

Costly Verification and Contract Design

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I. Introduction

The design of any regulation, including a private contract, should anticipate the path of its enforcement. Design should take into account enforcement costs that are conventionally defined to include the costs of litigation and the risk of error in judicial findings of fact and of law. In particular, a regulatory change is not efficient if the expected cost of its enforcement exceeds its benefit in improving incentives. Contract theory has a less nuanced regard for enforcement costs. The scholarship in this area typically invokes a binary classification of contract measures as either verifiable or unverifiable, and assumes that parties only use verifiable measures in their contracts. An agency contract, for instance, might condition payment on verifiable output but not on unverifiable effort. The implicit premise is that unverifiable measures are either too costly to verify or prone to be misperceived by the court that enforces the contract.

All contract measures are somewhat costly to verify. Even elementary measures, such as cash-flow and revenue, can be subject to manipulation, and require some judicial fact finding into the “true” cash-flow or revenue. At the same time, all measures have finite costs, and even large costs may be justified if the benefit from contracting on those measures is sufficiently high. Moreover, the parties can avoid large verification costs either if the agent performs as promised, or if the parties settle their dispute outside of court. So, the assessment of verification costs should reflect the expected path of performance and enforcement, and the costs should be weighed against the benefits of the particular measure in question. Thus, one might think of verifiability as defining a threshold in any given case between measures whose verification is efficient and those whose verification is not, because the expected enforcement costs outweigh the gains in incentives.

Commercial contracts in the real world condition performance on numerous measures (or signals), some of which appear at first blush to invite costly and uncertain litigation. Franchise contracts, for example, often provide for revenue sharing, termination rights triggered by breach of specified covenants, and penalties for breach of other covenants. Three features in particular should be intriguing to a contract theorist. First, even if the goal of contracting is to set optimal incentives along a single dimension (e.g. profits), commercial contracts sometimes use multiple measures. Second, these measures seem costly to verify: both in terms of litigation and error costs. Real world contracts often rely on both measures that are “easy” to verify and those that are not. Indeed, many of the measures employed in fact are vulnerable to manipulation, which further complicates verification. Third, the failure to meet various performance thresholds frequently gives rise to varying sanctions (e.g. penalties or termination), rather than the uniform compensatory measure of damages that pervades contract doctrine.

In this paper, we provide justification for using measures that are costly to verify, including measures that contract scholarship has deemed unverifiable and non-contractible. We begin with a sales contract between a buyer and a seller that conditions payment on a signal that we assume is costless to verify: the value (or quality) of the good. We then derive the conditions under which it is efficient for the parties to add a further measure that is costly to verify: the seller's investment in the quality of the good. Proving to the court that the seller did (or did not) fail to satisfy the investment threshold is costly to both the buyer and the seller, and the court may err in its fact finding.

In some cases, although the zero-verification-cost measure alone can optimize the seller's investment incentives, the solution imposes risk on the seller (that is costly if the seller is risk averse). Further, if the seller is wealth-constrained or judgment-proof, the contract cannot impose a fine for bad quality. It can only create investment incentives by paying for high quality. As a result, the seller receives a positive expected profit from the contract. This may have efficiency as well as distributional consequences. In some cases where the incremental surplus from high investment is small, the buyer may opt against the incentive contract because she would not be able to capture the surplus from doing so. If the contract includes a second signal, the court's assessment of the seller's investment, it permits the buyer (a) to reduce the risk on the seller from that produced by the first contract and (b) to reduce the seller's share of the contracting surplus, and thereby increase the attractiveness of the incentive contract to the buyer.

The efficiency of the second measure depends, of course, on its associated verification costs. However, the incidence of these costs depends in turn on the buyer's incentives to bring suit. If the buyer sues only when the seller breaches and if damages are sufficiently high, then the seller will perform. This is true even if the court may err in its fact finding, so long as the litigation outcome is positively correlated to the true state of nature. Verification (litigation) costs can be avoided in equilibrium: the seller performs and the buyer does not sue. We assume throughout that the parties have symmetric information, and we show how the damages for breach may be set to achieve this incentive.

II. An Illustrative Example

Suppose a buyer contracts with a seller for the production and delivery of a good at a future date. The value of the good to the buyer is probabilistic—the good can be worth either \$200 or \$100 to the buyer, and depends on whether the seller makes a reliance investment. The cost of the investment is \$10 and, if the seller makes the investment, the probability of the \$200 value is 50%. If the seller does not, the probability of obtaining the \$200 value is 25%.¹ We assume that the value of the widget is costless to verify and that the seller's investment choice is costly to verify. We are more precise about the costs of verification below.

¹ This formulation assumes that the seller's reliance investment has a direct externality on the buyer's value, i.e., seller's investment has a cooperative component. When this is true, popular mechanisms, such as options contract, cannot solve the investment and trading problems.

Buyer seeks to maximize the expected value of the good, net of the contract price, while the seller retains the price minus the investment cost. We assume that the buyer designs the contract and makes a take-it-or-leave-it offer to the seller. The seller's best alternative to contracting is to receive profit of zero from his outside option. We also assume that the seller is judgment proof, so that the contract price may not be negative in any state of the world. Under the given parameters, the contracting surplus is \$125 if the seller does not invest and \$140 if he does.² Thus, net of the investment cost, the seller's investment contributes \$15 to the surplus.

A. Contracting Only with the Verifiable Measure

If the buyer designs the contract without attempting to induce the seller to invest (a "fixed-price" contract), the buyer can capture the full contract surplus of \$125. However, the buyer's surplus may in fact fall if the contract provides the seller with an investment incentive, even though the joint surplus would rise to \$140. This concern may lead the buyer to incorporate multiple, and even costly, signals in the contract. We demonstrate this result below.

Suppose first that the contract only conditions price on the value of the good, which can be verified at zero cost. If the contract is not designed to induce the seller to invest, the buyer can simply set a fixed contract price of \$0 (the seller's opportunity cost) regardless of the value of the widget. The buyer would capture the entire contract surplus of \$125. If the buyer wants to induce the seller to invest, on the other hand, she must provide some monetary incentive to the seller (an "incentive contract"). Her best strategy in this case is to set the contract price at \$40 if the value of the good is \$200 and \$0 if it is \$100. The seller would choose to invest because he realizes a higher expected profit than without: $(1/2)(\$40) + (1/2)(\$0) - \$10 \geq (1/4)(\$40) + (3/4)(\$0)$.

Although the incentive contract yields efficient seller investment, it does impose a higher risk on the seller, and this risk bearing cost may offset some of the investment efficiency if the seller is risk averse.³ The incentive contract may be problematic even if the seller is risk neutral. Although it yields a larger joint surplus, the buyer must share the surplus with the seller, rather than driving the seller down to its reservation value.⁴ This is due to the fact that the seller's return from investment is probabilistic. In the current example, the buyer's expected profit under the incentive contract exceeds its profit under the first ($\$140 > \125).⁵ However, if the incremental surplus from the seller's investment were smaller, the seller's share of the surplus under the incentive contract could give the seller such a large share of the overall contract surplus as to leave

² $(1/2)(\$200) + (1/2)(\$100) - \$10 = \$140 > (1/4)(\$200) + (3/4)(\$100) = \$125$

³ Although we do not model a risk-averse seller, incentive-rent tradeoff with a risk-neutral but judgment-proof seller in our example is very similar to the incentive-insurance tradeoff with a risk-averse seller who is not judgment-proof.

⁴ The seller nets an expected profit of $(1/2)(\$40) + (1/2)(\$0) - \$10 = \10 .

⁵ $(1/2)(\$200 - \$40) + (1/2)(\$100) = \130 .

the buyer worse off than under the fixed-price contract. For instance, if the high widget value were \$160, instead of \$200, the contract price would need to be at least \$40 in the high widget value state to induce reliance. Under this contract, the buyer's expected profit would be \$110. A fixed-price contract, set at \$0, would induce no investment but yield an expected profit to the buyer of \$115.⁶

B. Contracting on Both the Widget Value and the Investment Choice

Now suppose the incentive contract is conditioned not only on the value of the widget, but also on a second measure, the seller's investment choice. The investment clause obligates the seller to make the \$10 investment and if the seller does not, he is in breach and is liable to the buyer for liquidated damages of D . Given our assumption that the seller is judgment-proof, we assume that D cannot be larger than the contract price that is promised to the seller.⁷ Whether the seller has made the investment is costly to verify. There are two sources of verification costs: first, both sides must incur litigation costs in proving (or disproving) to the court whether the seller really breached the clause, and second, the court is prone to make both types, I and II, of error.

We make several further assumptions about judicial fact finding about the seller's investment. First, each party bears a fixed cost of \$10 in litigation expenses. Second, the parties anticipate the judicial outcomes probabilistically and symmetrically. Third, although the evidence before the court is noisy, the court's fact finding is correlated with the truth in the following manner. If the seller has made the investment, the buyer will win and be awarded damages with probability $1/3$; if the seller breached, the probability increases to $2/3$. Therefore, if the seller has not breached, the buyer's expected return from litigation is $(1/3)D - \$10$, and the seller's expected loss is $(1/3)D + \$10$. Conversely, if the seller has breached, the buyer expects to earn $(2/3)D - \$10$ and the seller's expects to lose $(2/3)D + \$10$.

Verification costs can be reduced to nil in equilibrium if damages, D , are set so that the buyer is motivated to sue if the seller breached but not if the seller performed. If the seller breaches, the buyer has the incentive to sue if $(2/3)D - \$10 \geq \0 , or $D \geq \$15$. If the seller performs, the buyer will abstain from suing if $(1/3)D - \$10 \leq \0 , or $D \leq \$30$. Thus, if D is set between \$15 and \$30, the buyer can be induced to sue if and only if the seller breaches. For instance, if the liquidated damages is \$18, the buyer will sue if the seller breached and can expect to earn $(2/3)(\$18) - \$10 = \$2$. The seller would expect to lose $(2/3)(\$18) + \$10 = \$22$.

If the buyer were to include the investment clause with liquidated damages of \$18, she can also modify the monetary incentive structure. Instead of paying the seller

⁶ This problem might disappear if the seller were the party designing and making the take-it-or-leave-it offer, at least in this case where the buyer is not making an investment specific to the contract.

⁷ Although we can allow for expectation damages, because the value of the widget is much larger than the contract price and the seller is judgment-proof, it will be unlikely that the buyer will be able to collect expectation damages.

\$40 when the realized value of the widget is \$200, she can now pay the seller only \$20 and still provide the seller with the right incentive. Under this enhanced contract design, the investing seller will realize, in expectation, $(1/2)(\$20) + (1/2)(\$0) - \$10 = \0 . This leaves him in a better position than if he does not invest: although he would be entitled to the high-value contract price of \$20, it would be offset by his expected costs of litigation and liquidated damages (\$22). In equilibrium, therefore, the seller makes the reliance investment and the buyer captures the full \$140 in profit.⁸

A couple of points are worth emphasizing. First, despite the cost of verifying investment in court, the buyer can set liquidated damages so as to avoid this cost in equilibrium while providing a credible threat against the seller in case of breach. Second, the investment clause allows the buyer to alleviate (or cure) the residual inefficiency of relying solely on a signal that is costless to verify. In the example, the investment clause enabled the buyer to retain the contract surplus and thus made it attractive for the buyer to offer a more efficient incentive contract. Third, the investment clause provides a powerful, off-the-equilibrium incentive to the seller, thereby allowing the buyer to rely less on the monetary incentive: the pay-for-performance schedule can be less steep. This also reduces the risk borne by a risk-averse seller.

C. Choice Between Investment and Quality Measures

It is important to note that the optimal use of the quality and investment measures will vary from case to case. In some cases, both measures should be used. In others, a simple incentive contract based on the verifiable quality of the good is the best. And, in yet others, the contract should condition only on the higher-verification-cost measure of investment. The possibility that a contract would reject a signal that is costless to verify, in favor for one that is costly, is antithetical to conventional contract theory. This possibility is illustrated by the following variation to our example.

The buyer can implement the first best contract with only an investment clause when the seller's investment cost is sufficiently high relative to the cost of litigation. Suppose the seller's investment costs \$20, instead of \$10. The investment is still efficient, because the marginal increase to the joint surplus is \$25. To induce the seller to invest while not leaving him any rent, the buyer can set a flat price of \$20 and include an investment clause with the liquidated damages of \$18. In case the seller breaches, the buyer will sue the seller and the seller expects to lose $(2/3)(\$18) + \$10 = \$22$. The seller will have enough incentive not to breach the investment clause and the \$20 of state-independent price will be just enough to compensate him for the cost of investment. The seller receives no rent in equilibrium.

For the investment clause to improve on a simple incentive contract, the stakes should be relatively high compared to the cost of litigation. If, for instance, litigation

⁸ In this problem, so long as the liquidated damages is between \$15 and \$20, the seller will have an incentive to make the reliance investment. If the court were to grant expectation damages, the buyer might be able to collect only \$20 from the judgment-proof seller, and that provides enough incentive to make the reliance investment.

costs were \$30 for each party, instead of \$10, liquidated damages would have to be at least \$45 for the buyer to sue the seller in case of breach: $(2/3)D - \$30 \geq \0 implies $D \geq \$45$. Given that the seller is judgment-proof, in order to provide a credible litigation threat for breach of the investment clause, the buyer will have to raise the seller's price (in case of good outcome) to \$45. Since litigation does not occur in equilibrium, paying the seller \$45 when the value of the widget is \$200 implies that the seller will, now, receive a rent of $(1/2)(\$45) - \$10 = \$12.5$. This contract is less attractive for the buyer than relying only on the monetary incentive, since well-crafted monetary incentive alone could reduce the seller's rent to \$10.

III. Incorporating Efficient Breach

In the previous section, it was always efficient for the seller to make the costly reliance investment: not breaching the investment clause was always optimal. If the seller's investment cost is subject to variation and is unknown at the time of contracting, sometimes it may be efficient to allow the seller not to incur the cost of reliance. There are, at least, two ways of incorporating efficient breach. First, the parties themselves may allow, by adopting a more flexible standard in their contract, for the seller to "breach" when the investment cost is too high. Under that approach, the parties may not need to proceed to litigation in equilibrium since the contract explicitly allows the seller not to make the costly reliance investment. On the other hand, the parties can adopt a more rigid standard, which obligates the seller to make costly investment regardless of its cost, but resort to litigation in case of seller's breach.

To incorporate efficient breach, we modify the previous numerical example to allow for the seller's investment cost to be uncertain ex ante. Suppose the seller's cost of reliance investment can be either \$10 or \$40 with equal probabilities. We assume that the investment cost is realized after signing the contract but before the seller's investment decision. As before, we assume that both parties observe the choice of investment the seller makes, but they are costly to verify. For now, we remain agnostic about whether the buyer observes the realized investment cost. When the cost of investment is \$10, it is efficient for the seller to invest. However, when the cost is \$40, it is efficient for the seller not to rely: $(1/2)(\$200) + (1/2)(\$100) - \$40 < (1/4)(\$200) + (3/4)(\$100)$. Given the ex ante probabilities on cost, the maximum joint surplus the parties can achieve is $(1/2)((1/2)(\$200) + (1/2)(\$100) - \$10) + (1/2)((1/4)(\$200) + (3/4)(\$100)) = \132.5

A. Allowing Efficient "Breach" in the Contract

If the buyer were to allow the seller to adapt to the uncertain cost of investment without breaching the contract, she can use a more flexible standard in the contract. Suppose, the investment clause obligates the seller not to make reliance investment when reliance is inefficient (i.e., when the cost is \$40), but obligates the seller to invest when the cost is only \$10. For instance, the clause might require the seller to make "all commercially reasonable" investment and define "commercially reasonable" to mean the cost of investment being low. There are at least two ways the seller can breach this clause: by not investing when the cost is \$10 and by investing when the cost is \$40. In

litigation, if the seller has not breached the clause, we assume that the buyer has $1/3$ chance of winning, while, on the other hand, if the seller has breached, the buyer has $2/3$ chance of winning against the seller. As before, the liquidated damages is D and both sides must incur \$10 as litigation expenses.

The optimal contract depends on whether the cost of investment is observed by the buyer. If so, the buyer can condition payment on both the realized value of the widget and the realized cost of investment. Suppose the contract stipulates that when the seller's cost of investment is \$10, buyer has to pay the seller \$20 when the widget value is \$200 and \$0 when the value is \$100, but when the investment cost is \$40, buyer pays the seller \$0 regardless of the realized value of the widget. At the same time, the flexible investment clause (with the liquidated damages of \$18) requires the seller to invest when the investment cost is \$10 but not when the cost is \$40. This type of contract conditions the entire monetary incentive on the realized cost of investment.

When the investment cost is \$10, the seller has enough incentive to invest and the seller's rent is eliminated. The seller would not want to breach the investment clause since he knows that the buyer has the credible litigation threat and the seller will be worse off litigating the case. If the realized cost of investment is \$40, on the other hand, the contract obligates the seller not to rely and the buyer to pay \$0 independent of the value of the widget. The seller has no incentive to rely and that is optimal. The seller also receives no rent since he is receiving \$0 for sure. When the buyer can condition payment on the realized cost of investment, therefore, the buyer can achieve the first best: eliminate the seller's rent while inducing the seller to invest only when efficient.

If the buyer cannot condition payment on the realized cost of investment, the best the buyer can do is by agreeing to pay the seller \$18 when the widget value is \$200 and \$0 when the widget value is \$100; and also by including the flexible investment clause in the contract with the liquidated damages of \$18. The investment clause still obligates the seller to invest when the investment cost is \$10 and not invest when the cost is \$40. The difference from the previous example is that the monetary incentive is independent of the realized cost of investment.

When the investment cost is \$10, the seller has the incentive to invest. If he were to invest, his expected profit is $(1/2)(\$18) + (1/2)(\$0) - \$10 = -\1 . If he were to not invest and breach the investment clause, he will face a lawsuit from the buyer and from the lawsuit, he will expect to lose $(2/3)(\$18) + \$10 = \$22$. His expected profit from breaching the clause, therefore, is $(1/4)(\$18 - \$22) = -\$1$. The seller has just enough incentive not to breach the clause and make the reliance investment.

When the cost of investment is \$40, the incentives are reversed. By investing, even without the lawsuit, the seller expects a profit of $(1/2)(\$18) + (1/2)(\$0) - \$40 = -\31 .⁹ If he were to not invest, there won't be any lawsuit

⁹ Although litigation for breach of the investment clause will not take place when the cost of investment is \$40, the buyer, at least in theory, has a credible litigation threat in this case.

and the seller's expected profit is $(1/4)(\$18) + (3/4)(\$0) = \$4.5$. Seller will choose not to invest and realize the expected profit of \$4.5. Given that both costs of investment are equally likely, at the time of contracting, the seller's expected profit is $(1/2)(-\$1) + (1/2)(\$4.5) = \$1.75$. The buyer's expected profit, at the time of contracting, is \$130.75. Although the seller expects to lose money from making the reliance investment when the cost is \$10, this is more than off set by his expected positive profit from not having to make the investment when the cost is \$40. His expected profit (\$1.75) is high enough to beat his outside option of \$0.

Although allowing some flexibility to the seller leaves rent to the seller when the buyer cannot condition monetary incentive on the realized cost of investment, the contracting on the level of investment is still much better than relying only on monetary incentive. If the buyer could condition payment only on the verifiable widget value, in order to provide the necessary incentive to the seller to make the costly investment when the cost is \$10, the buyer would have to pay the seller \$40 when the widget value is \$200 and \$0 when the widget value is \$100. This allows the seller to capture \$10 of profit regardless of the cost of investment: when the cost is \$10, the seller invests and receives $(1/2)(\$40) + (1/2)(\$0) - \$10 = \10 and when the cost is \$40, the seller does not invest and receives $(1/4)(\$40) + (3/4)(\$0) = \$10$. Clearly, this is worse for the buyer.

B. Resorting to Litigation on the Equilibrium Path

The second approach is to contractually obligate the seller to always make the investment and to provide the seller with the incentive to breach when the investment cost is high. The parties would also want to provide the buyer with a credible threat of litigation when seller breaches since otherwise the seller might have an incentive not to rely even when the investment cost is low. Suppose the contract requires the seller to make the reliance investment and this is not conditioned on the investment cost. Let us assume, as before, when the seller does not invest, the buyer has a 2/3 chance of winning in litigation, but the probability drops to 1/3 when the seller invests. Also, both parties must spend \$10 as litigation expenses.

The best the buyer can do with this inflexible investment clause is to promise the seller \$20 when the widget value is \$200 and \$0 when \$100 and set the liquidated damages at \$15. We know that setting the liquidated damages at \$15 provides the buyer with the incentive to sue the seller for breach only when the seller has not relied. Also, when the cost investment is low, the seller has enough incentive not to breach. To see that this contract induces efficient breach, suppose the cost of investment is \$40. If the seller does not breach, his expected profit is $(1/2)(\$20) + (1/2)(\$0) - \$40 = -\30 . If he does, he knows that they will proceed to litigation, from which he expects to lose $(2/3)(\$15) + \$10 = \$20$. Therefore, when the seller breaches, his expected profit is $(1/4)(\$20 - \$20) + (3/4)(\$0) = \0 , which is higher than the expected profit in case of performance.

The price schedule is just sufficient to compensate the seller for his outside option. When the investment cost is low, the seller will rely and expect a profit of zero. When the investment cost is high, the seller will breach the contract, the parties will proceed to litigation, and the seller, in expectation, will earn zero. For the buyer, when the investment cost is low and the seller performs, she expects to earn \$140. When the investment cost is high, with litigation in equilibrium, buyer expects to earn $(1/4)(\$200 - \$20 + \$0) + (3/4)(\$100) = \$120$. At the time of contracting, therefore, the buyer's expected profit is \$130. Compared to the first best level of joint surplus (\$132.5), the parties' joint surplus is lower by \$2.5. This reflects the expected joint litigation expenses: $(1/2)(1/4)(\$20) = \2.5 .

When the parties know that they will proceed to litigation in equilibrium, this constrains the size of feasible liquidated damages. Having to litigate in equilibrium substantially reduces the seller's expected profit. Too big a damages will further reduce the seller's expected income so as to (potentially) make the entire enterprise not worthwhile for him, i.e., reduce his expected profit below his outside option. Hence, compared to the case where litigation never occurs in equilibrium, liquidated damages is smaller: \$15 versus \$18. Furthermore, although litigation imposes a deadweight loss, that loss is entirely born by the buyer. The reason is that the buyer, with her take-it-or-leave-it bargaining power, reduces the seller's expected profit down to zero and becomes the residual claimant.

C. Flexible versus Inflexible Standards: Considering Settlement

The example suggests that the buyer will, in general, prefer adopting the flexible standard in the contract since that minimizes the rent accrued to the seller and allows her to more easily implement the efficient outcome. Whether this indeed is true will also depend on how likely the parties can settle before proceeding to trial. Litigation in equilibrium was inefficient because it imposed a deadweight loss, and the buyer had to bear this cost because she was the residual claimant in the relationship. However, if the parties can settle before they proceed to trial, the buyer can avoid this deadweight loss and may still provide the right investment/breach incentive to the seller. Whether and how often the parties settle depends on various factors, but when the parties are symmetrically informed of all relevant variables, settlement can be quite likely.

Let us go back to the example with the inflexible investment clause and liquidated damages of \$15. While there are many ways of modeling settlement, we use a parsimonious version that allows the buyer to extract a positive settlement from the seller only when the buyer has a credible claim against the seller. After the seller has made the investment choice and the widget value has been realized, suppose the buyer makes a take-it-or-leave-it settlement offer to the seller.¹⁰ The seller can either accept or reject the offer, and if the seller accepts, the game ends. But if the seller rejects the offer, the buyer can then either file or not file the suit against the seller. Since the buyer will file the suit

¹⁰ We assume that the buyer makes a take-it-or-leave-it offer to the seller to be consistent with the assumption that the buyer had all the bargaining power at the time of contracting. This assumption, however, is not crucial.

only when the threat is credible, the seller will reject any positive settlement offer when the buyer's expected return from litigation is negative.

When the investment cost is \$10 and the seller has not breached, we know that the buyer has no credible litigation threat, so the buyer's settlement offer will always be rejected and the buyer will not file suit. The seller, on the other hand, receives no rent since the monetary incentive is just enough to cover his investment cost. When the investment cost is \$40 and the seller has breached, on the other hand, the buyer's expected return from litigation is \$0 and the buyer's litigation threat is weakly credible. The buyer will offer \$20 to the seller and the seller will accept. Anticipating this settlement result, at the time of signing the contract, the seller's expected profit is still zero. The buyer, on the other hand, expects not to incur any litigation cost and captures all the surplus. Her expected profit is \$132.5. When the buyer knows that she will always be able to settle, therefore, using the inflexible standard and relying on settlement is better than using the flexible standard.

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