Title: Equality Norms, Incentives, and Value Claiming in Scientific Licensing Contracts

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Keywords: Equality Norms, Incentives, Licensing Contracts

Abstract: Equal sharing of rewards is common everywhere but has rarely been studied in high-stakes decision making. Two samples of sharing contracts for university inventions are used to measure the extent of equal sharing and the factors associated with unequal sharing. The data show that equal sharing is very common; however, when inventions are likely to be valuable, lead inventors shift toward retaining a larger-than-equal share. However, this shift toward retaining a larger share is strongly dampened in royalty contracts that require post-invention effort. This dampened effect is consistent with the hypothesis that lead inventors want to incentivize ongoing co-inventor effort, possibly including concern that co-inventors will change their post-invention effort if they are either disappointed or surprised to get an equal share (reciprocity). These results show that the equal reward sharing observed in a large range of laboratory experiments in psychology and economics with smaller stakes is also evident in contracts for high value inventions.

Keywords: Equality Norms, Incentives, Licensing Contracts

Significance statement: Contracts governing the sharing of earnings from university inventions show evidence of a strong equal-sharing norm; the norm is relaxed only when inventions are sufficiently valuable and do not require a post-invention effort from inventors.

Introduction

Frederick Banting and John Macleod shared the Nobel Prize in 1923 for the discovery of insulin (1). Banting was furious that his young assistant Charles Best was not included and pledged to share the prize money equally with Best. (Only then did Macleod also pledge to share his money equally with *his* assistant.) This remarkable episode illustrates many facets of human nature: certain people (Banting) will sacrifice personal gain to enforce equality; others (Macleod) follow norms to save face; but, at such high stakes, self-interest is more typical (few Nobel winners share with their assistants as Banting did).

Equal sharing of resources is common in many domains in human societies, from sharing money in laboratory experiments and field experiments in developing societies (2,4-6), to the ubiquitous 50-50 split between artists and the gallery owners who display and sell their art (3). Equality is common even when unequal sharing could potentially better motivate people. To explore the strength of the influences of equality and self-interest in high-stakes reward sharing, we use data from academic licensing contracts.

Data

The data are from two large university technology transfer offices (TTOs). Each office earned over U.S. $40 million in licensing revenue in 2014. The two samples include approximately 1000 and 400 co-inventions with two or more inventors, primarily in bio-medical research, spanning 18 and 20 years, respectively. The invention revenues involved are rather large, about $500k in sample 1 and $50k in sample 2.[1]

[1] There are several reasons why average income in the sample 2 is smaller than average income in sample 1: i) in sample 1 we observe an invention only if an invention earns non-zero income whereas in sample 2 we observe all licenses, regardless whether the inventions earn any licensing income or not. ii) The observation window for licensing revenue is longer in sample 1. Despite these differences it is remarkable that the unequal sharing proportion in both the samples

The sample 1 data were collected from the Office of Technology Licensing (OTL), founded in 1970, at one of the leading private research universities in the world. In the 2013-2014 fiscal year alone, this particular OTL generated approximately $109 million in licensing income. A unit of analysis for this sample is an invention with two or more inventors that received positive revenues from 1996 to 2014. This sampling frame results in 1,038 inventions. The inventions in the sample were disclosed to the OTL between 1976 and 2013. The mean revenue earned by an invention in the sample window is $203 thousand. Licensing associates handle all inventions disclosed to the OTL by the university's faculty, employees, and students. A licensing associate typically has a graduate degree specializing in the technology domain in which most of their licensing activities are conducted. Because licensing associates are domain specialists, all inventions from a scientific department are typically assigned to the same associate, and one licensing associate can be in charge of multiple related departments. Inventors have no choice in which licensing associate handles their invention. Once an invention is disclosed to the OTL, the licensing associate in charge then decides if an invention has sufficient potential for commercialization. Licensing associates are responsible for their portfolio of inventions from the beginning through to commercialization; in deciding to move the technology forward, the licensing associate takes on the responsibility of facilitating the entire commercialization process.

The sample 2 data were collected from a Technology Transfer Office (TTO), founded in 1926. It is one of the largest public research universities in the U.S. In 2014 the TTO had $2 billion in endowment and generated approximately $50 million in licensing income. The

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are identical and shift similarly with the increase income, suggesting a consistent behavioral pattern.

procedure for licensing at the TTO in sample 2 is slightly different than that for the OTL in sample 1. The protection of intellectual property rights and the licensing activity at the TTO are separated. All inventions disclosed to the TTO are evaluated at monthly meetings attended by intellectual property managers, licensing managers, and other senior managers at the TTO for economic potential. Once an invention has been judged, by consensus, to possess economic potential, it is then submitted for intellectual property protection and licensing. A unit of analysis for this sample is a licensing contract that consists of one or more inventions licensed between 1990 and 2004 with two or more inventors. This sampling frame results in 415 licensing contracts. The inventions in the sample were disclosed to the TTO between 1970 and 2004. The mean revenue earned by an invention in the sample window is $43.9 thousand. Among 415 contracts in sample 2, 137 contracts involve multiple inventions in one license, so-called "bundled inventions", and the remaining 278 contracts are single invention-based.

In both samples we define equal sharing as when revenue from a single-invention is shared equally by co-inventors, or when different inventions in a bundle are equally weighted and shared. When we restrict the analysis to licenses with single inventions in sample 2, the results are consistent.

Co-inventors are free to choose any division of income among themselves. In rare cases of disagreement, the default is equal sharing. A legal advisor, who worked at the institution providing sample 2's data, for 28 years and then was associated with the institution for 25 years as an emeritus lawyer reported that he could not recall one instance of a dispute that required the default distribution to be employed. Discussions with scientists and licensing managers suggest that the sharing percentages are typically chosen by a lead inventor and subject to minimal negotiation among co-inventors. The best evidence for this is that almost invariably unequal contracts in both samples give higher shares to the lead inventor. In addition, there is strong evidence that the default is not the determinant in equal sharing in sample 1, where a slim majority of lead inventors have an unequal share in at least one of her or his inventions.

Results

There are four key results. First, the frequency of equal sharing, 80%, is high in both samples (Figures 1AB). However, the average total income for equal sharing contracts is much lower than for unequal sharing contracts (Figures 1CD). In sample 1, the equal and unequal sharing income averages (in thousands here and throughout) are \$63.5k and \$771k ($t = 6.23$, $p = 10^{-4}$, two-tailed using ln(income) throughout). In sample 2, the corresponding averages are \$23k and \$126k ($t = 4.26$, $p = 10^{-4}$).

The association between income and unequal sharing can be measured by a logistic regression of unequal sharing choice (=1) on income, shown in Figures 1EF . This regression puts a price tag on how much income it takes to entice an inventor to move away from equal sharing. The lead scientists need a large financial incentive to shift to unequal shares. For example, in sample 1 when income increases from the 25th to the 75th percentile (from \$3k to \$25.5k) the probability of adopting an unequal contract increases from 0.15 to 0.23. Similarly, in sample 2, when income increases between the same percentiles, \$51 to \$25.3k, the probability of adopting an unequal contract increases from 0.12 to 0.27.

Second, most inventors (73% of total inventors in sample 1 and 92% of total inventors in sample 2) use only one type of sharing-- always equal, or always unequal. However, a group of lead inventors switch between equal and unequal sharing (Figures 2AB). In this subsample of share switchers, there are strong associations between unequal sharing and income (Figures 2CD). In sample 1, share shifters earn, on average, \$35,871 in equal contracts and \$1,576,874 in unequal contracts; for sample 2 the corresponding earnings are $22,477 and $247,250 for equal and unequal contracts, respectively ($t = 5.53$, $p = 10^{-4}$ in sample 1; $t = 1.81$, $p = 0.075$ in sample 2). Furthermore, it is worth noting in Figure 2C that 218 individual inventors claim an unequal share at some point, whereas 215 always choose equal shares. This data has strong implications for the argument that the existence of a default is the prime motivation for equal sharing. With the majority of individuals claiming unequal shares at least some of the time it is clear that these inventors have minimal difficulty claiming more value when they see fit to do so. While a slight majority of inventors deviate from equal sharing some of the time, as stated above, the vast majority of inventions (80%) are shared equally. This evidence suggests lead inventors are choosing equal shares the vast majority of the time rather than being forced by the default. In the supplementary analysis of share switchers, we find that there is a tendency for inventors to shift toward equal sharing as they gain repeated invention experience (see supplementary analysis Table S3). Therefore, the notion that as inventors learn from experience the inventors shift to unequal shares is not supported.

Third, there are two possible explanations for the shift to unequal sharing. The "value-claiming" explanation is that lead inventors have a good idea which inventions will be highly successful and simply claim a higher, unequal share of income from those inventions. An alternative "motivation" explanation originates from economic theory (7): According to this account, lead inventors give themselves unequal shares so that *they*, not their collaborators,will put more effort into preparing the patent and helping licensees of some inventions. Unequal shares almost always increase the amount to the lead inventor, which suggests the allocation of shares is more like a decision made by the lead inventor rather than a negotiation.

The two explanations can be compared because sample 1 includes a 3-point measure of expected income. Regressions show that both expectations and unequal-sharing are associated with income (Table 1), each controlling for the other. Thus, there is evidence for both the value-claiming and motivation explanations.

Fourth, sample 2 contains data on which inventions are governed by either upfront fixed payment or by percentage royalty share contracts. In fixed contracts, there is one upfront payment, and typically no further work needs to be performed by the inventors. In contrast, the percentage royalty contracts are typically signed when additional effort is needed from the inventors, after contract signing, to help licensee firms convert the research into commercial products and services(8). The discovery of penicillin is but one example that illustrates this dynamic. Alexander Fleming's famous conjecture that a particular mould was inhibiting the growth of bacteria was made in 1928. Although the significance of this discovery was immediately understood, attempts to commercialize the insight and actually treat humans failed due to insufficient quantities of the drug being produced. Only in the early 1940s, when the chemical structure was decoded, did commercial production take off.

Royalty share contracts, therefore, implicitly include both a reward for the work previously completed and an incentive to provide future effort to help licensees with commercialization, while a fixed payment contract shares income for work already completed by the inventors. The need for marginal post-contract effort by co-inventors should influence the choice of sharing rule: If the lead inventor shares anticipated royalty income from the invention unequally (keeping a higher share for herself), then the co-inventors have a lower incentive to help with commercialization, compared to equal sharing. To avoid low effort, lead inventors in royalty contracts should therefore be more likely to share equally with co-inventors.

In sample 2, most contracts do have royalties, and royalty contracts are more likely to share equally when compared to fixed contracts (84% vs. 68%, test of difference: chi2(1) = 13.43 $p=10^{-4}$; Figure 3A). Royalty contracts also tend to produce more income than fixed contracts (Figure 3B). However, while the relation between unequal sharing and income is strong for fixed-fee contracts, the same relation is only weakly positive for royalty contracts (Figure 3C). For fixed contracts the probability of a contract having unequal shares when sample income increases from the 25th to the 75th percentile changes from 0.07 to 0.63. On the other hand, for royalty contracts the same percentile change in income changes the probability of unequal shares minimally from 0.13 to 0.18. In terms of economic significance: the probability that a fixed contract will have a 50% probability of shifting to unequal occurs at $14,186 of invention income. By contrast, the probability that a royalty contract will have a 50% probability of shifting to unequal is zero. In fact at the maximum income of invention (approximately $6 million) the probability of a royalty contract being unequal is 22%. This important difference is discussed below.

Discussion

These data add unique evidence to debates in the social sciences over the last two decades regarding human nature. Many experiments show that equal sharing of resources is a common norm when sharing is culturally expected (e.g., when resources are unearned). In these experiments, large deviations from equality are verbally shamed (9) and financially punished (4,5), including by disinterested third-parties (10,11).

An important empirical question is how much the relative concern for equality and selfish reward changes as the quantity of resources grows larger. Certain lab-in-the-field experiments in low-income countries have used relatively substantial stakes (equivalent to months of wages) and typically replicated results on concern for equality (12). The licensing data analyzed here involve much larger absolute sums: an average of $203k and $44k in the two samples. Even so, income from 80% of these inventions is shared equally. Furthermore, there is strong evidence that scientists trade off higher earnings for other intrinsic rewards, such as scientific freedom (13).

Strong equality norms are also observed in other domains, including sharecropping contracts (14), allocation of corporate budgets across divisions (15) and parental bequests to their children (16,17). The common argument that equal sharing in experiments is solely due to small stakes should now be considered dubious, given evidence from these many high-stakes domains and our evidence.

Despite the prevalence of equal sharing, lead inventors do trade off equality and selfish concern for their own income (Figures 1EF). Experimental evidence of prosociality typically shows persistent *individual differences* in how strongly people value their own outcomes compared to income equality, fairness, and reciprocal obligation. The strength of these differences is important; it is necessary for understanding changes in the human life cycle and for practical questions such as whether organizations should select and promote prosocial people or invest in acculturating everyone to be more prosocial. Our inventors do show persistent differences: Most of them *always* share equally or always share unequally.

Many experiments have shown that certain people are "*negatively reciprocal*", i.e., they are willing to incur a cost to punish another party who harmed them or did not benefit them as much as they expected (18,19). Some kinds of field evidence are also consistent with negative reciprocity: there is increased employee theft after pay reductions (20), a decrease in arrests after police unions lose wage arbitration (21), and a decrease in tire safety after a bitter strike at a tire plant (22). However, these field examples usually cannot eliminate alternative explanations. A parallel experimental literature shows evidence of *positive* reciprocity: i.e., people will often choose to benefit people who trusted them (23,24) or to work harder than necessary to repay the “gift” of a high wage (25,26). However, there are no conclusive field data on positive reciprocity.

The invention contract data provide field evidence that is consistent with reciprocity when comparing fixed and royalty-based contracts, but unfortunately, is not conclusive. A lead inventor could be concerned about reciprocity because additional effort by co-inventors is helpful to commercialize an invention (and increase royalty payments) after the contract terms are announced. Negative reciprocity is said to occur if co-inventors expect equal sharing, are disappointed if they get a less-than-equal share, and exert low effort as a result. (Positive reciprocity is the opposite: Co-inventors do not expect to get equal shares and work harder if they do.) However, even co-inventors who are *not* negatively reciprocal are expected to exert lower effort if their royalty contract gives them less-than-equal shares (compared to their effort under equal sharing). The fact that inventors seem to forego unequal shares for royalty contracts, mandating equal shares instead, suggests that they desire to maintain strong incentives for co-inventors to keep working, whether in the absence or presence of negative reciprocity. Negative reciprocity will increase the extent of effort withdrawal from unequal sharing, if equal sharing is expected.

If we had evidence of co-inventor beliefs about what shares they should get, we could investigate negative reciprocity in the form of lower earned revenue when co-inventors get lower shares than they believe they deserve (and positive reciprocity when they are pleasantly surprised to get an equal share). We do not have such data, but experiments which measure reciprocity with control conditions often do show precisely such negative and positive reciprocity.

For either reason, even when expected income is high, equal sharing should be more prevalent in royalty contracts (compared to fixed-payments). Indeed, lead inventors choose equal sharing more often for royalty contracts (Fig 3A) and do not switch to unequal sharing for higher-income inventions in royalty contracts (Figure 3C). The fixed-fee contract acts as a quasi-experimental control condition because reciprocated ongoing effort by co-inventors does not change income when the fee is fixed.

The difference in the income-sensitivity effect for fixed and royalty contracts is large. Consider inventions with income at the lowest and highest quartile boundaries. For fixed contracts, the estimated probability of choosing unequal sharing increases from 7% to 63% between those two income levels. For royalty contracts, the same change is much smaller, from 13% to 18%.

In conclusion, decades of careful observation and experimentation in many social sciences suggest four empirical regularities regarding human nature: people often share equally (27); equality is often sacrificed for very high personal gains; there are persistent individual differences in how inequality-averse and selfish people are (28); and people anticipate reciprocation by others. Ours is the first field study to find solid evidence for the first three of these regularities in high-stakes decision-making, and suggestive evidence of the fourth regularity of reciprocity.

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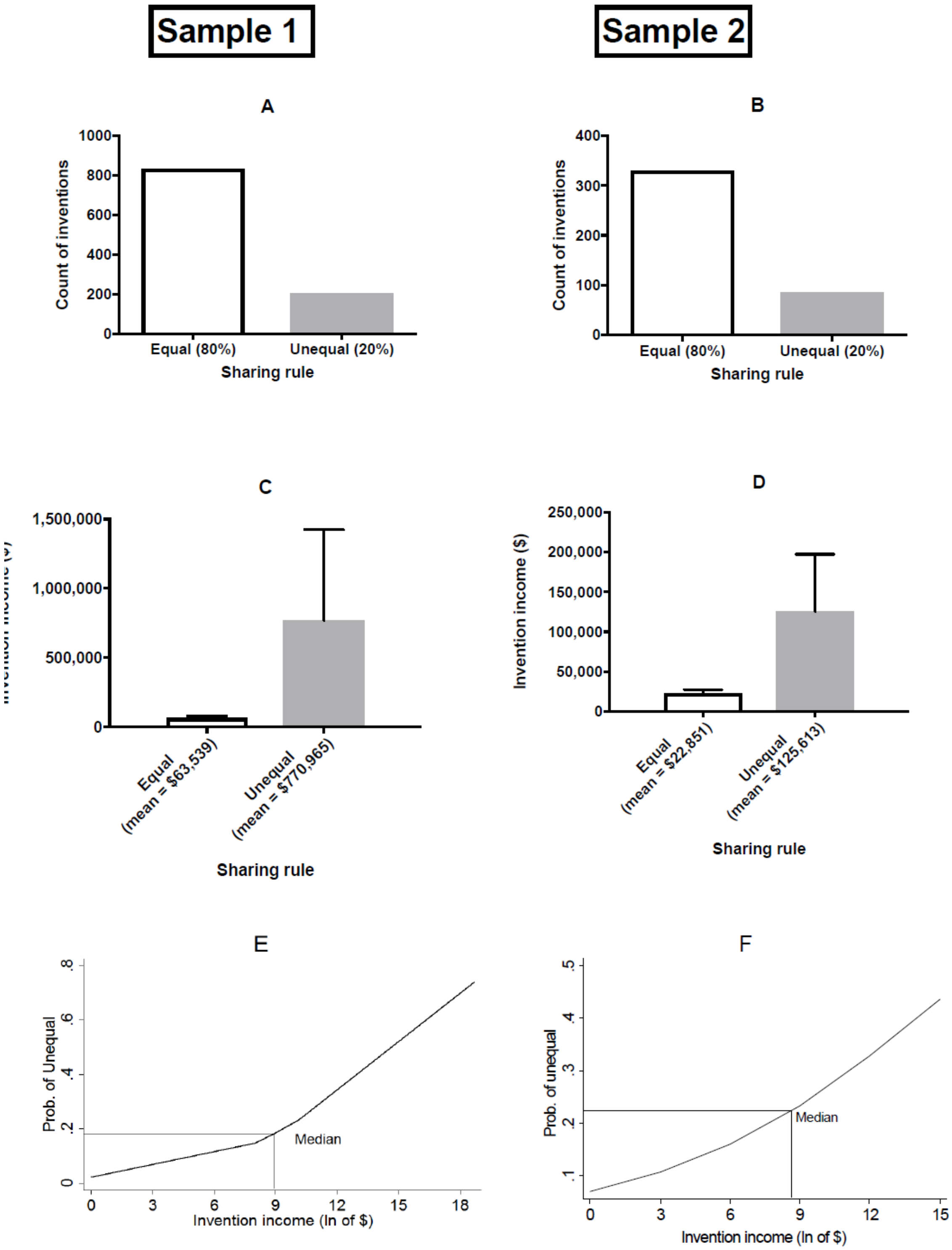

Fig. 1. Frequency and determinants of equal income sharing. (A, B) Total frequencies of contracts with equal and unequal sharing in samples 1 (private university) and 2 (public university). (C, D) The averages of dollar contract values, measured as accumulated income until the end of the sample periods. (E, F) Fitted logistic ("logit") regressions for the relation between

ln(income) and unequal sharing (=1). Unequal sharing is more likely for inventions that produce more income.

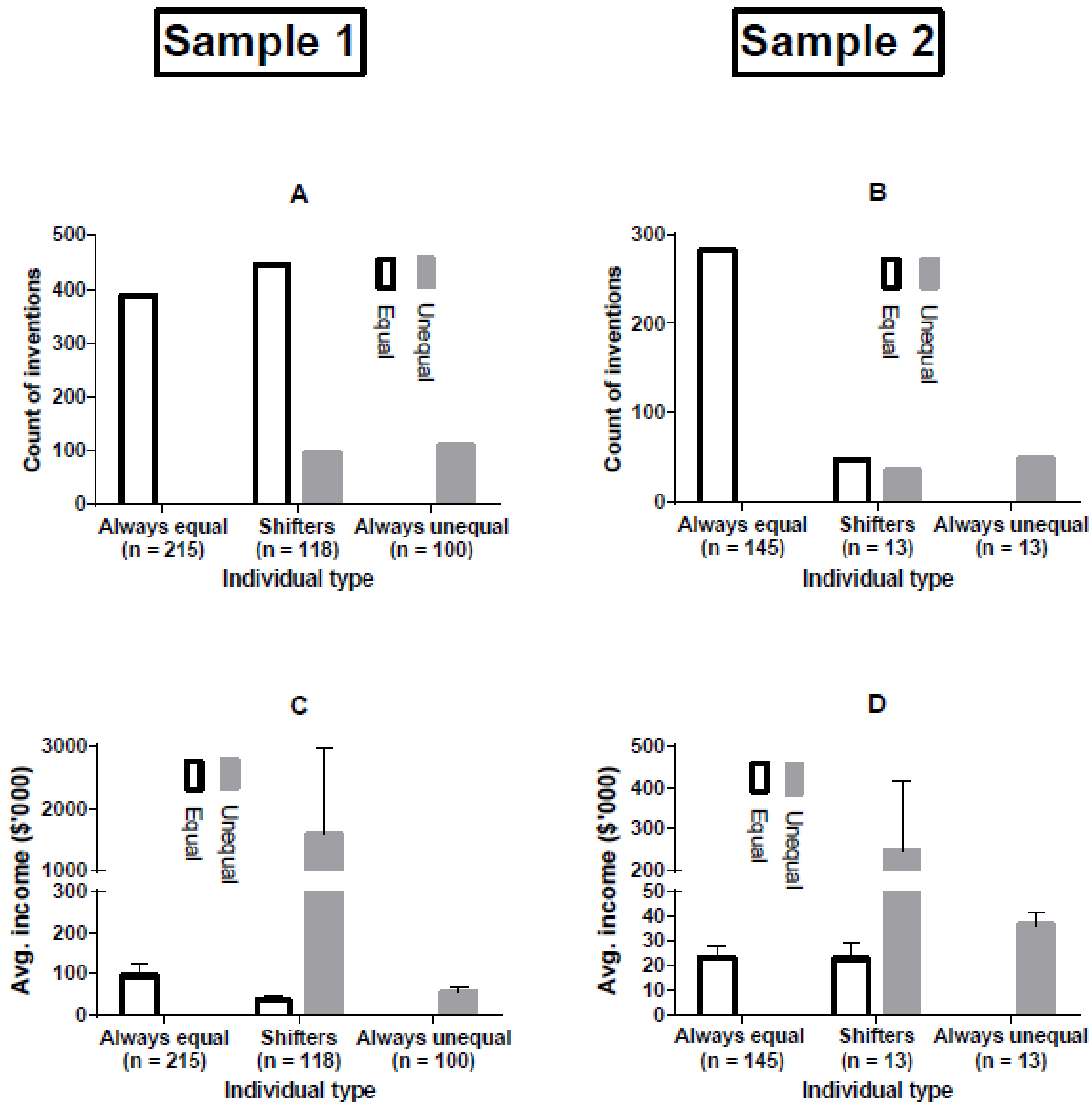

Fig. 2. Persistent individual differences in the lead inventors' choices of equal or unequal sharing. Lead inventors who switch between equal and unequal sharing across different inventions are labeled "Shifters". (A, B) The number of inventors of each type is in parenthesis underneath each count bar (e.g., there are (n=215) lead inventors who always share equally in sample 1). (C, D) For those inventors who shift sharing rules ("Shifters"), income is much higher for unequal sharing in both samples 1 and 2. Notice the scale breaks in the y-axis and the shift/unequal bar; low and very high incomes can be compared.

Sample 2

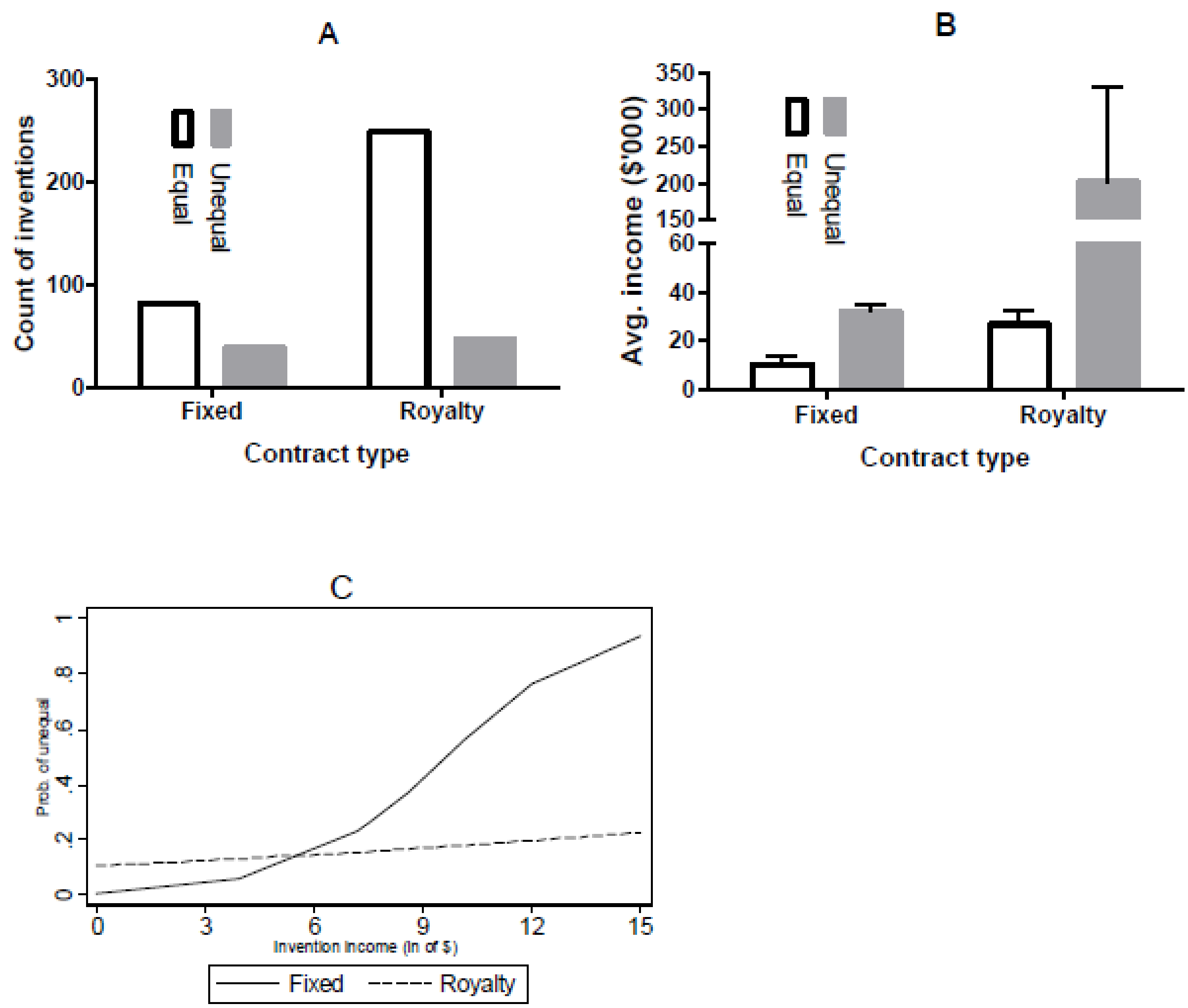

Fig. 3. Frequency and income of fixed and royalty contracts in sample 2. (A) Royalty contracts are more common than fixed contracts and more likely to have equal sharing ($\mathbf{X}^2(1)=13.4$, $p= 10^{-3}$) (B) Royalty contract inventions and unequal sharing contracts earn more income. (C) Fitted logistic regression results show the relation between ln(income) and the probability of choosing an unequal share contract for fixed (solid line) and royalty (dotted line) contracts. Unequal sharing is much less sensitive to income for royalty contracts (the interaction term of ln(income) and the royalty contract indicator is negative and significant ($\beta = -0.43$, $z = 3.77$, $p = 10^{-3}$).

Table 1. Expectations, Sharing Rule and Income

Dependent Variable: Invention Income (ln)	Specification (1)		Specification (2)		Specification (3)	
	Coeff.	(s.e.)	Coeff.	(s.e.)	Coeff.	(s.e.)
Different departments	0.38**	(0.17)	0.35**	(0.17)	0.37**	(0.16)
Experience of lead inventor	-0.011	(0.01)	-0.011	(0.01)	-0.012	(0.01)
Cumulative income of lead inventor(ln)	-0.12***	(0.03)	-0.099***	(0.03)	-0.100***	(0.03)
Licensing manager's expectation	0.50***	(0.13)			0.46***	(0.12)
Unequal sharing rule indicator			0.79***	(0.21)	0.70***	(0.21)
Inventor fixed effects	Yes		Yes		Yes	
Constant	6.10***	(1.36)	8.16***	(1.36)	10.1***	(1.40)
r2	0.59		0.59		0.60	
N	495		495		495	

Standard errors in parentheses; * p<.10, ** p<.05, *** p<.01. Both expectations and unequal sharing are correlated with invention income in sample 1. The sample consists only of share shifters who shift between the equal and unequal sharing rule. All estimations include fixed effects for the lead inventor. The dependent variable for the estimations is the *ln(income)* earned by an invention. The *licensing manager's expectation* is the 3-point rating by the licensing manager of likely income (3 high, 1 low) Inventors from *different departments* is an indicator variable (different=1, same =0). *The experience of the lead inventor* is the count of prior inventions disclosed by the lead inventor. C*umulative income of lead inventor(ln)* is the natural log of cumulative income earned by the lead inventor prior to the focal invention. *Unequal sharing rule* is an indicator (unequal=1, equal=0).

Supplementary Materials:

Supplementary Analysis

Table S1-S3

External Databases S1-S2

Supplementary Analysis

Likelihood of Using an Unequal Sharing Rule

We currently assume that the inventors can anticipate the income an invention will receive. This assumption allows us to use the ex post measure of the income an invention receives to predict the income sharing rule. We code a variable as '1' if the inventors adopted an unequal sharing rule and '0' for inventions that were to be equally shared. Because the dependent variable, the income sharing rule, is bounded by zero and one, we use a logit estimation to explain the limited dependent variable. The results are reported in Table S1 in Specifications 1, 2, and 3. In samples 1 and 2, the coefficients are significant ($\beta = 0.26$, $p = 10^{-4}$; $\beta = 0.15$, $p = 10^{-4}$ in samples 1 and 2, respectively; refer to Table S1 Specifications 1 and 2). The coefficient remains significant in the single invention cases of sample 2 ($\beta = 0.29$; $p = 10^{-4}$; refer to Table S1, Specification 3). This result confirms that, as the value of the license increases, under the assumption that the value of the invention is approximately known, the inventors are more likely to adopt an unequal sharing rule.

Share Shifters' Likelihood of Using an Unequal Sharing Rule

The data in both samples allow for the classification of lead inventors, the heads of laboratories that are principal investigators on grants and organize the research team, into three types based on observed behavior. The behavior relates to the manner in which income is shared in the licenses they lead. In sample 1, 37.4% of contracts are always equal, 10.5% are always unequal and 52.1% shift between equal and unequal (refer to Fig. 2A). We refer to the latter group as "shifters". This means that the lead inventors shift between equal and unequal contracts. By solely examining the shifters, we can control for individual and institutionally specific alternative explanations for why these scientists shift between equal and unequal sharing rules and provide a more rigorous test of the incentive hypothesis. This natural experiment also allows us to gauge the extremity of the lead inventor's responsiveness to expected invention income. The findings confirm that, as the value of the invention income increases, the lead inventors are more likely to push for unequal shares, with the lead inventor obtaining the largest share. In the sample 2, 67.95% of inventor contracts are always equal, 11.81% are always unequal and 20.24% shift between equal and unequal (refer to Fig. 2B). Recall that when the contracts have an unequal share, it implies that the lead inventor receives a larger than equal share. In sample 1, the shifters earn $36 thousand under equal contracts and $1,581 thousand with unequal contracts (see Shifters of Fig. 2C). The shifters in sample 2 earn $22 thousand under equal contracts and $247 thousand for unequal contracts (refer to Shifters of Fig. 2D). The t-test of the sample 1 difference is significant ($t=5.53$, $p = 10^{-4}$), as is the t-test of the sample 2 difference ($t=1.81$, $p = 0.075$).

On the sub-sample of share shifters, we estimate a logit regression to evaluate the likelihood of the inventors shifting into an unequal contract by the income an invention receives (refer to Table S1, Specifications 4, 5, and 6). In sample 1, the coefficient for the natural log of invention income was 0.33, which is significant (refer to Table S1, Specification 4; $p = 10^{-4}$). In sample 2, the coefficient for the natural log of invention income was 0.10, which is marginally significant (refer to Table S1, Specification 5; $p = 0.079$). In the single invention cases of sample 2, the coefficient was 0.276, which is also marginally significant (refer to Table S1, Specification 6; $p = 0.065$). The probability of a contract having unequal shares changes from .12 to .21 between sample income values in the 25th versus 75th percentile in sample 1. That is, in sample 1, when invention income increases from $2,426 to $20,470, an increase of $18,044 results in a .09 increase in the probability of an invention having an unequal sharing rule. Similarly, there is a .1

increase in probability of an unequal rule (from .40 to .50) in sample 2 when income increases from the 25th to the 75th percentile, from $877 to $32,835, an increase of $31,958 in income. These results confirm both the importance of incentives, measured by the invention income, and the extreme amounts needed to induce lead inventors to deviate from inequality in the choice between equal and unequal contracts.

---Insert Table S1 here---

Likelihood of Using an Unequal Sharing Rule by Fixed and Royalty Contracts

In Sample 2, we add to the estimation of Table S1 Specification 1 an indicator variable if the contract was a fixed upfront payment (coded as '0') or a performance-based royalty contract (coded as '1'). We also add the interaction between invention income and the indicator variable of contract type. The results are reported in Table S2, Specification 1. In Specification 2, in Table S2 we use the estimation in Table S1 from Sample 2 and restrict it to the sub-sample of fixed upfront payment contracts. In Specification 3, we use the estimation in Table S1 from Sample 2 and restrict it to the sub-sample of royalty contracts.

The results in specification 1 of Table S2 confirm that there is a significant difference in slopes for royalty and fixed price contracts as income from an invention increases. The coefficient of the interaction term is negative and significant (β = -0.43; p = 10^{-3}). The figure in the main table confirms that, for royalty contracts, it is less likely that inventors choose an unequal rule as the income for the invention increases. The results in specifications 2 and 3 of Table S2 confirm the preceding insight by showing that the coefficient of invention income is significant and positive in the sub-sample with fixed contracts ($\underline{\beta}$ = 0.49; p = 10^{-3}) and not in the sub-sample with royalty contracts ($\underline{\beta}$ = 0.06; p = 0.155). We replicate the same regressions in the single invention cases of sample 2 in Table S2 in Specifications 4, 5, and 6. The results are consistent.

---Insert Table S2 here---

Lead Inventor Experience and Likelihood of Using an Unequal Sharing

We delve deeper into the role of experience and sharing rule by checking if the sharing rule changes as the lead inventor gains experience. On the subsample of share-shifters, we estimate a logistic regression to evaluate whether shifting into an unequal contract depends on a lead inventor's sharing experience as well as the income of the invention. We include a series of indicator variables that indicate the time order of lead inventor's sharing experience; the first sharing experience by the lead inventor is an omitted category (refer to Table S3, Specification 1). In sample 1, the coefficient for the natural log of invention income was still significant (coeff=.21, p=0.003). When compared to the first invention sharing experience by the lead inventor (the omitted category and hence the comparison group), the coefficients for the rest sharing experience were all negative and significant except 4th contract. The F-test of joint significance of the indicator variables is p= 10^{-4} (chi2(4)=49.84). The important point to note is that the results of this indicator variable analysis goes against the argument that lead inventors learn from experience and shift to unequal contracts. The negative coefficients of the experience variables support the opposite view, that if anything with experience lead inventors are more likely to shift to equal sharing when controlling for the anticipated income of the contract.

We repeat the same exercise in sample 2 (refer to Table S3, Specification 2). The coefficient for the natural log of invention income is positive (coeff=.098, p=0.112). When compared to the first invention sharing experience by the lead inventor (the omitted category and hence the comparison group), the coefficients for the rest sharing experience were all negative and significant. The F-test of joint significance of the indicator variables is p= 0.1021 (chi2(4)=7.73). The important point to note, similar to the evidence in Sample 1, is that the results of this indicator variable analysis goes against the argument that lead inventors learn from experience and shift to unequal contracts. Again the negative and significant coefficients of the experience variables support the opposite view, that if anything with experience lead inventors are more likely to shift to equal sharing when controlling for the anticipated income of the contract.

---Insert Table S3 here---

Table S1: Logit Estimation of Likelihood of Choosing an Unequal Sharing Rule by Invention Income Earned

Dependent variable: Unequal rule indicator	Specification (1) Sample 1 (Full sample)	Specification (2) Sample 2 (Full sample)	Specification (3) Sample 2 (Single invention)	Specification (4) Sample 1 (Share shifters)	Specification (5) Sample 2 (Share shifters)	Specification (6) Sample 2 (Single invention)
Invention income (ln)	0.26***	0.15***	0.29***	0.33***	0.10*	0.28*
	(0.04)	0.04	0.07	(0.06)	(0.06)	(0.15)
Constant	-3.83***	-2.58***	-3.74***	-4.56***	-1.09**	-3.09**
	(0.43)	0.35	0.62	(0.62)	(0.52)	(1.35)
Log likelihood	-497.42	-200.55	-122.80	-238.96	-55.70	-29.50
N	1038	415	278	541	84	52

Standard errors in parentheses; * p<.10, ** p<.05, *** p<.01

Table S2: Logit Estimation of Likelihood of Choosing an Unequal Sharing in Sample 2

Dependent variable: Unequal rule indicator	Specification (1) Full Sample	Specification (2) Fixed Contract Sample	Specification (3) Royalty Contract Sample	Specification (4) Single Invention Sample	Specification (5) Single Invention, Fixed Contract Sample	Specification (6) Single Invention, Royalty Contract Sample
Invention income (ln)	0.49***	0.49***	0.06	0.47***	0.47***	0.11
	(0.11)	(0.11)	(0.04)	(0.11)	(0.11)	(0.08)
Royalty contract indicator	2.63**			1.54		
	(1.07)			(1.22)		
Income * Royalty	-0.43***			-0.36***		
	(0.11)			(0.13)		
Constant	-4.75***	-4.75***	-2.12***	-4.52***	-4.52***	-2.98***
	(1.00)	(1.00)	(0.37)	(1.01)	(1.01)	(0.69)
Log likelihood	-182.51	-54.05	-128.46	-107.0	-50.5	-56.5
N	415	119	296	278	106	172

Standard errors in parentheses; * p<.10, ** p<.05, *** p<.01

Table S3: Logit Estimation of Likelihood of Choosing Unequal Sharing Rule by Invention

Dependent variable: Unequal rule indicator	Specification (1) Sample 1		Specification (2) Sample 2		Specification (3) Sample 2 (Single Invention)	
Invention income (ln)	0.21***	(0.07)	0.098	(0.06)	0.33**	(0.17)
Lead inventor's sharing experience						
1st (reference category)	–		–		–	
2nd	-1.19**	(0.42)	-2.39**	(0.94)	-2.04*	(1.17)
3rd	-1.80***	(0.47)	-2.13**	(0.96)	-2.69*	(1.42)
4th	-1.86***	(0.48)	-1.70*	(1.00)	-2.01	(1.46)
5th and over	-2.51***	(0.37)	-1.50**	(.75)	-0.93	(0.98)
Constant	-1.64**	(0.75)	0.45	(0.81)	-2.22	(1.58)
Log likelihood	-213.21		-51.14		-26.31	
N	541		84		52	

Income Earned and Lead Inventor's Sharing Experience in the Share Shifters Sub-Samples
Standard errors in parentheses; *p<.10, ** p<.05, *** p<.01