 1, we know that the equilibrium level of muscles would increase accordingly and impose a substantive harm against her $\left(f_e(m^*) \uparrow 1\right)$. But only up until the point where institutional protections become good enough, after which effort increases steadily ($e^* \uparrow 1$) given that, by Lemma 1, the optimal level of muscles decreases precisely because of the attenuation in the harm $\left(f_e(m^*) \downarrow 1\right)$ that retribution would inflict against her.

Empirical implications of the theoretical model

In our framework, the equilibrium level of tax evasion is a mixture of two key quantities. First, the effectiveness of a state (fiscal) institutions to detect and thereby audit financial discrepancies, given the sophistication of the wealthy citizen's evasion scheme. And, second, the protections that a state (legal) institutions offer to the investigator in her evidence discovery endeavor, given the retaliation that would be inflicted by the wealthy evader. Formally, the expected tax evasion in equilibrium is given by

$$\begin{aligned} Y &= \underbrace{f_a\left(b^*\right)\,\big(1 - f_\sigma(e^*(m^*))\big)\,\tau}_{\text{Unsanctioned detected discrepancies}} \;+\; \underbrace{\big(1 - f_a(b^*)\big)\,\tau}_{\text{Undetected discrepancies}} \\ &= f_a\left(b^*\right)\, f_e(m^*)\,\tau \,+\, \big(1 - f_a(b^*)\big)\,\tau \end{aligned}$$

We can think of the above theoretical quantity as the "true" level of tax evasion. In practice, the fallibility of fiscal institutions can impose measurement constraints that render an unbiased estimation unattainable. For example, Zucman (2013, 1321-1322) shows that "around 8% of households' financial wealth is held through tax havens, three-quarters of which goes unrecorded" even though "statistical agencies have put considerable resources into improving their data". In our framework, the constraints on measurement emerge from the side of undetected discrepancies. Thus, we weight such component by a parameter $\gamma \in (0, 1)$ in order to define the theoretical *estimate* of tax evasion. Formally,

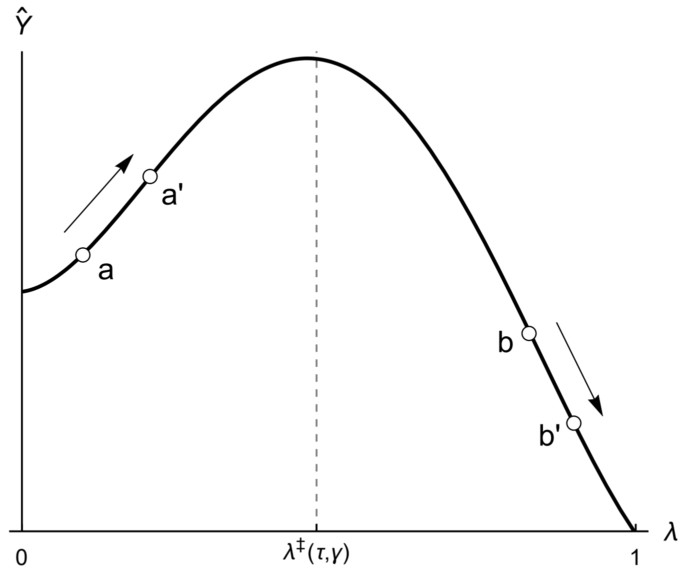
$$\begin{aligned} \hat{Y} &= f_a\left(b^*\right)\, f_e(m^*)\,\tau + \gamma\,\big(1 - f_a(b^*)\big)\,\tau \\ &= f_a\left(b^*\right)\, f_e(m^*)\,\tau + \gamma\,\big(1 - f_a(b^*)\big)\,\tau \,+\, \Big[\big(1 - f_a(b^*)\big) - \big(1 - f_a(b^*)\big)\Big]\,\tau \\ &= Y \,-\, \underbrace{\tau\,(1-\gamma)\,\big(1 - f_a(b^*)\big)}_{\text{Downward bias}} \end{aligned}$$

The last equality indicates how data restrictions results in underestimating the evasion level. It also stresses that the magnitude of this downward bias is increasing in the brains investment by the wealthy, as it becomes harder for institutions to red flag financial discrepancies. Moreover, it shows that muscles does not contribute to the bias.

Proposition 1. *There exists a unique* $\lambda^{\ddagger}(\tau, \gamma) \in (0,1)$*, increasing in* $\tau \in (0,1)$ *and decreasing in* $\gamma \in (0,1)$*, such that if* $\lambda \leq \lambda^{\ddagger}(\tau, \gamma)$ *then* $\partial \hat{Y} / \partial \lambda > 0$*; otherwise,* $\partial \hat{Y} / \partial \lambda < 0$.

The proposition above provides the following empirically testable prediction: the expected estimate of tax evasion displays an inverted-U shape along the quality of institutions. Indeed, this prediction is a direct result of the measurement constraints because it brings to the front the strategic interaction between the wealthy citizen and the investigator in the production of hard evidence on the financial offense. Figure 1 below illustrates the empirical implication.

Figure 1. Theoretical Estimates of Offshore Tax Evasion



Note. The penalty tax and the constraint rates are $\tau = 1/2$ and $\gamma = 1\%$, which induces $\lambda^{\ddagger}(\tau, \gamma) \approx 2/5$.

When institutions are frail enough ($\lambda \leq \lambda^{\ddagger}$), the improvement in quality $a \uparrow a'$ increases the estimated evasion precisely because the heightened incentives for the wealthy to capitalize on muscles reduces the equilibrium effort of the investigator. But the reverse happens when institutions are strong enough ($\lambda \geq \lambda^{\ddagger}$), where the quality gain $b \uparrow b'$

decreases the estimate due to the more lenient equilibrium distortion of muscles on effort. Put equivalently, by Lemmas 1 and 2 we know that the probability that the wealthy citizen is sanctioned displays an U-shape along institutional quality and, as a consequence, the probability of unsanctioned detected discrepancies must display the opposing direction.

The Empirics

We utilize the European Commission (2019) estimates of offshore wealth by individuals in international financial centers as a proxy of our theoretical expected estimate of tax evasion. These estimates comprise 37 countries during the 2002-2016 time period, and include wealth channeled through screening arrangements such as the creation of anonymous shell companies in countries with lax regulations. There are at least two advantages of using this data as dependent variable. First, to the best of our knowledge, this is the most recent and comprehensive data that can be found in the literature and it was produced by a specialized unit of researchers of an official governmental institution. Second, these estimates are calculated for individuals and not at a more aggregated level, such as businesses or corporations, making them nicely aligned with our theoretical model. Nonetheless, these are lower bound estimates to the extent that their employed computational method does not account for life insurance contracts, cash money, real estates nor the practice of dual fiscal residency —data limitations that fit our theoretical expectation of measurement constraints rendering an unbiased estimation unattainable.

Table 1 below provides descriptive statistics for all the variables we use in our empirical analysis. Given that our expected estimate of tax evasion is a function of the quality of institutions, we utilize the rule of law index in World Bank's *Worldwide Governance Indicators* as our key explanatory variable. We argue that such index is a good proxy for institutional strength because it measures the "perceptions on the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence" (Kaufmann, Kraay and Mastruzzi 2010, 4). Methodologically, it is a standardized latent measure based on a model of thirty-two variables related to the rule of law. As such, we interpret the rule of law variable as an umbrella measure that captures the degree of impartiality and non-arbitrariness of legal and fiscal institutions. It is worth stressing that data availability is an important driver for our decision to choose this index instead of others. That said, we highlight the finding of Versteeg and Ginsburg (2017, 102) showing how "indicators created by the Worldwide Governance Indicators, the Heritage Foundation, and the World Justice Project are almost identical, with their pair-wise correlations all exceeding 0.95".

Table 1: Descriptive Statistics

	Obs.	Mean	Std. Dev	Min	Max
Tax Evasion	555	3.28	1.66	0.63	7.26
Rule of Law	555	1.05	0.30	0.08	1.38
Top Tax Rate	555	0.32	0.09	0.10	0.49
Top 1% Income	535	0.11	0.04	0.06	0.23
Stability	555	1.12	0.24	0.21	1.41
GDP	555	12.96	1.77	9.22	16.66
Inflation	555	2.06	0.30	1.40	3.01
Press Freedom	409	2.30	0.96	0	4.46
Wealth	235	33.92	1.42	29.99	36.63

Note. All variables are log-normalized and winsorized at the 1% to account for outliers.

The table above also shows additional variables which we include as controls because they could arguably affect individual incentives to evade taxes, even in the absence of substantial variation in the strength of institutions. The Online Appendix provides a detailed description of these controls and the rationale for factoring them in the analysis.

Empirical Specification

We implement an ordinary least squares panel specification with country and year fixed effects. With country fixed-effects, the panel structure of the regression model permits us to address long-run factors that could provide favourable conditions for tax evasion in some countries (but not in others) many decades before the period of analysis. Analogously, the inclusion of year fixed-effects allows us to capture common trends across panels that could be potentially related to international actions to deter the incentives to evade taxes. To test the non-linear theoretical relationship between estimated evasion and institutional quality, the simplest empirical specification is the following quadratic regression:

$$Y_{j,t} = \alpha_j + \beta_t + \theta \text{ Rule of Law}_{j,t} + \delta \left(\text{Rule of Law}_{j,t} \right)^2 + \eta \mathbf{X}_{j,t} + \epsilon_{j,t}$$

where for each country j at year t, $\mathrm{Y_{j,t}}$ is the estimate of offshore wealth; α_t is the set of country fixed effects; β_t is the set of year fixed effects; $\text{Rule of Law}_{\mathrm{j,t}}$ is our measure of the quality of institutions; $\mathrm{X_{j,t}}$ is the vector of controls; and $\epsilon_{j,t}$ is the error term.

Table 2 below summarizes the results of the panel regressions. In line with our theoretical expectations, columns (1) to (7) show that the estimate of tax evasion displays an inverted U-shape along our measure of institutional quality. This follows from the direction of the coefficients being $\theta > 0$ and $\delta < 0$, where the latter satisfies the necessary and sufficient conditions to guarantee the strict concavity of the dependent variable as a function of the rule of law measure. The table also shows that the statistical significance of our key explanatory variable persists across the board, even when we include all controls.

Table 2: Panel regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rule of Law	6.08***	3.51*	6.06***	6.03***	5.92***	6.13***	3.52**
	(1.90)	(1.83)	(1.90)	(1.96)	(1.88)	(1.96)	(1.77)
Rule of Law^2	-3.00***	-2.03**	-3.00***	-2.97***	-2.98***	-3.02***	-2.01**
	(0.96)	(0.84)	(0.96)	(1.01)	(0.95)	(0.99)	(0.83)
GDP		1.16***					1.14**
		(0.45)					(0.46)
Stability			0.04				-0.18
			(0.28)				(0.33)
Inflation				-0.04			-0.07
				(0.13)			(0.09)
Top Tax Rate					-1.35**		-0.57
					(0.69)		(0.72)
Top 1% Income						0.99	0.47
						(1.78)	(1.59)
Fixed Effects	X	X	X	X	X	X	X
Observations	555	555	555	555	555	555	555
R^2 (within)	0.48	0.55	0.48	0.48	0.49	0.48	0.56

Note. Standard errors are clustered at the country level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Additionally, we show that the empirical specification is robust to alternative correlational structures of standard errors by conducting a Prais-Winsten estimation that allows for first-order autocorrelation coefficients for each country. These results are shown in the second column of Table 3 below, where the first column displays our earlier results for the full model for comparison purposes. Moreover, we consider the possibility that the drivers of our dependent variable (omitted in the error term) are correlated with past and future measures of rule of law, which can occur if the level of tax evasion today affects future evasion via institutional efforts to fight it. To that end, we employ a system Generalized

Method of Moments to account for a dynamic structure of the panel data by using the estimator developed by Blundell and Bond (1998), which includes lagged differences of the dependent variable as instruments for the level equation. As shown in the third column of Table 3, our main findings do not qualitatively change when allowing for such possibility.

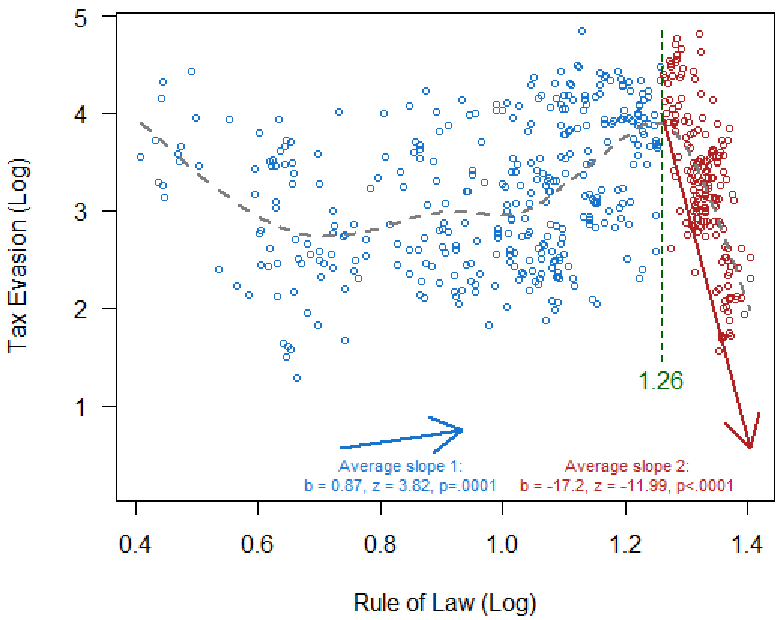
Table 3: Robustness results

	(OLS)	(Prais-Winsten)	(Blundell-Bond)
Rule of Law	3.52**	1.64*	2.48*
	(1.77)	(0.89)	(1.49)
(Rule of Law)^2	-2.01**	-1.14**	-1.24*
	(0.83)	(0.45)	(0.75)
L.Tax Evasion			0.63***
			(0.08)
Fixed Effects	X	X	X
Controls	X	X	X
Observations	555	555	518

Note. Standard errors are clustered at the country level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

As a final point, we acknowledge that recent methodological literature would query the validity of our empirical specification to test for an inverted U-shaped relationship, on the grounds that quadratic regressions "can elevate the rates of false-positive and false-negative" (Simonsohn 2018, 2). We address this concern by implementing the "Robin-Hood Algorithm" put forward by Simonsohn (2018), which runs a (non-parametric) cubic spline regression to recover an approximated global maxima, which is then used to split the sample in two, and then run a simple ordinary least squares regression on each side. If the slope of the parameter goes from positive to negative, and if both are statistically significant, we would then have evidence in support of an inverted U-shape relationship.

Figure 2. Interrupted Regression: Robin Hood Algorithm



Note. The gray dashed line is the non-parametric fit for the algorithm-determined threshold (green dashed line) that partitions the sample in two, left (in blue) and right (in red). At each side, the algorithm runs our preferred specification without the quadratic term. We exclude 5% of outliers to facilitate the interpretation of the graph. Winsorizing all variables at 5% level delivers very similar results.

Figure 2 shows the results of the implementation of this algorithm. We find that the first slope (colored in blue) is strictly positive and the second slope (colored in red) is strictly negative, and both of these coefficients are strongly statistically significant. Accordingly, we interpret this interrupted regression as a further piece of evidence in support of our theoretical prediction.

Conclusion

Exposing major tax evaders may come at a high cost. In turn, this potential punishment could affect the incentives of investigators to search for evidence of wrongdoing. This calls for new ways of theorizing about tax evasion tactics. We undertake this problem by proposing a novel theoretical framework that advance our understanding on how the very wealthy seem to able to systematically get away with tax evasion. Substantively, our key innovation is to distinguish the unconditional probability that the wealthy evader is financially audited from the probability that he ends up facing pecuniary sanctions conditional on being audited. This separation results in the need to study the type of strategies the wealthy employ to try to manipulate these probabilities. This paper studies two broad strategies that we term "brains" –which affects the former probability through the sophistication of a tax evasion scheme– and "muscles" –which affects the latter probability through its distortionary effect on the incentives of an investigator to uncover hard evidence. After characterizing the optimal behaviour of the wealthy, we produce an empirically testable prediction that we take to the data: the expected estimates of offshore tax evasion has an inverse U-shaped relationship with the quality of institutions. Building a panel dataset of offshore wealth by individuals for thirty-seven countries between 2002 and 2006, we show robust evidence in support of our prediction based on an array of parametric and nonparametric-based methods.

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Supplementary material

This appendix contains the mathematical proofs of the paper,

three extensions of the theoretical model and additional empirical analyses.

Contents

1 The Theory

1.1 Comments on the main model

There are three points worth stressing. First, we pointed out in the main text that the key innovation of our model is to distinguish the unconditional probability that the wealthy evaders are financially audited from the probability that the wealthy face pecuniary sanctions conditional on being audited. It is this separation that allows us to introduce retaliatory measures as a potential means available to the wealthy to manipulate the probability of being sanctioned. In this sense, it is important to further emphasize that our approach puts together two previously disconnected strands of the literature: the existing theoretical models of tax evasion (see Yitzhaki 1987) and the models where "nasty" interest groups can retaliate against public officials (Dal Bo and Di Tella 2003) to pressure them into taken some specific action.

Second, it is indeed possible to conceptually distinguish between the role of institutions with respect to detection of the citizen's tax evasion and the protections surrounding the investigator. As in Besley and Persson (2011), we could think of the former as the state fiscal capacity to administer, monitor and enforce taxation, and about the latter as the state legal capacity to "provide regulation and legal services such as the protection of property rights or the enforcement of contracts" (6). In our modelling choices, however, we are assuming that these two capabilities are perfectly correlated. Although inconsequential for the core results, it is chosen as a substantiated simplicity to the extent that fiscal and legal capacities tend to be complements since "investments in one aspect of the state reinforce the motives to invest in the other" (Besley and Persson 2011, 15).

Finally, the subsections to follow contain three extensions of our core model. By modifying the timing of events such that the wealthy can invest in muscles *after* he has learnt that he is being audited, we show that all results continue to hold. Subsequently, we further stress that our results cannot be obtained in a world in which the wealthy could only engage in brains. And, to close the subsection, we show that results hold even if we allow the penalty tax rate itself to be correlated with the quality of institutions.

1.2 Mathematical proofs

1.2.1 Statement and Proof of Remark 1.

Remark 1. *Fix some* $\tilde{m} \in [0,1]$*. Then,* $\partial e^*(\lambda, \tilde{m})/\partial\lambda > 0$ *and* $\partial e^*(\lambda, \tilde{m})/\partial\tilde{m} < 0$*.*

Proof. Fix some $\tilde{m} \in [0,1]$. Let the investigator's expected utility be equal to $\mathbb{E}[u_I|\tilde{m}] = e\ (1 - f_e(\tilde{m})) - e^2/2$. From the first order condition, $\partial\mathbb{E}[u_I|\tilde{m}]/\partial e = 0$, it is straightforward to see that the optimal effort is equal to $e^*(\lambda, \tilde{m}) = 1 - f_e(\tilde{m}) = 1 - (1-\lambda)\,\tilde{m}$, with $\partial e^*(\lambda, \tilde{m})/\partial\lambda = \tilde{m} > 0$ and $\partial e^*(\lambda, \tilde{m})/\partial\tilde{m} = \lambda - 1 < 0$. This completes the proof. ■

1.2.2 Proof of Lemma 1.

Proof. In anticipation of the investigator's optimal behaviour, we can write the tax evader's expected utility as follows

$$\begin{aligned}\mathbb{E}[u_E|e^*] &= \Pr(a=1|b)\left(\Pr(\sigma=1|e^*)\,(1-\tau)+\Pr(\sigma=0|e^*)\,\right)+\Pr(a=0|b)-\frac{b^2}{2}-\frac{m^2}{2}\\ &= \lambda(1-b)\Big(e^*(\lambda,m)\,(1-\tau)+(1-e^*(\lambda,m))\Big)+\big(1-\lambda(1-b)\big)-\frac{b^2}{2}-\frac{m^2}{2}\\ &= 1-\lambda(1-b)\,\tau\,\big(1-(1-\lambda)\,m\big)\;-\frac{b^2}{2}-\frac{m^2}{2}\end{aligned}$$

From the first order conditions $\partial\mathbb{E}[u_E|e^*]/\partial b=0$ and $\partial\mathbb{E}[u_E|e^*]/\partial m=0$, we obtain $b^*=\lambda\,\tau\;(1-(1-\lambda)\,m^*)$ and $m^*=\lambda\,\tau\,(1-\lambda)(1-b^*)$, and thus

$$b^*(\lambda,\tau)=\frac{\big(\lambda\,\tau\,(1-\lambda)\big)^2-\lambda\,\tau}{\big(\lambda\,\tau\,(1-\lambda)\big)^2-1}\qquad\text{and}\qquad m^*(\lambda,\tau)=\frac{(1-\lambda)\,\lambda\,\tau\,(\lambda\tau-1)}{\big(\lambda\,\tau\,(1-\lambda)\big)^2-1}$$

To show that $b^*(\lambda,\tau)$ is strictly increasing in λ, notice that

$$\frac{\partial b^*(\lambda,\tau)}{\partial\lambda}=\frac{\tau\Big(1+\tau\,(1-\lambda)\,\lambda\big[\lambda+(3\,\lambda-1)\,(1+\lambda\,\tau^2)\big]\Big)}{\Big(\big(\lambda\,\tau\,(1-\lambda)\big)^2-1\Big)^2}\tag{1}$$

By inspection of (1), the denominator is positive. To see that the numerator is also positive, notice that (i) the term $(3\,\lambda-1)$ is the only component that can be negative, and (ii) its negative magnitude is maximized when $\tau\to 1$ due to its interaction with the term $(1+\lambda\,\tau^2)$. Suppose that $\tau\to 1$; then, we can rewrite the numerator as $(1+7\,\lambda^2+3\,\lambda^4\,)-(2\,\lambda+8\,\lambda^3)$. Noting the latter component is increasing in λ, it suffices to show that $\lim\limits_{\lambda\to 1}(1+7\,\lambda^2+3\,\lambda^4\,)-(2\,\lambda+8\,\lambda^3)=1>0$. We now turn to prove the non-monotonicity of $m^*(\lambda,\tau)$. To start, note that

$$\frac{\partial m^*(\lambda,\tau)}{\partial\lambda}=\frac{\tau-\tau\,\lambda\Big(2-\tau\Big[-2+\lambda\,(3+(1-\lambda)^2\,\tau\,(1-\lambda(2-\lambda\,\tau))\Big]\Big)}{\Big(\big(\lambda\,\tau\,(1-\lambda)\big)^2-1\Big)^2}\tag{2}$$

Utilizing (2), it is straightforward to obtain that (i) $\lim\limits_{\lambda\to 0}\partial m^*(\lambda,\tau)/\partial\lambda=\tau>0$ and (ii)

$\lim_{\lambda\to 1} \partial m^*(\lambda,\tau)/\partial\lambda = -\tau\,(1-\tau) < 0$. Subsequently, by the Intermediate Value Theorem there must exists some $\lambda^\dagger(\tau) \in (0,1)$ such that if $\lambda \leq \lambda^\dagger(\tau)$, then $\partial m^*(\lambda,\tau)/\partial\lambda > 0$; otherwise, $\partial m^*(\lambda,\tau)/\partial\lambda < 0$. To check that this is an maxima, we examine

$$\begin{aligned}
\frac{\partial^2 m^*(\lambda,\tau)}{\partial\lambda^2} &= \frac{\partial}{\partial\lambda}\left(\frac{\tau-\tau\,\lambda\Big(2-\tau\Big[-2+\lambda\,(3+(1-\lambda)^2\,\tau\,(1-\lambda(2-\lambda\,\tau))\Big]\Big)}{\big((\lambda\,\tau\,(1-\lambda))^2-1\big)^2}\right)\\
&= -\frac{1}{(1-(1-\lambda)^2\lambda^2\tau^2)^3}\Big[2\tau\Big(1+\tau+\lambda\tau(-3-\tau(1-\lambda)(3+\lambda(-3(4+\tau)\\
&\quad +\lambda(12-\tau(1-\lambda)(-12+\tau(1-\lambda)(-1+\lambda(3+\lambda(-3+\lambda\tau))))))))\Big]
\end{aligned} \tag{3}$$

from where it is easy to check that $\lim_{\lambda\to 0} \partial^2 m^*(\lambda,\tau)/\partial\lambda^2 = -2\tau(1+\tau)$ which is strictly negative. In addition, note that $\lim_{\lambda\to 1} \partial^2 m^*(\lambda,\tau)/\partial\lambda^2 = -2\tau(1-2\tau)$, which implies that (i) we can guarantee the strict concavity of $m^*(\lambda,\tau)$ for any $\tau \in (0,1/2]$, and (ii) for any $\tau \in (1/2,1)$, by the Intermediate Value Theorem we can guarantee the existence of a maxima for any $\lambda \leq \lambda^m \in (0,1)$ for which $\partial^2 m^*(\lambda,\tau)/\partial\lambda^2 < 0$. Taken together, these results imply that $m^*(\lambda,\tau)$ is overall concave with a slight convexity arising towards the right tail ($\lambda \to 1$) when the penalty tax rate is very high ($\tau > 1/2$).

Finally, we have to examine how the optimum varies with the tax rate. By inspection of (2), as $\tau \to 0$ it must be that the numerator can only become weakly negative for some $\lambda \in (0,1)$ —this logic also follows through observing (i) and (ii) before. In turn, the numerator in (2) must be strictly negative as such parameter value increases ($\uparrow \tau$). It then follows that the maximum value function $m^*(\lambda^\dagger(\tau),\tau)$ is decreasing in $\tau \in (0,1)$. ■

1.2.3 Proof of Lemma 2.

Proof. From Remark 1, we know that for some fixed $\tilde{m} \in (0,1)$, then $\partial e^*(\lambda, \tilde{m})/\partial\lambda > 0$ for any $\lambda \in (0,1)$. Thus, any changes in the relationship between effort and institutional protections can be attributed to the effects imposed by the optimal level of muscles. For the first part of Lemma 2, notice that by Remark 1 and Lemma 1 we can write $e^* = (1 - f_e(m^*))$. For the second part, we derive

$$
\begin{aligned}
\frac{\partial^2 e^*}{\partial\lambda^2} &= -\frac{\partial^2 f_e(m^*(\lambda,\tau))}{\partial\lambda^2} \\
&= -\frac{\partial^2 m^*(\lambda,\tau)}{\partial\lambda^2} + \frac{\partial}{\partial\lambda}\Big(m^*(\lambda,\tau) + \lambda\frac{\partial m^*(\lambda,\tau)}{\partial\lambda}\Big) \\
&= -\frac{\partial^2 m^*(\lambda,\tau)}{\partial\lambda^2} + \frac{\partial m^*(\lambda,\tau)}{\partial\lambda} + \Big(\frac{\partial m^*(\lambda,\tau)}{\partial\lambda} + \lambda\frac{\partial^2 m^*(\lambda,\tau)}{\partial\lambda^2}\Big) \\
&= -(1-\lambda)\,\frac{\partial^2 m^*(\lambda,\tau)}{\partial\lambda^2} + 2\,\frac{\partial m^*(\lambda,\tau)}{\partial\lambda}
\end{aligned}
$$

Utilizing (2) and (3), it is easy to check that $\lim_{\lambda\to 0} \partial^2 e^*/\partial\lambda^2 = 2\tau(2+\tau)$ which is strictly positive. Letting $b \approx 1/2$, note that

$$
\begin{aligned}
\lim_{\lambda\to\frac{1}{2}+b} \frac{\partial^2 e^*}{\partial\lambda^2} &\approx \big(1-(1/2+b)\big)(2\tau(1-2\tau)) - 2\tau(1-\tau) \\
&\approx \tau(-1+2b(2\tau-1)) > 0 \leftrightarrow \tau > \frac{1+2\,b}{4\,b}
\end{aligned}
$$

where the last inequality holds ($\tau < 1$) since $b \approx 1/2$. These results imply that e^* is overall convex, with a slight concavity arising towards the tail ($\lambda \to 1$) when the tax rate is very high —which is precisely the expected reverse reasoning of what we showed in Lemma 1 in the analysis of muscles. ■

1.2.4 Proof of Proposition 1

Proof. From the main text, let $\hat{Y}(\lambda, \tau, \gamma) = Y - \tau(1-\gamma)(1 - f_a(b^*))$. To start, suppose that the measurement constraints are degenerately high ($\gamma \to 0$). Then,

$$\begin{aligned}
\frac{\partial \hat{Y}(\lambda, \tau, 0)}{\partial \lambda} &= \frac{\partial}{\partial \lambda}\Big(f_a(b^*)\, f_e(m^*)\, \tau \Big) \\
&= \frac{\partial}{\partial \lambda}\bigg(\lambda \left(1 - b^*\right)(1-\lambda)\, m^*\, \tau \bigg) \\
&= \underbrace{\tau\,(1-b^*)\left[m^*(1-2\lambda) + (1-\lambda)\,\lambda\, \frac{\partial m^*}{\partial \lambda} \right]}_{:=\Delta_a(\lambda)} - \underbrace{\tau\,(1-\lambda)\,\lambda\, m^*\, \frac{\partial b^*}{\partial \lambda}}_{:=\Delta_b(\lambda)}
\end{aligned} \tag{4}$$

Let $\Delta(\lambda) \equiv \Delta_a(\lambda) + \Delta_b(\lambda)$ and $\varepsilon \approx 0$. Employing (1) and (2), observe that

$$\begin{cases}
\lim\limits_{\lambda \to \varepsilon} \Delta(\lambda) \approx \tau(1-\varepsilon)\varepsilon(1-2\varepsilon)(1+\tau(1-\varepsilon)) \geq 0 \\
\lim\limits_{\lambda \to 1-\varepsilon} \Delta(\lambda) \approx -\tau\varepsilon\Big(\tau\varepsilon(1-\varepsilon)^2 + (1-\tau(1-\varepsilon))(1 - 2\,\varepsilon + (1-\varepsilon)^2 \tau(1-\tau)))\Big) \leq 0
\end{cases}$$

With the above results, we can apply the Intermediate Value Theorem: there must exist some $\lambda^{\ddagger}(\tau, 0) \in (0,1)$ such that if $\lambda \leq \lambda^{\ddagger}(\tau, 0) \in (0,1)$, then $\partial \hat{Y}(\lambda, \tau, 0)/\partial \lambda > 0$; otherwise $\big(\lambda > \lambda^{\ddagger}(\tau, 0)\big)$, then $\partial \hat{Y}(\lambda, \tau, 0)/\partial \lambda < 0$. Finally, suppose now that the measurement constraints are negligible ($\gamma \to 1$). Then, we examine

$$\begin{aligned}
\frac{\partial \hat{Y}(\lambda, \tau, 1)}{\partial \lambda} &= \frac{\partial}{\partial \lambda}\Big(f_a\,(b^*)\ f_e(m^*)\, \tau \Big) + \frac{\partial}{\partial \lambda}\,\Big(\big(1 - f_a(b^*)\big)\, \tau \Big) \\
&= \underbrace{\frac{\partial}{\partial \lambda}\Big(f_a\,(b^*)\ f_e(m^*)\, \tau \Big)}_{:=\Delta(\lambda)} + \underbrace{\tau\left(-1 + b^* + \lambda\, \frac{\partial b^*}{\partial \lambda} \right)}_{:=\Delta_c(\lambda)}
\end{aligned} \tag{5}$$

Proceeding similarly as before, observe that (iii) $\lim\limits_{\lambda \to \varepsilon} \Delta_c(\lambda) = -\tau(1 - \varepsilon\,(1+\tau)) < 0$

and (iv) $\lim_{\lambda \to 1-\varepsilon} \Delta_c(\lambda) = \tau(-1 + 2\,\tau\,(1-\varepsilon))$ which is positive if and only if $\tau > 1/2$. Let $\Delta = \Delta(\lambda) + \Delta_c(\lambda)$Putting together these results with those above, we have

$$\begin{cases} \lim_{\lambda \to 1-\varepsilon} \Delta \approx -\tau - \tau(3+4\tau)\varepsilon^2 - 2\tau^2\varepsilon^4 + 2\varepsilon\tau(1+\tau) + \tau\varepsilon^3(2+5\tau) \leq 0 \\ \\ \lim_{\lambda \to 1-\varepsilon} \Delta \approx -\tau(1-\varepsilon)\big(1 - 2\tau + \varepsilon(2 + 2\tau\epsilon - (2-\varepsilon)(1-\varepsilon)\tau^2 + (1-\varepsilon)\tau^3)\big) \end{cases}$$

where the last approximation above is negative if and only if $\tau < 1/2$ and it is positive otherwise. Intuitively, when we move from degenerately high measurement constraints ($\gamma \to 0$) to the case when these constraints are negligible ($\gamma \to 1$), the overall direction of the expected estimated evasion turns almost strictly decreasing along institutional quality. Using the similar reasoning from the Intermediate Value Theorem, there must then exist a critical $\gamma^{\dagger}(\lambda,\tau) \in (0,1)$ such that for any $\gamma \leq \gamma^{\dagger}(\lambda,\tau)$, we can guarantee that the expected estimated evasion has an inverted-U relationship with the quality of institutions for any $\tau \in (0,1)$. ■

1.3 Extensions to the model

1.3.1 Alternative timing of events

This extension has one objective: to show that our main results hold when we allow the tax evader to invest in muscles only after he learns that he is going to be audited. In order to achieve that objective, we assume that everything in the model remains as before, with the exception of the timing of events, which is now as follows: **(1)** The tax evader chooses how much to invest in brains; **(2)** Nature determines whether or not the tax evader will be audited. If an audit does not start against him, then the citizen goes unpunished, payoffs are realized and the game ends. If an audit starts, then the evader invests in muscles and the game moves to the next stage; and **(3)** The investigator exerts effort to find hard evidence against the tax evader: if hard evidence is found, then the citizen is indicted; otherwise, the citizen goes unpunished. Payoffs are realized and the game ends.

Proceeding backwardly, we start with the investigator's optimal effort. Notice that, from her viewpoint, nothing changes from the baseline model: her behaviour will depend on the muscles investment by the evader. Thus, the results from Lemma 1 continue to hold in this modified setting. We now turn to the evader's choice of muscles, in anticipation of the investigator's equilibrium effort, $e^*(\lambda, m) = 1 - (1-\lambda)\, m$. The expected utility that the evader maximizes is equal to

$$\mathbb{E}\big[u_E | a = 1, e^*(\lambda, m)\big] = \Pr\big(\sigma = 1 | e^*(\lambda, m)\big)\,(1-\tau) + \Pr\big(\sigma = 0 | e^*(\lambda, m)\big) - \frac{m^2}{2} \quad (6)$$

$$= 1 - \tau\big(1 - (1-\lambda)\, m\big) - \frac{m^2}{2} \quad (7)$$

It is straightforward to see that the solution to the optimal investment in muscles, which results from taking the first-order condition (i.e. $\partial\mathbb{E}[u_E|a = 1, e^*(\lambda, m)]/\partial m = 0$), is equal to $m^*(\lambda, \tau) = \tau\,(1-\lambda)$ and, thereby, $e^*(\lambda, \tau) = 1 - \tau\,(1-\lambda)^2$. Inputting these equilibrium results into (6), the evader's expected utility after the history in which he is audited equals to $\mathbb{E}\big[u_E | a = 1, e^*(\lambda, m^*)\big] = (1-\tau) + \big((1-\lambda)\,\tau\big)^2/2 := V^a(\lambda, \tau)$. In anticipation of this sub-game, the evader makes her choice of brains via maximizing the following expected utility

$$\mathbb{E}[u_E \,|\, b] = \Pr(a = 1 \,|\, b)\, V^a(\lambda, \tau) + \Pr(a = 0 \,|\, b) - \frac{b^2}{2}$$

$$= \lambda\,(1 - b)\, V^a(\lambda, \tau\,) + \big(1 - \lambda\,(1 - b)\big) - \frac{b^2}{2}$$

Similarly as before, we recover the optimal investment by taking the first-order condition (i.e. $\partial\mathbb{E}[u_E \,|\, b]/\partial b = 0$), which yields $b^*(\lambda, \tau) = \lambda\ (1 - V^a(\lambda, \tau))$. With these equilibrium objects, we can re-write the expected estimate of tax evasion as follows:

$$\tilde{\mathbb{E}}[\text{Evasion}] = \tau\left[\Pr(a = 1|b^*)\ \Pr(\sigma = 0|e^*(m^*)) + \underbrace{\gamma\,\big(1 - \Pr(a = 1 \,|\, b^*)\big)}_{\text{Measurement constraints}}\right]$$

$$= \tau\left[\lambda\ (1 - b^*)\,(1 - e^*(m^*)) + \gamma\ (1 - \lambda\ (1 - b^*))\right] := \tilde{\beta}_E(\lambda, \tau, \gamma)$$

Suppose, as in the main text, that the measurement constraints are degenerately high ($\gamma = 0$). If so, notice that

$$\frac{\partial\tilde{\beta}_E(\lambda, \tau, 0)}{\partial\lambda} = (1 - \lambda)\,\tau^2\,\overbrace{\left[1 - \lambda\,\Big(3 + \tau(2(1 - 2\lambda) + \tau\,(1 - \lambda)^2)(3\lambda - 1)\Big)\right]}^{\Lambda(\lambda,\tau)}$$

For the first order conditions, we have to find the values of λ such that the equation above is equal to zero. A trivial solution is when $\lambda \to 1$. We can then focus on the other component, which we have denoted as $\Lambda(\lambda, \tau)$. It is easy to check that $\lim_{\lambda\to 0} \Lambda(\lambda, \tau) = -1 < 0$ and $\lim_{\lambda\to 1} \Lambda(\lambda, \tau) = 2\,(1 - \tau) > 0$. By the Intermediate Value Theorem, there must exists some $\tilde{\lambda} \in (0, 1)$ such that if $\lambda \leq \tilde{\lambda}$, then $\partial\tilde{\beta}_E(\lambda, \tau, 0)/\partial\lambda > 0$; otherwise ($\lambda > \tilde{\lambda}$), then $\partial\tilde{\beta}_E(\lambda, \tau, 0)/\partial\lambda < 0$. This completes the proof that our main results continue to hold even when we allow the tax evader to invest in muscles only after he learns that he is going to be audited.

1.3.2 The muscle-effort mechanism

As we mentioned in the main text, the innovation of this paper is that we allow a tax evader to utilize extra-legal means to affect the generation of hard evidence by a tax investigator. The objective of this extension is to formally highlight why our main results could not be obtained in a world in which the evader can only invest in brains.

Remark 2. *Suppose that $m = 0$. Then, for any $\lambda \in (0, 1)$, $\tau \in (0, 1)$ and $\gamma \in [0, 1]$, the following inequality holds: $\partial^2 \hat{Y}(\lambda, \tau, \gamma)/\partial \lambda^2 > 0$.*

In the absence of distortions to the effort exerted by the investigator, the above remark tells us that the expected estimate of tax evasion would be strictly decreasing along the quality of institutions. To see why this is the case, notice first that $e^*(\lambda, 0) = 1$ and that $b^*(\lambda, \tau) = \lambda\,\tau$. These two facts can be easily obtained by inspecting the proofs of Lemma 1 and Lemma 2. Subsequently, by letting $\tilde{\mathbb{E}}[\text{Evasion}] = \hat{Y}_E(\lambda, \tau, \gamma)$, we can then derive

$$\begin{aligned}
\frac{\partial^2\, \tilde{\beta}_E(\lambda, \tau, \gamma)}{\partial\, \lambda^2} &= \frac{\partial^2}{\partial\, \lambda^2}\left(\tau\left[\Pr(a = 1|b^*)\ \Pr(\sigma = 0|e^*(0)) +\ \gamma\left(1 - \Pr(a = 1\,|\,b^*)\right)\right]\right) \\
&= \frac{\partial^2}{\partial\, \lambda^2}\left(\tau\,\gamma\left(1 - \lambda\ (1 - \lambda\,\tau)\right)\right) \\
&= 2\,\gamma\,\tau^2
\end{aligned}$$

and since every term above is weakly positive, the second derivative tells us that the expected estimate of tax evasion must be convex along $\lambda \in (0, 1)$. This completes our formal statement and its proof.

1.3.3 Allowing for parameter correlation

The objective of this subsection is to show that our core results continue to hold when the penalty tax rate is not flat but, instead, positively correlated with the strength of institutions. This may happen if, on average, sanctions tend to be more lenient in developing countries than in developed ones; for instance, due to state capture by the very rich. To that end, we allow for a linear correlation: define $\tau(\lambda) = \lambda/n$, with $n > 1$ in order to guarantee that $0 < \tau(\lambda) < 1$. As in the main text, we let $\gamma = 0$ in order to bring to the front the source of the inverted U-shape. Then,

$$\frac{\partial \hat{Y}(\lambda, \tau(\lambda), 0)}{\partial \lambda} = \frac{\partial}{\partial \lambda}\left(\frac{(1-\lambda)^2 \lambda^4 (n-\lambda^2)^2}{(n^2 - (1-\lambda)^2 \lambda^4)^2}\right)$$

$$= \frac{C \overbrace{\left[n^3 (2-3\lambda) + (1-\lambda)^2 \lambda^7 + n (1-\lambda)^2 \lambda^4 (2-3\lambda) + n^2 \lambda^2 (5\lambda - 4)\right]}^{:=\tilde{\Lambda}(\lambda,n)}}{(n^2 - (1-\lambda)^2 \lambda^4)^3}$$

with $C = 2(1-\lambda)\lambda^3 (n-\lambda^2)$ is a term grouped to exclude trivial zero-solutions (when $\lambda \to 1$) and, thereby, to focus on the term inside the square brackets. By inspection, it is possible to verify that $\lim_{\lambda \to 0} \tilde{\Lambda}(\lambda, n) = 2n^3 > 0$ and that $\lim_{\lambda \to 1} \tilde{\Lambda}(\lambda, n) = n^2 - n^3 < 0$. By the Intermediate Value Theorem, there must exist some $\lambda_n^{\ddagger} \in (0,1)$ such that if $\lambda \leq \lambda_n^{\ddagger}$, then $\partial \hat{Y}/\partial \lambda > 0$; otherwise, $\partial \hat{Y}/\partial \lambda < 0$. And all the core reasoning in the proof of Proposition 1 carries on smoothly even with parameter correlation.

2 The Empirics.

The dataset and .do file are available both at request and at (i) the dataset: `https://www.dropbox.com/s/63fp9wk1pm2c27h/Evasion%202023%20submission.dta?dl=0` and (ii) the .do file: `https://www.dropbox.com/s/h8v3o9qyqyxgol4/Do%20polished%202023.do?dl=0`.

2.1 Variable Description

In order to calculate the estimates of *Tax Evasion*, the European Commission (2019) employs a method first developed by Zucman (2013), which hinges on the global discrepancy between international portfolio assets and liabilities. The particulars of this method, based on macroeconomic statistics, make it very unlikely that a measurement error would be heterogeneous across countries. The EU document also contains alternative, though less comprehensive, estimates (EU Commission 2019, Table 1). For the list of countries included in the analysis, see Appendix Section 2.3.1. The rational for the choice of these estimates as dependent variable is to maximize the number of country-year observations.

Our preference towards the *Rule of Law* index in World Bank's *Worldwide Governance Indicators* with respect to alternative statistics by the World Justice Project and the Heritage Foundation is due to data availability and methodological reasons. On the former, data from the World Justice Project is available only since 2012 and it is comparable across years since 2015. On the latter, the Heritage Foundation's index heavily relies on assessments by country experts, which can suffer from ideological biases.

The variable *Top Tax Rate*, constructed mainly from the *Comparative Income Taxation*

Database (Genovese, Scheve and Stasavage 2016), measures the highest marginal tax rate for individuals. This could capture incentives for the wealthiest citizens to evade more as the tax rate increase (see Torgler 2005). We would also like to take into account the empirical evidence about the strong association between wealth inequality and tax evasion (Alstadsaeter, Johannesen and Zucman 2019). Unfortunately, reliable estimates of wealth inequality exist only for a handful of countries. To partially account for this, we include the variable *Top 1% Income*, which comes from the *World Income Inequality Database* and measures the share of the top one percent of the income distribution. In Table B1, we also conduct the empirical analysis using estimates of total private net wealth from the *World Income Inequality Database*. We do not include it in our main analysis for two reasons. First, because it is only available for a smaller number of countries relative to the variable *Top 1% Income*. And, second, it is very highly correlated with GDP.

Since evasion incentives arise from uncertainty concerns regarding regime changes from popular uprisings, we include the variable *Stability* which is an index found in the The World Bank's *Worldwide Governance Indicators*, and it measures the "perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism." Controlling for this variable would further avoid to confound the effect of our measure of rule of law with one specifically related to threats to the political stability of the country, since these threats do not play a clear role in the brains-muscles mechanisms highlighted in our theoretical model. An additional institutional variable which can affect incentives to evade is the freedom of the press. We do not include it in our main analysis because of the smaller sample availability. Nonetheless, Table B1 shows results with a measure of

Press Freedom, which comes from the *World Press Freedom Index* compiled by Reporters Without Borders. The inclusion of this variable does not alter the main findings.

Finally, we would also want to account for the effects that the economic characteristics of a country may have on our dependent variable. As shown by some scholars (Crane and Nourzad 1986; Caballé and Panadés 2004), there is a positive association between the inflation rate and aggregate evasion. Our variable *Inflation*, which comes from the OECD database, accounts for this. Using data from The World Bank's *Worldwide Development Indicators*, we also include Gross Domestic Product (GDP).

2.2 Robustness Checks

The main specification exploits within country variation in the rule of law. This choice might raise some concerns related to a potential effect capturing insufficient variation in the main variables. We first address these concerns graphically; Figure B1 and B2 show that the variation within countries for tax evasion and rule of law index appears not negligible. More importantly, we perform the test proposed in Aronow and Samii (2015) to understand the heterogeneity of the results in a traditional "average-effect" OLS model. We find that the effective sample for which the effect of rule of law on tax evasion is sizable, and it is not very different from the nominal sample of 37 countries. More precisely, only 11 countries have small or trivial weights in the contribution to the average effect (with mean weight per country equal to 0.027 and median weight 0.016). Interestingly, the top 6 contributing countries, with values more than twice the mean weight, are Hungary, Brazil, India, Greece, Croatia and Malta, countries with values of rule of lax in the middle of the sample distribution. As a minor point, the inclusion of time and country fixed effects does not change much neither the significance nor the magnitude of the coefficients (see Table B2). We interpret this as a further indication that the within country variation is sufficient to deliver relevant estimates.

In the main text, we found that the theoretical prediction of an inverted-U shape relationship between the amount of evasion in a country and its quality of institutions is supported by the data. Now, we show that the results hold even a deeper scrutiny. First, it can be difficult to substantively interpret what a smooth continuous increase (or decrease) of our rule of law measure exactly entails, as this index is a standardized latent measure based on a model of thirty-two variables. As such, a within country unit change could be caused by a number of different factors that may not sufficiently capture our theorized mechanisms. We address this concern by breaking up this continuous measure into deciles, as an across-decile movement is likely to require an overall change in a large number of the variables that comprise this index.* As illustrated in Figure B3, when replicating the full model with this new approach, the theorized inverted-U shape persists.

We acknowledge that evasion methods could potentially spillover across countries. In Table B1, we show that the coefficients are even more precisely defined if we substitute regional fixed effects for country fixed effects in our preferred regression. Finally, we make use of alternative estimates of tax evasion by the International Monetary Fund (IMF) in order to increase the number of countries. This data is available only for 2016. The corresponding regression in Table B4 confirms the U-shaped relationship between

*More precisely, we calculate the deciles according to the in-sample distribution of the index of rule of law, and we carry out the same exercise for our *Stability* control variable. The corresponding regression table can be found in Table B3.

amount of evasion and rule of law index. For year 2016, the World Justice Network provides estimates of rule of law for almost two hundred countries. We then use them as an alternative main independent variable, instead of the World Bank one, and shows that the results are unaffected. When we include all controls, we do not reach conventional levels of statistical significance, probably due to the cross-sectional nature of the data and the biased sample, given the above-mentioned problem of data availability for countries with poor and medium level of quality of institutions.

This analysis has the following limitations. First, the estimates of tax evasion, despite being the best possible for our purpose, do not cover the universe of evasion forms. For example, as explicitly written in the EU document, these estimates do not include domestic evasion, nor evasion by corporation only. Wealthy citizens may be able to evade domestically in some countries more than others and even if country fixed effects should account for this possibility, within country variation in the capacity of evading domestically, or complex substitution mechanisms between domestic and offshore evasion are not addressed in the empirical analysis. Second, a larger sample of countries could clearly provide a stronger test of the model. We hope that in the future disclosure agreements and new estimation techniques will permit to study the political economy of offshore tax evasion with better data. In this sense, the construction of a measure of incidence of violence towards tax enforcement officials, or at least a reasonable proxy for it, would surely improve the empirical analysis of muscles. Finally, the assumption of the model of exogenous quality of institutions merits a further note. Potentially, in countries with low quality of institutions a powerful wealthy citizen may decide to change institutions instead of evading his taxes with the current institutions. This strategy seems instead very unreasonable in countries with high quality of institutions. We leave this insight for future research.

2.3 Additional Tables and Figures

Figure B1: Tax Evasion variable for all countries in sample

Figure B2: Rule of Law index variable for all countries in sample

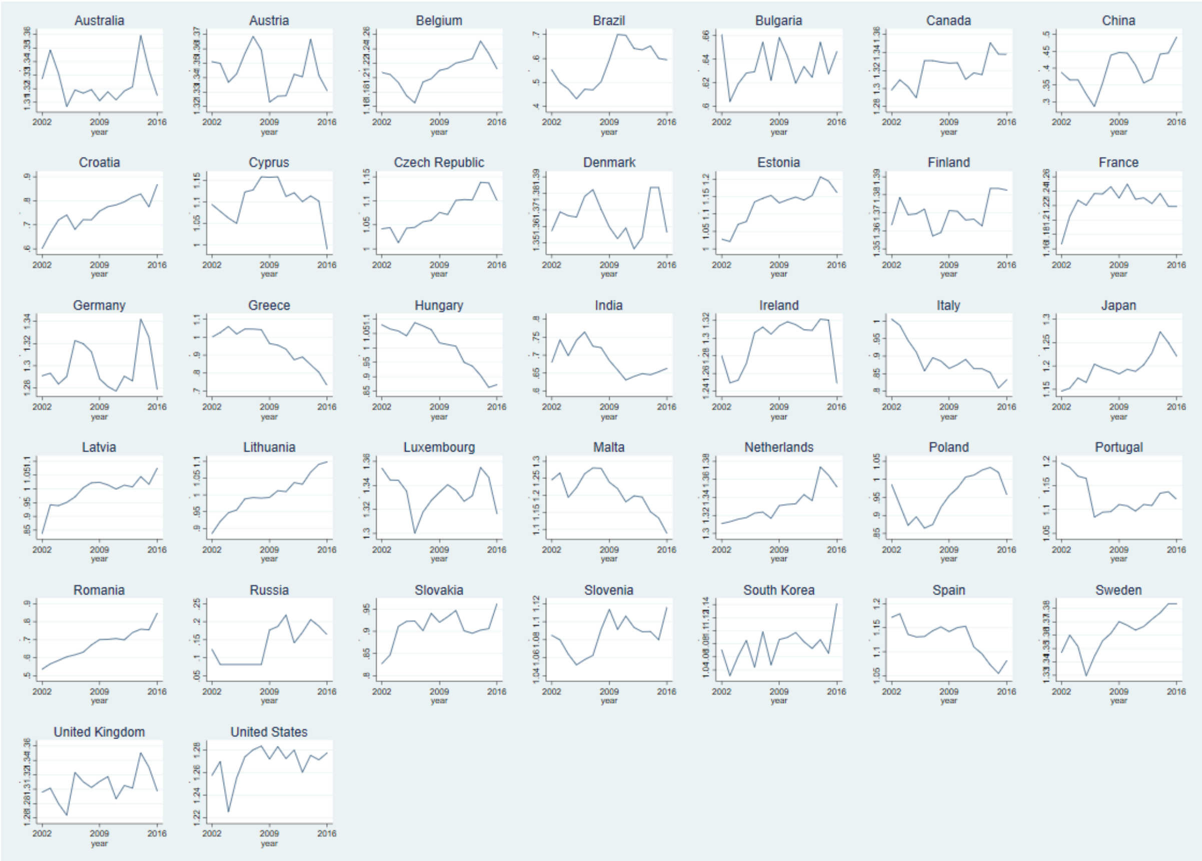

Figure B3: Deciles of Rule of Law on Tax Evasion

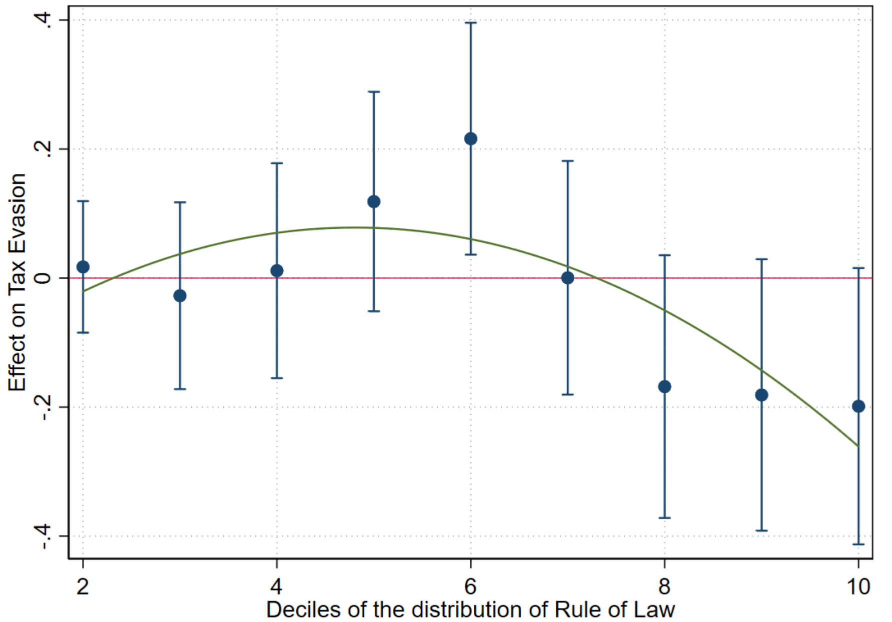

Table B1: Additional Controls and Regional Fixed Effects

	(1)	(2)	(3)	(Regions)
Rule of Law	5.89***	8.65***	7.44***	2.47***
	(1.97)	(0.98)	(2.24)	(0.91)
Rule of Law^2	-2.89***	-3.46***	-2.99**	-1.43**
	(1.02)	(0.68)	(1.17)	(0.56)
Press Freedom	-0.11		-0.26	
	(0.08)		(0.17)	
Private Wealth		0.01	0.01	
		(0.03)	(0.02)	
Controls			X	X
Country Fixed Effects	X	X	X	
Region Fixed Effects				X
Year Fixed Effects	X	X	X	X
Observations	409	235	197	555
R^2 (within)	0.51	0.52	0.61	0.55

Note. Given the data available, we use the following regions: Northern Europe, Southern Europe, Western Europe, Eastern Europe, America, Asia and a residual group. Standard errors clustered at the country level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B2: Main Regression with and without Fixed Effects

	(FEs)	(No FEs)	(FEs)	(No FEs)
Rule of Law	6.08***	5.72***	3.52**	2.63**
	(1.90)	(1.82)	(1.77)	(1.26)
Rule of Law^2	-3.00***	-2.47**	-2.01**	-1.34**
	(0.96)	(1.06)	(0.83)	(0.66)
Controls			X	X
Country Fixed Effects	X		X	
Year Fixed Effects	X		X	
Observations	555	555	555	555
R^2 (within)	0.48	0.09	0.56	0.46

Standard errors clustered at the country level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B3: Regression results with deciles

	(1)
Deciles Rule of Law 2.	0.02
Deciles Rule of Law 3.	-0.03
Deciles Rule of Law 4.	0.01
Deciles Rule of Law 5.	0.12
Deciles Rule of Law 6.	0.22
Deciles Rule of Law 7.	0.00
Deciles Rule of Law 8.	-0.17
Deciles Rule of Law 9.	-0.18
Deciles Rule of Law 10.	-0.20
Deciles Stability 2.	0.31*
Deciles Stability 3.	0.27
Deciles Stability 4.	0.17
Deciles Stability 5.	0.21
Deciles Stability 6.	0.21
Deciles Stability 7.	0.18
Deciles Stability 8.	0.19
Deciles Stability 9.	0.24
Deciles Stability 10.	0.32
GDP	-0.30
GDP^2	0.05
Top Tax Rate	-0.62
Inflation	-0.16
Top 1% Income	-1.28
Observations	433

Standard errors clustered at the country level are omitted from the table.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B4: Alternative Dependent and Main Independent Variables in 2016

	(IMF-WB)	(IMF-WB)	(IMF-WJP)	(IMF-WJP)
Rule of Law	3.53***	1.25	34.98***	16.08
	(1.00)	(1.57)	(11.58)	(10.17)
Rule of Law^2	-1.44***	-0.07	-37.25***	-15.46
	(0.55)	(0.72)	(12.18)	(11.17)
Controls		X		X
Observations	162	123	99	81
R^2	0.05	0.15	0.05	0.22

Note. IMF stands for International Monetary Fund, WB for World Bank and WJP for World Justice Project. Data comes from IMF estimates of the amount of individual tax evasion by country in 2016. Robust standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

2.3.1 List of countries in the sample

1. Australia
2. Austria
3. Belgium
4. Brazil
5. Bulgaria
6. Canada
7. China
8. Croatia
9. Cyprus
10. Czech Republic
11. Denmark
12. Estonia
13. Finland
14. France
15. Germany
16. Greece
17. Hungary
18. India
19. Ireland
20. Italy
21. Japan
22. Latvia
23. Lithuania
24. Luxembourg

25. Malta
26. Netherlands
27. Poland
28. Portugal
29. Romania
30. Russia
31. Slovakia
32. Slovenia
33. South Korea
34. Spain
35. Sweden
36. United Kingdom
37. United States

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