Protecting Antiquities: A Role for Long-Term Leases?*

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Most countries prohibit the export of certain antiquities. This practice often leads to illegal excavation and looting for the black market, which damages the items and destroys important aspects of the archaeological record. We argue that long-term leases of antiquities or sales contracts with an option to buy the object back at a prearranged price would raise revenue for the country of origin while preserving national long-term ownership rights. We show that leases, which leave the country of origin in charge of future recontracting, are optimal mechanisms for resolving adverse selection and have good properties for addressing corruption. Option contracts deliver more revenue now and are therefore useful for reducing credit constraints. Allowing those who reveal information on the existence of antiquities the right to lease the object overseas for a fixed period could create incentives to provide this information.

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1 Introduction

To preserve cultural heritage, 140 countries ban the export of certain antiquities. Some see these export bans as vital for preserving cultural heritage and decry the alienation of objects sold abroad.

Others believe these export bans fuel the destructive black market in antiquities, arguing that the large monetary difference in art value at home and abroad coupled with weak enforcement generate incentives for illicit trade.[1] Illegal trade is surreptitious, and actions that conceal antiquity trade often destroy archeological sites, damage objects, and reduce economic value. Looters use fast methods of excavation such as bulldozers, dynamite, and pneumatic drills.[2] They work to keep site locations secret and often disguise the origin of objects by intentionally damaging sites to camouflage their activities and breaking objects into fragments to pass international borders.[3] For illegally traded objects, it is difficult to both search for and extract rent from the highest value buyer. The value to many potential buyers may be reduced because of limitations on the ability to display the object and because of danger of detection and prosecution. These factors reduce the price for the object relative to what sellers would obtain under legal trade.[4]

In this paper, we argue that allowing either lease markets or markets for sales with explicit options to repurchase could raise revenue for artifact-rich countries and create incentives for maintenance and preservation, while keeping long-term ownership rights for the country of origin. By putting the object in the hands of the highest value consumer at each point in time, such markets would reduce the size of the black market and generate funds that could be used for the legal excavation of at-risk sites or other needs. Further, by restricting transactions to leases or sales contracts with an explicit option to repurchase, the future ownership rights of objects can be preserved, enabling a country to manage its cultural heritage without restricting already excavated objects from flowing to highest value use.

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[1]An Italian antiquities trafficker was recently caught offering Hellenistic marble statues of Marsyas and Apollo for $850,000. The statues were originally purchased from a Turkish farmer for $7,000. See Bagli (1993) and Borodkin (1995).

[2]See Coggins (1972), Bator (1982), and Prott & O'Keefe (1990) for many examples.

[3]Ross (1995) estimates that over 50 percent of archaeological sites in Mali have been severely damaged or destroyed by illegal looting. Archeologists, who rely on the stratification of objects to make inferences, have limited access to pristine sites and no access to objects already extracted illegally. Owners of artifacts have no legal channel by which they can return objects back to the public domain, leading to limited knowledge concerning the number of objects still existing and complicating arrangements that might lead to repatriation.

[4]Christie's Auction House estimates that the original owners of artifacts typically receive 2 percent of the object's final sale price. See Beech (2003).

Of course it would be vital to include clauses in these contracts mandating proper care and maintenance of the objects and requiring insurance etc., but such contracts are fairly standard, for example in museum lending programs.[5]

To see why leases might be useful, consider the case of Nigeria. In the last three decades, at least seven of the major museums in Nigeria have been the victims of major robberies; the most notable occurring at the Ife museum in 1994 with estimated loses of $200-250 million.[6] Illegal excavation of archeological sites has also escalated with the most significant losses occurring from Nok sites in northern Nigeria. Nigeria's museum system has struggled to generate funds to maintain security and preserve objects. Tourism revenue for major exhibits is limited and the total 2008 public budget for museum and monument preservation was under $16 million. A lease program that rotated a portion of Nigeria's collections internationally could potentially generate revenue and reduce the potential of theft by moving at risk objects abroad and funding museum security.

The general strategy used in this paper is to first consider why a benevolent planner might choose to impose an export ban when faced with a choice set consisting only of an export ban or free market. We then expand the set of possible government policies to show that many of the governments objectives may be better achieved by restricting transactions to leases or sales contracts with an explicit option to repurchase.

After developing the model in Section 2, Section 3 considers a model with asymmetric information regarding the value that foreign collectors and the social planner assign to an object. If a country is initially poor but may become rich later, it may be optimal to initially transfer usage rights to a foreign collector, but for the artifact to return to the country of origin if the home country becomes wealthier. If the Social Planner is fairly certain that it will want the object in the long run, but its future value is private information, sale and repurchase contracts may be inefficient, since attempts by foreign collectors to extract surplus from the government may prevent efficient transactions. Either leases or a sales contracts with an option to buy the object back at a prearranged price may help avoid this hold up problem. In a world without credit constraints, leases dominate both sale and repurchase contracts and option contracts since negotiation occurs after the resolution of uncertainty and with the home country in control of the auction. With credit constraints, options often dominate leases since they can relieve credit constraints by allowing objects to be used as

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[5]See Bresler & Lerner (2004) for a discussion of insurance and contract requirements for loans between museums.

[6]See Akinade (1999) and Shyloon (2000).

collateral for borrowing.

In Section 4 we consider the possibility that in each generation, corrupt officials in charge of antiquities can extract value from antiquities by selling them abroad at the expense of future generations. We show that in this environment, laws imposing export bans may be preferable to free trade. In an effort to constrain the corrupt officials, a benevolent government may create legislation which limits flexibility of future officials. However, for reasonable parameter values, allowing leases may be preferable to either free trade or complete export bans. Leases prevent the expropriation of value from future generations while still granting freedom to optimally allocate usage rights today.

Finally, in section 5, we consider an economy in which objects are in private hands but where a subset of high quality objects generate a positive externality for other citizens if the objects are moved to public institutions. The government faces two forms of asymmetric information. First, the government does not know where the objects exist and thus must provide information rents to the private owners to reveal the location of an object. Second, the government cannot distinguish between high and low quality units without the use of a bureaucrat who estimates its value and generates a report. When a proportion of bureaucrats are corrupt and are willing to pass low quality objects off as high quality, a cash program may become insupportable. A program that allows objects revealed to the government to be leased can provide information rents while at the same time generating signals of quality based on market prices. Differential lease lengths between professionally excavated objects and looted objects can promote site preservation and legal excavation.

There is precedent for art being leased to cross international borders. The King Tut exhibit which circulated in the United States and London from 2005-2008 was leased to a private company in order to generate proceeds for Egypt. The lease agreements for the King Tut exhibit specified transportation, display, and storage conditions in order to reduce moral hazard. Egypt charged a flat fee of $5 million dollars per city and required insurance of roughly $1 million dollars per city. The exhibit was valued at $650 million dollars.[7]

Leases have also recently been used to resolve disputes over ownership. The Menil collection in Houston negotiated with the Church of Cyprus a 25-year lease of two 13th century Byzantine frescoes it recovered in 1982 from sources with disputed claims. More recently, the Metropolitan agreed to return a collection of objects believed to be looted from Italy in exchange for a long-term loan of objects with similar value.

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[7]See Boehn (2005).

Our paper is related to Bator (1982) and Borodkin (1995) who write from a legal perspective, and advocate the use of markets to reduce looting in developing countries. These papers concentrate on the increased information that is revealed when markets are legal and when individuals have private information and partial ownership claims over the location of objects still in the ground. As a way of generating stronger incentives for individuals to report found sites, Wendel (2007) advocates the use of "possessory estates,"a shared trust set up by the government that grants a proportion of proceeds to an individual who reports the location of an antiquity site. Our paper is complementary to these analyses, focusing on the efficiency and preservation incentives generated by different contract structures.

Lease contracts have been briefly mentioned in press by Butcher & Gill (1990), Asgari[8], and Gerstenblith (2001). In all three of these articles, leases are proposed as a way to move objects between museums in order to decrease demand for new pieces from foreign countries. We believe our paper is the first to formally model the effects of export bans and lease markets and to suggest leases and option contracts as a broad alternative to export bans.

2   The Benchmark Model

Our baseline model considers a single antiquity, referred to as the object. There are $N + 1$ actors — the social planner and N foreign collectors. Initially the antiquity is in the hands of the social planner who must decide whether to keep the object or sell the object abroad. Selling an object abroad generates revenue but also transfers the rights to choose the mechanism used in future negotiations.

The social planner in our baseline model is benevolent and maximizes social welfare for its constituents. At each time, $t \in \{0, 1, \ldots, T\}$ (with the possibility that $T = \infty$), the government's constituents get utility from non-antiqutity "consumption", c_t, and domestic antiquity "usage" x_t. Relative to the size of the total budget, the value of the object is assumed to be small. As such, we simplify the problem by assuming a linear tradeoff in each period between art and usage with social utility in each period defined as

$$S(c_t, x_t) = (1 + \gamma_t)c_t + D_t x_t, \tag{1}$$

where D_t is the domestic utility of art usage and $1 + \gamma_t$ represents the marginal utility of

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[8]Asgari argues that ten year leases may be used between major museums to reduce incentives to purchase illicit artifacts. See Erdem (1993).

consumption.

We allow the taste for art D_t to be stochastic with the potential to change over time and allow the marginal utility of consumption to potentially vary over time, as might be the case if countries face constraints on international borrowing. Let D_t be bounded between $\underline{D}$ and $\overline{D}$ and distributed according to a cdf $H_t(.)$ which has an increasing hazard rate.[9] D_t is unknown both to the home country until period t so that any contracting done before period t must be done excluding this information.

Barring credit constraints, all actors in our model share a common intertemporal discount rate of $\delta \in [\frac{1}{2}, 1]$ and can save on assets at interest rates R. We assume $\delta R = 1$ so that in the case of no credit constraints ($\gamma_t = 0$ for all t), the social planner would smooths consumption over time and use the object in periods when D_t is greater than the market rent. In section 3.2 we allow for credit constraints by assuming $\gamma_0 \geq \gamma_t$ for all $t > 0$. In this case, the home country prefers to collateralize objects and consume the proceeds today to better smooth intertemporal consumption.

There are $\{i = 1, \ldots, N\}$ foreign collectors who are potentially interested in legally using the object. Each foreign collector has a private per-period value for art consumption F^i bounded between $\underline{F}$ and $\overline{F}$ and distributed according to a cdf $A(.)$ which is time invariant, and has an increasing hazard rate. We assume that $V_t^i(c_t, z_t) = c_t + F^i z_t$ where $z_t \in \{0, 1\}$ is a binary variable that is 1 when the foreign collector legally keeps the object abroad. Without loss of generality, we assume that the buyers are ordered in ascending value. Thus F^N and F^{N-1} represent the highest and second highest values respectively.

Maintenance—Preserving art requires expenditure M at the beginning of each period to maintain the object. We consider M to be a reduced form parameter that includes the cost of preventing damage and theft by looters. While in reality, M is best represented by a continuous variable that influences the probability and severity of loss, we make the stark assumption that M is binary and that if it is not paid, the artifact is immediately destroyed. It is worth noting that in the continuous case contracts which make the future value of an object more valuable are likely to increase maintenance. Thus any mechanism that increases the future valuation of an object to the party with possession increases incentives for maintenance.

Implicitly, the assumption that M occurs prior to the use of an object excludes some forms of moral hazard that may be important, such as ensuring the safe transportation of

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[9]This assumption ensures that the virtual cost of the seller is monotonic and the mechanism design problem is regular.

objects and the guarantee return of objects in future periods. In countries with high-quality legal systems, experience with loans between museums suggests that these forms of moral hazard may be adequately addressed through contracts. In countries with low-quality legal systems, however, these types of moral hazard are likely to affect the ability to use antiquities as pledgable assets for loans since the international seizure of art may be infeasible. In most of the analysis in the paper, we focus on the case where the value for home use in period 0, $D_0 < \underline{F}$, so that it is optimal to move the object abroad at time zero independent of credit constraints. In calculating the first best, we make the stark but plausible assumption that the only way to collateralize objects in a period is to move them abroad.

Timing— Each subsequent period is comprised of three stages: a contracting stage, a maintenance stage, and a consumption stage:

1. **Contracting:** In the contracting stage, the owner of the antiquity chooses whether to offer the object to other buyers. We make two key assumptions. First, we assume that whoever owns the object gets to decide the selling procedure. Thus, if a foreign collector owns the object, the foreign collector chooses the selling procedure optimal to him. This will typically be an optimal auction. Second, we assume that the party offering the contract always has commitment power.

2. **Maintenance:** The party holding an object after the sales stage must immediately pay M to prevent the destruction of the object. We assume that $F^N > M$ so that there is at least one foreign collector who will maintain the object.

3. **Consumption:** All players consume for the period and play continues to the next period.

In Section 4, we introduce a law writing stage prior to period 0. In this stage, the Social Planner can write a law which binds future domestic actors. Initially, we assume that the Social Planner has a choice only between allowing free trade or passing an export ban which restricts foreign usage to zero. We then expand the set of possible restrictions to allow for explicit restrictions on the type of contracts able to be signed.

2.1 First Best

When there is no asymmetric information concerning the value of objects and there are no credit constraints, the usage of an object depends only on the value of the object at

home relative to the objects value abroad. Since an object moved abroad will always be transferred to the buyer with the highest value, this will occur any time $D_t > F^N(1 + \gamma_t)$. The net present value of an object is:

$$\sum_{t=0}^{\infty} \delta^t \big(\max((1 + \gamma_t)F^N, D_t) - (1 + \gamma_t)M \big). \tag{2}$$

When there exists credit constraints, the only way to collateralize an object is to move it abroad. In this case, a social planner may allow for some allocation in the first period in order to generate more first period consumption. With credit constraints, this will occur when:

$$(1 + \gamma_0)F^N + \sum_{t=1}^{T} \delta^t [F^N - M](\gamma_0 - \gamma_t) > D_0. \tag{3}$$

3   Transaction Costs and the Role of Leases

In this section we explore how uncertainty about the future and asymmetric information shape the optimal contract for sharing objects abroad. When a country is initially poor but may want objects back in the future, it must decide how best to move the object and secure its return. When the value for domestic usage is unknown, selling the object today and attempting to repurchase it in the future may be inefficient, since attempts by foreign collectors to extract surplus from the government may prevent efficient transactions. Keeping ownership rights to an object in the home country via a lease or fixing prices in future negotiations with an option allows the government to exert influence on future negotiations and eliminate this hold up problem.

While we concentrate on the role that leases play in reducing inefficiency due to asymmetric information, it is worth noting that leases also help in reducing inefficiencies caused by foreign tax laws and attachment effects. Most art donated to public museums have both formal and informal restrictions placed on their resale. When foreign governments create tax incentive for the donation of antiquities to local museums, restrictions on resale of these objects can lead to difficulty in recovering objects sold abroad. Leases and options overcome this problem by leaving the object in the jurisdiction of the home government.

When collectors' are loss averse, ownership of an object is likely to lead to a change in reference point which increases the value of the object relative to money. In a sale and repurchase scheme, negotiations in the sale and resale phase are likely to occur at two different

reference points. This may drive a wedge in the price paid for an object and the price at which an object may be repurchased. Leases and options mitigate this effect by fixing the repurchase agreement in the original reference state.

We initially study a special case of the model, where the taste for art is small so that $D_0 = \underline{D} < \underline{F}$. However, there is potential for the country to value art in the future. Let D_1 be drawn from distribution $H_1(.)$ and assume that all exogenous variation is resolved at this point so that $D_t = D_1$. There exists some future states of the world in which the home country does not value the object. There exist other states of world where the government wishes to repatriate the object with certainty. Thus, $H_1(\underline{F}) > 0$ and $H_1(\overline{F}) < 1$. This assumption incorporates the idea that asymmetric information surrounding the government's willingness to pay for an object is most likely more acute than foreign collectors' valuations. For collectors, there is typically a public estimation of investment value which is public information to all parties. In most government decisions, however, an official is typically assigned to deal with repatriation and must estimate the net present value of future utility that citizens of its country would get from the object. Given the highly subjective nature of this estimation it may be difficult for a foreign buyer to accurately gauge the government's willingness to pay.

As before, foreign collectors have a private value for art consumption F^i which is independently drawn from cdf $A(.)$ which is time invariant. For clarity, we consider an independent private values environment in which we assume that the foreign buyers (i) have independent valuations, (ii) are risk neutral, (iii) are not credit constrained, and (iv) are symmetric with valuations drawn from the same distribution functions. Under these characteristics, if an object is sold using either the efficient or optimal auction for sellers, the winner of the object will be the foreign collector with the highest intrinsic valuation for the object F^N.

Keeping the mnemonics $D = Domestic$, $F = Foreign$, $H = Home$, $A = Abroad$ in mind, the problem can be though of as a two-period allocation problem.

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\begin{array}{c|cc}
 & \underline{\text{Period } 0} & \underline{\text{Period } 1+} \\
\text{Domestic} & D_0 = \underline{D} & D_1 \sim H_1(.) \\
\text{Foreign} & F_0^i \sim A(.) & F_t^i = F_0^i
\end{array}
\tag{4}
$$

In period 0, all of the foreign collectors have greater value for object than the home country and thus the object should be moved abroad in a first-best world. In period 1, the home country learns its new domestic valuation and may value the object more than foreigners.

3.1 Sales and Repurchase Contracts

Sale and repurchase contracts involve two contracting phases: a sale phase in which the home country auctions the object to the foreign buyers, and a repurchase phase in which the foreign collector who won the object in period 0 offers the object back to the home country in period 1. In order to analyze the contract, we first construct the optimal mechanism for the foreign collector who is attempting to sell the object back to the social planner in period 1. Using the expected revenue from this resale auction, we then return to period 0 to analyze efficiency.

Repurchase Phase: For readability we define

$$\tilde{P} = P + M \tag{5}$$

and designate the hazard rate of distribution H_t and A as

$$\psi_{H_t}(\tilde{P}) = \frac{h_t(\tilde{P})}{1 - H_t(\tilde{P})}, \psi_A(\tilde{P}) = \frac{a(\tilde{P})}{1 - A(\tilde{P})}. \tag{6}$$

The foreign collector in our problem has commitment power and thus selects the mechanism that maximizes his expected utility.[10] To avoid the decrease in monopoly power associated with intertemporal price discrimination, the foreign buyer commits to offering the object back to the social planner exactly once in period 1. The optimal price is found by solving the standard per period monopoly problem

$$P_t^M = \arg\max_{P_t}[P_t - (F^N - M)][1 - H_t(\tilde{P}_t)], \tag{7}$$

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[10]As is well know in the literature on durable goods (e.g. Gul, Sonnenschein & Wilson (1986) and McAfee & Vincent (1997)), a lack of commitment in sequential bargaining or auction settings weakens the ability of the foreign buyer to make offers above their marginal valuation. In our model, less commitment increases overall efficiency since bargaining weakness eliminates holdup. It is our view that foreign collectors have at least some commitment power due to either sequential rationality or high transaction costs. There are also a number of other forces that lead to transaction frictions with similar properties to those shown here. First, the alternative to selling an object is often to donate it to a museum. Objects donated to museums often have explicit or implicit restrictions on resale which limit resale. Second, foreign collectors may be prone to endowment effects which generate a wedge between willingness to pay and willingness to accept. When there is both asymmetric information and endowment effects, the breakdown of one negotiation may increase attachment to an object and lead to entrenchment if future negotiation.

and then aggregating up over all periods:

$$P^{Resale} = \sum_{t=1}^{\infty} \delta^{t-1} P_t. \tag{8}$$

Taking the first order condition of Equation 7, and noting that in the baseline case $P_t = P_1$, the solution takes on the familiar monopoly solution

$$P^{Resale} = \frac{\delta}{1-\delta}\left[F^N - M + \frac{1}{\psi_{H_1}(\tilde{P}^M)}\right] \tag{9}$$

where P^M is set such that:

$$P^M = F^N - M + \frac{1}{\psi_{H_1}(\tilde{P}^M)} \tag{10}$$

Step 2 - Sale: Returning to the auction in stage 1, a foreign collector with value F^i incorporates the monopoly rents into his original value. Thus, the value of an object to a foreign collector with value F^i is:

$$V^i(F^i) = \frac{1}{1-\delta}(F^i - M) + \frac{\delta}{1-\delta}\frac{1 - H_1(\tilde{P}^M)}{\psi_{H_1}(\tilde{P}^M)}. \tag{11}$$

Consider the $\lim_{N\to\infty}$. When the optimal reserve price is less than $V(\overline{F})$, the optimal and efficient auction will both generate revenues equal to $V(\overline{F})$ and the foreign collectors expected value goes to zero. However, the monopoly power of the foreign collector in the second period creates residual inefficiencies in the initial auction. By attempting to extract rents from the domestic owner, the foreign collector offers an inefficiently high price in period 1. While these rents are recaptured by the domestic owner in period 0, the allocation in the future is inefficient which leads to a permanent loss of possible total utility.

Since the collector's utility is always zero and his utility is linear, maximizing domestic utility subject to the foreign collector's IR constraint yields the socially optimal price:

$$P_t^{FB} = F^N - M. \tag{12}$$

In a sale and repurchase scheme, $P_t^M \geq P_t^{FB}$ and thus there exists possible realizations of D_1 in which an object is misallocated to the foreign collector when the object has a greater value at home.

3.1.1 Delayed Sales

Whereas objects that leave the country can potentially stay in foreign hands inefficiently, a home country who is restricted to sales contracts may also respond to the hold up problem by restricting sales in the initial period. As a simple example, continue to assume that $N \to \infty$ so that $F^N = \overline{F}$. Comparing the revenue that the home country expects to receive in period 1 when it has control of the auction mechanism versus when it does not, the home country expected loss from a sale is:

$$S^{FB} - S^{Sale} = \frac{\delta}{1 - \delta} \underbrace{[H_1(\tilde{P}^{Resale}) - H_1(\overline{F})]}_{\substack{Probability \ of \\ Inefficient \ Trade}} \underbrace{[E(D_1|\overline{F} \leq D_1 \leq \tilde{P}^{Resale}) - \overline{F}]}_{Expected \ Loss}. \qquad (13)$$

Intuitively, the magnitude of this inefficiency is equal to the probability of an inefficient trade multiplied by the expected loss when such an event occurs. When the discount rate is small, the home country may have incentive to hold the object until uncertainty is resolved.

3.1.2 Leases

At its core, the problem with selling an object and trying to repurchase it in the future is a contractual one. Both the foreign collector and the domestic owner have an incentive to distort prices and consumption in order to increase rents in the second stage. However, since these rents are already priced into the initial auction, strategic action leads to pure efficiency losses without any change in the overall share of profits.

Leases diminish the effects of asymmetric information by leaving the choice of mechanism in both periods to the government, which can use auctions to significantly reduce the asymmetric information about the valuations of the foreign collectors. Consider a lease auction in which the government leases the object to the foreign collector in the first period but retains future ownership rights. As is well known from the auction literature on sequential auctions, it is weakly welfare decreasing to use information about the value of the winning bidder in one auctions on subsequent auctions. We thus assume the government constrains the information generated in the auction by running an optimal English auction in stage 1 in which the second highest bid price but not the true bid of the winner is revealed.

Given the information revelation of the initial auction, the domestic owner knows the

value of the second highest agent F^{N-1} and the density function of the highest bidder:

$$a^N(F) = \begin{cases} \frac{a(F)}{1-A(F^{N-1})} & F > F^{N-1}, \\ 0 & otherwise. \end{cases} \tag{14}$$

The home country attempting to maximize profit in the second period solves:

$$\max_p \quad [1 - A^N(\tilde{P})]P + A^N(\tilde{P})[D_2 - M]. \tag{15}$$

Noting that since:

$$A^N(\tilde{P}) = \frac{A(\tilde{P}) - A(F^{N-1})}{1 - A(F^{N-1})}, \tag{16}$$

$A(F^{N-1})$ drops out of the FOC leaving an optimal period 2 offer price of:

$$P = max\left(D_2 + \frac{1}{\psi_A(\tilde{P})}, F^{N-1}\right) - M. \tag{17}$$

What is most interesting with this result is that the optimal pricing rule from equation (17) is equivalent to running an English auction in each period with a reservation price dependent only on the home countries value and the initial distribution. As the number of bidders goes toward infinity, such a lease auction converges to the socially efficient price $P = max(D_2, F^N) - M$.

Theorem 1 *When the government's utility function is linear, the buyers' valuation are independent and identically distributed, and there are no credit constraints, the optimal allocation mechanism is to lease objects each period using an anonymous English auction with reservation price:*

$$P_t^{RES} = D_t - M + \frac{1}{\psi_A(\tilde{P}_t^{Res})} \tag{18}$$

Proof: Proof is in the appendix.

As indicated in the theorem, the optimal lease contract generalizes readily to a more complicated environment where D_t grows over time.[11] Since contracting in each forward period is done once uncertainty about the home countries value is resolved, the reserve price

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[11]That is $D_t = D_{t-1} + Z_t(.)$ where $Z_t(.)$ is bounded below at zero.

in each period extracts the maximum expected value.[12] Further, since the true valuation of the highest valued bidder stays private, there is no incentives for individuals to strategically manipulate their bids.

3.2 Credit Constraints and Option Contracts

In many environments where objects are threatened, the government is likely to be credit constrained. This section looks at the case where the total value of an object is small relative to the nation's budget, but where the marginal utility of money differs over time. As before, we assume that the value of the object relative to the total budget is small and that the marginal utility of consumption in each period is $(1+\gamma_t)c_t$. The country is poor today and is credit constrained so that $\gamma_0 \geq \gamma_t$ for all t. As such, the social planner prefers to (i) consume the value of the object in period 0 and (ii) prevent holdup in future periods.

An alternative to a lease in this circumstance is to sell an object to the foreign buyer with an explicit option to repurchase the object in the future at a fixed strike price s_t. In the appendix, we show that one optimal option mechanism in such an environment is to run an English auction with a strike price in each period equal to:

$$s_t(p) = \left[R^t p_t + \frac{\gamma_0 - \gamma_t}{(1 + \gamma_0)(1 + \gamma_t)} \frac{H_t(\hat{s}_t)}{\psi_{H_t}(\hat{s}_t)} \right], \tag{19}$$

where p_t is the winning bid for period t and $\hat{s}_t = (1 + \gamma_t)s_t + M$.

Raising the strike price above the bid price creates some states of the world in which the object stays in the hands of the foreign collector inefficiently. At the same time, however, an increase of the strike price over the winning bid increases the value of the contract to the foreign collector. This second effect increases bids and leads to greater revenue in period 0 but a larger expected repayment in period 1.

When $\gamma_0 = \gamma_t$, there is no benefit to shifting the period of payment and thus $s_t = R^t p_t$. When $\gamma_0 > \gamma_t$, the home country gains from from the larger payments in period 1. This leads to a tradeoff between the expected increase in revenues relative to the inefficiency caused in the second period. As $\gamma_0 - \gamma_t$ grows large, the strike price mimics that of a sale and repurchase contract that would be offered by the foreign collector with the second highest

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[12]Unlike in the sale and repurchase contract, lack of commitment by the home country in a lease contract with identity of the buyer may decrease efficiency. See Hart & Tirole (1988) for a discussion. Similar to Dewatripont (1989), in our model increasing the lease length can limit renegotiation and increase efficiency when the government in the home country lacks commitment power.

valuation.

A second property of the optimal option contract is that the reservation price must be set prior to the home country learning its true valuation. In the case of no credit constraints, the optimal reservation price is:

$$P^{Res} = \delta^t \left[E(D_t | D_t < R^t P^{Res}) + \frac{1}{\psi_A(P^{Res})} \right]. \tag{20}$$

The reservation price is analogous to that of the lease auction, with the difference being that the auction is done in period 0 prior to the true valuation of D_t being known. Conditioning on the expected value of D_t decreases the efficiency of the auction and may lead to additional problems with commitment, since after high realizations of D_t, the home country would like to exercise the option and offer the object to the winner at a higher reserve price.

Like the lease contract, the optimal option contract eliminates the holdup problems of the sale contract by settling all negotiations ex-ante. A careful comparison of Equations 19 and 20 to the optimal lease option provides intuition as to which environments the lease or option contract is likely to be preferred. When there are no credit constraints, the shifting of payments from period t to period 0 does not improve the welfare of the home country. Since the reservation price must be established with less information about the future, however, the option contract will typically have an inefficient reserve price relative to the lease auction.

Theorem 2 *When future valuations of the home country are unknown to all parties and there are no credit constraints, a lease auction maximizes social welfare of the home country.*

Proof: Proof is in the appendix.

In many instances, the efficiency differences between the lease and option contract are likely to be very small. For instance, if the number of bidders is large, it is unlikely that the reservation price in either auction is likely to bind. Option and lease contracts are also likely to have similar transaction costs and restrictions placed on buyers. Under both contracts, the contract being signed must have clear provisions for insurance, care, and resale in order to prevent buyer side moral hazard.

Where the two contracts differ the most significantly is in the surplus they generate for consumption in the initial period. When credit constraints exist and the country is expected to get wealthier over time, options may dominate leases since the country has the ability to consume more than its per period valuation. This will unambiguously be the case if the

government knows its future valuations. In this case the strike price and reserve price are identical to those of the lease auction but all payments occur in period 0 rather than the future.

Theorem 3 *When future valuations of the home country are known but private information and credit constraints bind, an auction that sells the object with an option to repurchase maximizes social welfare of the home country.*

Proof: Proof is in the appendix.

4   Corruption and Intergenerational Conflict

In the previous section, we assumed that the government sought to maximize social welfare. In this section we show that if in each period, there is a probability that a corrupt official can appropriate the value of the object from future generations, laws restricting international art transactions may be optimal. When the only laws that can be passed is an export ban, a benevolent social planner may choose to enact such a law in order to constrain corrupt officials at the cost of restricting good ones from acting optimally. For reasonable parameter values, less draconian export restrictions that allow one period leases are superior to both free trade and complete export bans. Sales with repurchase options are not attractive in this environment.

To focus directly on the role of corruption, we assume that there are no transaction frictions and that objects may be bought from and sold to foreign buyers at a constant per-period price P. We continue to assume that the value of D_t is stochastic and restrict attention to the case where the shocks are independent and identically distributed shocks from a common CDF $H(.)$. We initially assume that there are no credit constraints so that the marginal utility of consumption is normalized to 1.

In this section, we consider a situation in which the government can pass a law prior to period 0 that binds all future regimes. We assume that decisions in subsequent periods are made by a sequence of new officials who act as a social planner with probability $1 - \epsilon$ but who maximize their own consumption with no regard for current or future generations with probability ϵ. Corrupt officials have access to some portion of the proceeds via kickbacks and thus always choose to move objects abroad for the maximum amount of time legally possible. For clarity, we study the stark case in which corrupt officials have access to all the revenue from a transaction and thus consume all the proceeds from exchange.

A good official who has no constraints on his action may act in one of two ways. If the potential for corruption is small, a good bureaucrat allows an object to be used by the foreign collector any time $D_t < P$ and keeps the object local otherwise. Alternatively, if the potential for corruption is large, a good official may wish to sell an object today and distribute the earnings during his tenure to prevent corrupt officials from expropriating this value in the future. This will be the case if $\frac{1}{1-\delta} P > \mathbb{E}_D \sum_{t=0}^{\infty} \delta^t (1 - \epsilon)^t \big(\max(P, D_t) - M \big)$. Under an export ban, the object always stays in the country resulting in a value of $\mathbb{E}[D_t]$ in each period that a corrupt official is not in power.

Theorem 4 *If the only law available to a benevolent social planner is an export ban or free trade, there are no credit constraints, and $P < \mathbb{E}[D_t]$, as $\delta \to 1$, there exists probabilities ϵ^* and $\tilde{\epsilon}$ such that if $\epsilon \in (\epsilon^*, \tilde{\epsilon})$ the government passes an export ban.*

Proof: Proof is in the appendix.

In this model, export bans act as a very blunt tool to constrain corrupt future officials from acting in a malevolent way. By attempting to reduce the ability of future corrupt leaders to steal funds, the government limits the ability of good officials to make welfare improving trades.

Leases act as a way of balancing concerns of corruption with efficiency. Such leases may achieve a good balance of restricting the long-term damage that corrupt officials can do while still giving benevolent ones the ability to make Pareto-improving short-term trades.

To see this, note that with free trade, the country gets $\max(P, D_t) - M$ each period before the first corrupt leader arrives. Afterwards it gets nothing.[13] The net present value of this stream is:

$$\mathbb{E}_D \sum_{t=0}^{\infty} \delta^t (1 - \epsilon)^t \big(\max(P, D_t) - M \big). \tag{21}$$

Under an export ban, a corrupt official will consume the usage value of an object in the period that they are in power, but an object will stay in the country of origins for future generations.[14] As long as it is always in the interest of a benevolent official to maintain an

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[13]Recall that the foreign collector is in charge of negotiation on objects sold abroad. Since there is no asymmetric information, the home country gains nothing from recovering objects that were sold by a corrupt official.

[14]In reality, export bans are typically porous and a proportion of objects will be smuggled when officials are corrupt. We view the NPV shown here as an upper bound of value generated by an export ban.

object, the NPV of an export ban is:[15]

$$\sum_{t=0}^{\infty} \delta^t (1 - \epsilon)^{min(t,1)} \big(\mathbb{E}[D_t] - M \big). \tag{22}$$

Under a constitution or international treaty that permits one period leases but not sales, the NPV of the stream is:

$$\mathbb{E}_D \sum_{t=0}^{\infty} \delta^t (1 - \epsilon)^{min(t,1)} \big(\max(P, D_t) - M \big). \tag{23}$$

This implies that for any positive ϵ, allowing leases but not sales dominates free trade. If P exceeds D_t in some state of the world, then allowing leases but not sales is preferable to a complete export ban.

As noted in section 3.2, one caveat is that allowing leases but not sales dominates free trade only if there are no credit constraints. In a model with credit constraints, it may be desirable to transfer long-run claims on the object in exchange for higher consumption in the short run. However, since the actions of a credit constrained official will resemble those of a corrupt official, discriminating between the two cases may be difficult. Just as with an export ban, commitment to an international standard carries with it some cost in the flexibility of agents to respond to changes in the overall environment.

While in this section, the level of corruption was exogenous, in reality corruption is likely to be greatest when the potential size of a kickback is large and where there is scope for discretion. If officials have the option of choosing the term length of a lease or the return price in an option contract, for instance, corrupt officials will increase the length of the contract or set the return price too high to mimic a sale.

In order for lease and option markets to reduce the negative effects of corruption, commitment must be made both to the type of contracts allowed and to the way in which objects are auctioned. An external organization that standardizes allowable contracts and carries out auctions via an open and transparent procedure is vital. As in Kremer & Jayachandran (2006) and Pogge (2001), an external international organization that binds itself to specific types of exchanges can limit discretion of corrupt officials. Amending the laws of receiving countries to allow future generations in the source countries to seize objects not sold through

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[15]If the value for keeping an object in the home country is smaller than the maintenance value, a benevolent official may choose to not invest in maintenance and allow the object will be destroyed. This will occur if $\sum_{t=\tau}^{\infty} \delta^{t-\tau} \mathbb{E}[D_\tau] > M$ for any time period τ.

the organization reduces incentives of buyers to recontract and purchase goods away from the central exchange. This in turn can generate commitment when corruption is at the level of the government.

5   Leases as Information Rent

In the previous section, we considered the case in which the government had unambiguous ownership rights over the object. In this section, we study a case in which the government needs to create incentives for citizens to reveal the existence of objects. For example, in some cases, the government has property rights in archeological sites, but citizens know where the sites are and the government does not. In other cases, private owners may have objects which under law are classified as property of the state. We argue that granting lease rights for a set number of years for objects revealed to the government may provide such incentives and may be robust to corruption problems in valuing objects that might make a cash reward system untenable.

Expanding on the baseline model, consider an economy with high (H) and low (L) quality objects which are distributed randomly across a large number of potential domestic owners. Private owners of objects are subject to a blanket export ban which limits their ability to legally sell objects abroad. However, each owner in the economy is in contact with a smuggler who will pay $\frac{1}{1-\delta}V^H$ or $\frac{1}{1-\delta}V^L$ in exchange for a high or low quality object. For simplicity, we assume that owners have linear utility for consumption and that the value for the smuggled goods exceeds the private value they place on the objects.

Objects that are disclosed to the government generate a domestic externality $\frac{1}{1-\delta}D^H$ and $\frac{1}{1-\delta}D^L$ which the private owner of the good do not take into account. For excavated objects, this externality includes direct effects such as the utility gained to citizens for knowing an object is in the country of origin and the increased probability that an object ends up in a local museum. It also includes indirect effects such as information on the location of looted sites and increased information about existing objects which helps prevent theft and smuggling. For unexcavated archeological sites, this externality includes the knowledge gained from careful excavation and the increased ability to protect potential at risk sites.

The government accurately estimates the proportion (p) of high quality objects in the economy and the externality to its constituents for domestic use ($\frac{1}{1-\delta}D^H$ and $\frac{1}{1-\delta}D^L$). It has de jure rights to all domestic objects in the economy but lacks information in two

dimensions. First, the government does not know the location of objects and must provide an information rent to domestic owners in order to convince them to reveal their objects. Second the government cannot distinguish between high- and low-quality units without the use of a bureaucrat who estimates its value and generates a report.

Some bureaucrats are corrupt and may adversely alter a report to the government by reporting a low quality object as high quality. Assume that a proportion b of low quality objects are passed through the hands of corrupt officials who will accept a bribe B as compensation for deception.

The timing of the game is similar to a single period version of our standard model. Prior to period 0, the government decides upon an incentive mechanism and purchase rule which it makes public and can commit to. For example, the government could pay a reward for all objects revealed, or a higher reward for objects assessed as high value. Next, the individual owners decide whether to publicly disclose their object or sell them to the smuggler. Publicly disclosed objects are randomly assigned to bureaucrats for assessment. If an individual owner is assigned to a corrupt bureaucrat, the owner chooses whether to offer a bribe to certify that an object is of a particular quality. Finally, the bureaucrats generate their reports and the governments incentive mechanism is implemented.

We consider two cases of the model, one in which the governments value for objects is greater than the foreign valuation for both high and low quality goods and a second case where the government aims to only retain high quality units. Starting with case one, let $D^H \geq V^H$ and $D^L \geq V^L$ and suppose first that the only mechanism available to the government is to provide cash transfers that are contingent on bureaucratic reports. Let T^H and T^L be transfers made to owners whose objects are reported as high and low respectively. Setting the IR constraint for individuals holding both high and low quality goods to the value of their outside option, we have

$$
\begin{aligned}
T^H &= \frac{1}{1-\delta}V^H, \\
(1-b)T^L + b(T^H - B) &= \frac{1}{1-\delta}V^L.
\end{aligned}
$$

Rearranging in terms of T^H and T^L yields:

$$T^H = \frac{1}{1-\delta}V^H,$$

$$T^L = \frac{1}{1-\delta}V^L - \frac{b}{1-b}\left(\frac{\delta}{1-\delta}\Delta V - B\right).$$

Note that for low quality objects, the possibility of meeting a corrupt bureaucrat reduces the costs of providing incentives for low quality objects that are truthfully reported by a bureaucrat.

In terms of T^H and T^L, the total cost for procuring all objects is

$$[p + (1-p)b]T^H + (1-p)(1-b)T^L.$$

Plugging in for T^H and T^L yields a total project cost of:

$$p\frac{1}{1-\delta}V^H + (1-p)\frac{1}{1-\delta}V^L + (1-p)bB. \tag{24}$$

Compared to the first best, a cash program that aims to retain all objects requires additional transfers of $(1-p)bB$ to be paid to bureaucrats which ultimately must be paid by the government. In cases where these transfers are seen as wasteful, such bribes may make the total cost of the program prohibitive.[16]

The effect of bribery is exacerbated in the case where $D^H \geq V^H$ and $D^L < V^L$ which we view as the most likely situation. In this case, the government would like to retain objects with a large externality and allow other objects to be moved out of the country. Corruption generates inefficiency both by making the total size of the program larger than it should be and by generating inefficiency through the misallocation of some low quality objects to the domestic market.

Since only high-quality objects are desired by the government, the government offers a single information rent of $\frac{1}{1-\delta}V^H$ for each object identified as high quality. The gross cost for the program is thus

$$[p + (1-p)b]V^H \tag{25}$$

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[16]Corrupt bureaucrats could, of course, also charge bribes to individuals with high quality objects to truthfully reveal quality. In this case the information rents for high types must be increased by bB and the rents to the low types can be decreased by $\frac{b}{1-b}bB$. The total transfers for the project increases by pbB.

The net allocation gain, not taking into account the cost of the program is

$$\frac{1}{1-\delta}\Big[p[D^H - V^H] - (1-p)b[V^L - D^L]\Big]. \tag{26}$$

In the case where $D^L < V^L$, corruption generates an allocating inefficiency in addition to the transfers allocated to bureaucrats. For every low quality object left in the country, the overall welfare of the country decreases, since the government is paying revenue that would otherwise be generated from abroad. When b is large relative to p, these losses can potentially swamp the gains from securing the high quality objects making a cash program untenable.

The advantage of a lease program, is that the information rents generated by an object can be linked directly to the value of the object. Let τ be the first τ such that

$$\sum_{t=0}^{\tau} \delta^t P \geq p\frac{1}{1-\delta}V^H. \tag{27}$$

A government that allows owners to lease objects for a time greater than τ in exchange for future ownership rights provides information rents to individual buyers without the need for intermediation. In practice, the length of the lease τ necessary depends on the value that a smuggler can provide to an individual relative to the market price P for legally transferred leases. This will be related both to the ability of the country to police illegal markets and to the relative worth of legal leases versus illegal sales.

It is also worth noting that lotteries, as well as lease arrangements, could allow the value of objects to be split without declaring their value and could create incentives to reveal objects without a need for the state to estimate objects' value, but under lotteries the parties bear more risk and, as argued above, lease arrangements that give ownership rights to the state may achieve preferable intertemporal allocation.

6   Conclusion

Debates between cultural nationalists and internationalists have focused on the desirability of export bans. We argue that it may be appropriate to consider a broader class of contracts, including leases and perhaps sales with options to repurchase. Under three of the potential rationales for export bans we consider — the difficulty of repurchasing objects once sold,

the possibility that corrupt officials will expropriate the value of the national patrimony, and the need for external price signals in providing information rents — leases or sales with options to repurchase may protect a countries long-term interest in objects as well or better than export bans while generating more revenue for the country and improving maintenance incentives.

We have noted that leases are likely to be preferable in the presence of corruption or asymmetric information while option contracts are likely to be optimal in an environment with credit constraints.

While in Section 3, we analyzed trade frictions in relation to information asymmetries, it is worth noting that leases and options also help in reducing inefficiencies caused by two other sources: attachment effects and foreign tax law. When collectors' are loss averse, ownership of an object is likely to lead to a change in reference point which increases the value of the object relative to money. In a sale and repurchase scheme, negotiations in the sale and resale phase are likely to occur at two different reference points. This may drive a wedge in the price paid for an object and the price at which an object may be repurchased. Leases and options mitigate this effect by fixing the repurchase agreement in the original reference state.

Most art donated to public museums have both formal and informal restrictions placed on their resale. When foreign governments create tax incentive for the donation of antiquities to local museums, restrictions on resale of these objects can lead to difficulty in recovering objects sold abroad. Leases and options overcome this problem by leaving the object in the jurisdiction of the home government.

The simple models we examine here may abstract from important issues. First, objections to the sale of important cultural items may relate to unwillingness to alienate objects from the nation or distaste for "commodification" of antiquities.[17] In this case, sales with repurchase options may be unacceptable, but leases may still be acceptable. If leases for general revenue are not acceptable, leases which dedicate revenue to the preservation of antiquities may be more acceptable.

Second, we do not address the case of disputed ownership (including when objects are overseas). It seems likely that in such cases, such as between Greece and Britain concerning the Elgin marbles, leases may be a way to effectively split ownership and thus avoid legal costs without declaring the value of the object.

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[17]See Benabou & Tirole (2007) and Roth (2007) for discussions of behavioral and social effects that might limit the use of markets.

Third, we have assumed that the valuation of foreign buyers does not change with respect to the type of contract that they enter into. It may be the case that for some private collectors, ownership itself generates value which is lost under leases and option contracts. In such circumstances, the sale of fractional ownership rights may be preferable to other contracts where a portion of ownership is sold to the foreign collector. Fractional ownership allows for both sharing and foreign ownership, but requires more sophisticated contracting which may be difficult in an international setting. Nonetheless, given the large amount of looted objects moving to private hands, such contracts may be worth exploring.

In some cases, antiquities may effectively be open access resources, that can be extracted by a variety of individuals at some cost. In this case, as with any policy that increases the domestic value of antiquities, there is potential that the introduction of lease markets can exacerbate looting by giving individuals incentive to grab objects today. In principal, the length of the lease can also be used as an incentive for individuals to preserve unexcavated sites. In exchange for the location of an unexcavated site, individuals could be given an extended lease to objects legally excavated by professionals. By providing greater rents to individuals that leave objects in the ground for legal excavation, individuals could be rewarded for the potential risk posed by other looters and for the cost of policing the site prior to excavation.

This paper considers a fairly abstract setting, but before a lease program could be put in place, a host of implementation issues would need to be addressed including lease length, rules governing care of the objects, insurance, and procedures for soliciting bids. The lease length should be long enough to provide information rents to private individuals but short enough to limit rent extraction from future generations of corrupt officials. If transaction costs are substantial, relatively longer leases may be desirable. We also do not address moral hazard in maintenance and return of the object by the receiving country. Based on existing experience with loans between museums, our sense is that these issues could be adequately addressed contractually, as long as the legal system in the receiving country is sufficiently well-functioning.

A standardized and open procedure for the trade of objects is likely to be very important for the success of a lease or option market. The ability of lease and option contracts to reduce the effects of corruption is predicated on the ability to constrain individuals and limit discretion. Otherwise, objects could be transferred to favored buyers in exchange for kickbacks. Standardized contracts, which fix both the maximum lease length and the option price relative to the sale price are vital for this purpose. The requirement that the leasing

procedure be open reduces the incentive to loot new objects and may help deter the illegal sale of objects by allowing for identification of stolen objects moving forward.

Finally, although this analysis has focused on markets for antiquities, it is worth noting that parts of the analysis may have implications for other contracting situations. In particular, the argument in Section 3 may help explain other patterns of asset ownership.

7 Appendix

7.1 Optimal Option Contract

In this section we construct the optimal option mechanism. The construction is taken in two parts. Part 1 starts from a VCG mechanism and determines the maximum price that could be charged in an alternative direct mechanism which invokes truth telling but uses a different option strike price rule. By varying the strike price rules, the constructed pairs of sale price and strike price trace out the entire set of possible allocations which are incentive compatible and allocate the object either to the highest valued foreign collector or the seller. Given this set of possible allocation rules, Part 2 determines the optimal direct mechanism from this set and then constructs the corresponding indirect mechanism that uses the bidding procedures of the English auction.

Lemma 1 *Let (p, s) be a purchase and strike price from a second price auction where an object is sold in period 0 at price p, but where the home country has the option to repurchase the object in period t at price $s = R^t p$. Then, an alternative direct mechanism where the contract (p', s') is awarded to the buyer with the highest valuation invokes truth telling if $s' > s$ and*

$$p' = [1 - H_t(s')]\delta^t s' + H_t(s')p. \tag{28}$$

    Proof. In the original second price auction, the winner is exactly compensated for any payments that he makes in any situation that he does not win the object. Thus, just as in the standard second price auction, it is a weakly dominant strategy for each buyer type to truthfully bid their present discounted value. Under these conditions, $p = \delta^t F^{N-1}$ and $\delta^t F^N \geq p$. For incentive compatibility to hold in the alternative direct mechanism, it must be the case that for any F^N, the present discounted value of the new contract is at least as good as the present discounted value of the old contract. This occurs if:

$$[1 - H_t(s')][\delta^t s' - p'] + H_t(s')[\delta^t F^N - p'] \geq [1 - H_t(s)][\delta^t s - p] + H_t(s)[\delta^t F^N - p]. \tag{29}$$

For truth telling to be an optimal, it also must be the case that no individual has an incentive to overstate their value. Thus, equation 29 must hold with strict equality when $F^N = F^{N-1}$.

    The first term on the RHS is zero. Rewriting the equation with this term removed yields:

$$p' \leq [1 - H_t(s')]\delta^t s' + H_t(s)p + [H_t(s') - H_t(s)]\delta^t F^N. \tag{30}$$

Each of the RHS terms is positive for $s' > s$ with the last term increasing in F^N. For $\delta^t F^N = \delta^t F^{N-1} = p$, equality occurs when:

$$p' = [1 - H_t(s')]\delta^t s' + H_t(s')p. \tag{31}$$

For types with $\delta^t F^N > p$, $H_t(s')p \leq H_t(s)p + [H_t(s') - H_t(s)]\delta^t F^N$ and thus for the case in which $F^N > F^{N-1}$, incentive compatibility holds with strict preference at the new contract price p' for all types with $F^N > F^{N-1}$. These two conditions ensure truth telling remains a weakly dominant strategy in the alternative direct mechanism which offers contracts (p', s'). Note that the payment rules between (p', s') and (p, s) can differ since the allocation rule between the winning buyer and the seller change in response to s. ∎

Theorem 5 *When the government's utility function is linear and the buyers' valuations are independent and identically distributed, the optimal mechanism which restricts all contracting to period 0 is to sell future ownerships via an English auction with an option to repurchase in period t at an option* strike *price*

$$s_t(p_t) = \left[R^t p_t + \frac{\gamma_0 - \gamma_t}{(1 + \gamma_0)(1 + \gamma_t)} \frac{H_t(\hat{s}_t)}{\psi_{H_t}(\hat{s}_t)}\right], \tag{32}$$

where $\hat{s}_t = (1 + \gamma_t)s_t$. *The reservation price for the auction is:*

$$P_t^{Res} = \frac{\delta^t}{1 + \gamma_0}\left[H_t(\hat{s}_t)\left[E(D_t | D_t < \hat{s}_t) + \frac{1}{\psi_A(F(P_t^{Res}))}\right] + [1 - H_t(\hat{s}_t)](1 + \gamma_t)s_t(P_t^{Res})\right] \tag{33}$$

where

$$F(P_t^{Res}) = R^t P_t^{Res} - \frac{\gamma_0 - \gamma_t}{(1 + \gamma_0)(1 + \gamma_t)} \frac{1 - H_t(\hat{s}_t)}{\psi_{H_t}(\hat{s}_t)} \tag{34}$$

Proof. THEOREM 5: Consider the class of direct mechanisms which invoke truth telling. By the envelope theorem, all incentive compatible mechanisms with the same allocation rule must have the same payment rules up to a constant. Lemma 1 provide a class of allocation rules between the highest valued buyer and the seller for $s \in [Rp, \infty]$ which are incentive compatible. This class of allocation rules exhausts the set of possible allocations which 1) allocates ownership rights to either the highest valued buyer or the seller, 2) limits all contracting to period 0, and 3) has the seller's allocation monotonically increasing in own valuation.

The home country seeks to maximize its welfare subject to satisfying the incentive compatibility constraints of the buyers. For a given reserve price s, the home country will exercise the option if $D_t > s(1 + \gamma_t)$. Letting $\hat{s} = s(1 + \gamma_t)$, it thus maximizes:

$$max_s(1 + \gamma_0)p(s) + [1 - H_t(\hat{s})]\delta^t[E(D_t|D_t > \hat{s}) - \hat{s}] \tag{35}$$

where

$$p(s) = \delta^t\big[[1 - H_t(\hat{s})]s + H_t(\hat{s})F^{N-1}\big]. \tag{36}$$

The equation for $p(s)$ uses the results from Lemma 1, substituting in for p with $\delta^t F^{N-1}$, the price paid in the original second price auction.

Taking the FOC with respect to s yields:[18]

$$\frac{\partial L}{\partial s} : \big[-s + F^{N-1}\big]h_t(\hat{s})(1 + \gamma_t)(1 + \gamma_0) + [1 - H_t(\hat{s})](1 + \gamma_0) - [1 - H_t(\hat{s})](1 + \gamma_t) = 0. \tag{37}$$

Simplifying yields:

$$s = F^{N-1} + \frac{\gamma_0 - \gamma_t}{(1 + \gamma_0)(1 + \gamma_t)}\frac{1}{\psi_{H_t}(\hat{s})}. \tag{38}$$

Equation 38 provides important intuition as to the effect that credit constraints have on the mechanism chosen by the seller. Without credit constraints, $s = F^{N-1}$ and the home country optimally selects the mechanism which is efficient from an ex-ante standpoint. Increases in the price paid in period 0 does not adequately compensate the home country for potential inefficiencies in the future and thus there is no wedge between the sale price today and the present discounted strike price. Further, if D_1 is known, the optimal option is identical to a lease auction in both reservation price and strike price.

When there are credit constraints, however, revenue received today is more valuable than money used in repurchasing the object in the future. To increase payments today, the home country introduces inefficiencies in the strike price to generate additional funds. The relative markup of the strike price over the purchase price is increasing in the size of the credit constraint and in the amount of distortion that these rents generate in the allocation of the object in the future.

To determine the optimal reservation price, the next step is to determine the bidder type who has the same virtual valuation as the seller taking into consideration the payments that

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[18]Note that $\frac{\partial}{\partial \hat{s}}E(D_t|D_t > \hat{s}) = \frac{\partial}{\partial \hat{s}}\frac{1}{1-H(\hat{s})}\int_{\hat{s}}^{\infty} xh(x)dx = \frac{h(\hat{s})}{1-H(\hat{s})}[E(D_t|D_t > \hat{s}) - \hat{s}]$. Thus $\frac{\partial}{\partial s}[1 - H(\hat{s})][E(D_t|D_t > \hat{s}) - \hat{s}] = -[1 - H(\hat{s})](1 + \gamma_t)$.

can be used to reduce credit constraints in the first period. This is akin to solving a monopoly problem which compares the gains from trading with a threshold type F^c against the virtual valuations paid out to all types with valuations greater than F^c. The home country solves:

$$\max_{F^c, s} \ [1 - A(F^c)] \underbrace{\big[p(s, F^c)(1 + \gamma_0)}_{\substack{Probability of \\ Initial Sale}} + \underbrace{(1 - H_t(\hat{s}))}_{\substack{Probability of \\ Exercise}} \underbrace{\delta^t [E(D_t | D_t > \hat{s}) - \hat{s}]}_{\substack{Expected Value Conditional \\ on Option Exercise}} \big] + A(F^c) \delta^t [E(D_t)],$$

(39)

where

$$p(s, F^c) = \delta^t \big[[1 - H_t(\hat{s})]s + H_t(\hat{s})F^c\big].$$

(40)

Adding $E(D) - E(D)$ to the end of this maximum and noting that

$$E(D_t) = E(D_t | D_t < \hat{s})H(\hat{s}) + E(D_t | D_t > \hat{s})[1 - H(\hat{s})],$$

(41)

the maximum simplifies to:

$$\max_{F^c, s} \ \delta^t [1 - A(F^c)]\big[[H(s)][-E(D|D < \hat{s}) + \hat{s}] + p(s, F^c)(1 + \gamma_0) - \hat{s}\big] + \delta^t E(D).$$

(42)

The last term is independent of both choice variables and can be removed. δ^t is also constant across terms and can be excluded. Taking these simplifications and expanding $p(s, F^c)$ yields:

$$\max_{F^c, s} \ [1 - A(F^c)]\Big[[H(\hat{s})][-E(D_t | D_t < \hat{s}) + \hat{s}] + [1 - H_s(\hat{s})]s(1 + \gamma_0) + H_t(\hat{s})F^c(1 + \gamma_0) - \hat{s}\Big].$$

(43)

This can be further reduced to:

$$\max_{F^c, s} \ [1 - A(F^c)]\Big[[H(\hat{s})][\hat{s} - E(D_t | D_t < \hat{s})] - H_t(\hat{s})(1 + \gamma_0)[s - F^c] + s(\gamma_0 - \gamma_t)\Big].$$

(44)

Taking the FOC with respect to the option price s and F^c yields:

$$\begin{aligned}
\frac{\partial L}{\partial s} &: [1 - A(F^c)]\big[(1 + \gamma_t)H(\hat{s}) - h(\hat{s})(1 + \gamma_t)(1 + \gamma_0)[s - F^c] \\
&\qquad\qquad -(1 + \gamma_0)H(\hat{s}) + [\gamma_0 - \gamma_t]\big] = 0, \\
\frac{\partial L}{\partial F^c} &: -a(F^c)\big[H(\hat{s})[\hat{s} - E(D_t | D_t < \hat{s})] - H_t(\hat{s})(1 + \gamma_0)[s - F^c] + s(\gamma_0 - \gamma_t)\big] \\
&\qquad\qquad +[1 - A(F^c)]H_t(\hat{s}) = 0.
\end{aligned}$$

(45)

Simplifying the second equation yields

$$-a(F^c)\left[-H(\hat{s})E(D_t|D_t < \hat{s})\right]+[1-H_t(\hat{s})](\gamma_0-\gamma_t)s+(1+\gamma_0)H(\hat{s})F^c\right]+[1-A(F^c)]H_t(\hat{s}) = 0 \tag{46}$$

Further simplifications yields:

$$F^c = \frac{E(D_t|D_t < \hat{s})}{1+\gamma_0} - \frac{1-H_t(\hat{s})}{H_t(\hat{s})}\frac{\gamma_0-\gamma_t}{1+\gamma_0}s(F^c) + \frac{1}{\psi_A(F^c)}\frac{1}{1+\gamma_0}. \tag{47}$$

where $s(F^c)$ is the optimal strike price for a buyer of type F^c. This optimal strike price is found from first FOC above and is identical to the one found in Equation in 38:

$$s(F^c) = F^c + \frac{\gamma_0-\gamma_t}{(1+\gamma_0)(1+\gamma_t)}\frac{1}{\psi_{H_t}(\hat{s})}. \tag{48}$$

For intuition, substituting of the optimal strike price into Equation 47 yields:

$$F^c = \frac{1}{1+\gamma_0}\left[\frac{H_t(\hat{s})}{H_t(\hat{s})+z}\left[E(D_t|D_t < \hat{s}) + \frac{1}{\psi_A(F^c)}\right] - \frac{z}{H_t(\hat{s})+z}\left[\frac{\gamma_0-\gamma_t}{(1+\gamma_0)(1+\gamma_t)}\frac{1}{\psi_{H_t}(\hat{s})}\right]\right], \tag{49}$$

where

$$z = [1 - H_t(\hat{s})]\frac{\gamma_0-\gamma_t}{1+\gamma_0}. \tag{50}$$

As expected, the threshold type for which the optimal option contract gives zero allocation is decreasing in credit constraints. As period 0 credit constraints grow large, the home country solely values the revenue that it can gain in the first period. In the limit as $lim_{\gamma_0 \to \infty}F^c = \underline{F}$ and $s(F^{N-1}) = F^{N-1} + \frac{1}{\psi_{H_t}(\hat{s})}$. This result is similar to a sale auction in which the foreign collector has bargaining power in the second period.

As credit constraints grow small, the home country sets the strike price such that there is no hold up problems in the second period and excludes buyers whose virtual valuations are expected to be zero. Note that when $\gamma_0 = \gamma_t = 0$ and D_t is known, the option contract and lease contracts are identical except for the timing of payments. Further, when there are no credit constraints but D_t is unknown, the optimal reservation price in a second price auction is:

$$P^{Res} = E(D_t|D_t < P^{Res}) + \frac{1}{\psi_A(P^{Res})}. \tag{51}$$

Note that the reservation price is based on $E(D_t|D_t < P^{Res})$ since D_t is unknown. In contrast to the optimal lease auction, the option auction is inefficient since the auction is done prior

to learning the sellers true valuation in the future.

While there are in principle many indirect mechanisms with the same allocation rules as the one considered here, the English auction has the advantage of the valuation of the highest bidder not being revealed in each period. Since the second price auction and English auction are identical in the IPV setting considered here, we next construct the second price auction which corresponds to the optimal direct mechanism shown above. With credit constraints, the strike price of the option will be above the valuation of the object for the foreign buyer. Thus, foreign buyers will bid above their their type. Given a strike price $s(\beta(F^{N-1}))$ that is based on the final bid price $\beta(F^{N-1})$, a foreign buyer will bid:

$$\beta(F^{N-1}) = \delta^t\big[[1 - H_t(\hat{s})]s(\beta(F^{N-1})) + H_t(\hat{s})F^{N-1}\big] \tag{52}$$

Reverse engineering, the type corresponding to a bid of $\beta(F^{N-1})$ in a second price auction with strike price rule $s(\beta(F^{N-1}))$ is:

$$F^{N-1}(\beta(F^{N-1}), s(\beta(F^{N-1}))) = \frac{R^t\beta(F^{N-1})}{H_t(\hat{s})} - \frac{[1 - H_t(\hat{s})]}{H_t(\hat{s})}s(\beta(F^{N-1})) \tag{53}$$

In order for the strike price to be optimal, it must be that:

$$s(\beta(F^{N-1})) = F^{N-1}(\beta(F^{N-1}), s(\beta(F^{N-1}))) + \frac{\gamma_0 - \gamma_t}{(1 + \gamma_0)(1 + \gamma_t)}\frac{1}{\psi_{H_t}(\hat{s})} \tag{54}$$

Substitution yields the optimal strike price for the second price auction:

$$s(\beta(F^{N-1})) = R^t\beta(F^{N-1}) + \frac{\gamma_0 - \gamma_t}{(1 + \gamma_0)(1 + \gamma_t)}\frac{H_t(\hat{s})}{\psi_{H_t}(\hat{s})}. \tag{55}$$

Turning to the reservation price, the price at which a bidder of type F^c will drop out of the auction is:

$$\beta(F^c) = \delta^t\big[[1 - H_t(\hat{s})]s(\beta(F^c)) + H_t(\hat{s})F^c\big], \tag{56}$$

substitution in for the cutoff F^c yields:

$$\beta(F^c) = \delta^t\Big[[1 - H_t(\hat{s})]s(\beta(F^c)) + H_t(\hat{s})\Big[\frac{E(D_t|D_t < \hat{s})}{1 + \gamma_0} - \frac{1 - H_t(\hat{s})}{H_t(\hat{s})}\frac{\gamma_0 - \gamma_t}{1 + \gamma_0}s(\beta(F^c)) + \frac{1}{\psi_A(F^c)}\frac{1}{1 + \gamma_0}\Big]\Big], \tag{57}$$

or

$$\beta = \frac{\delta^t}{1 + \gamma_0}\Big[H_t(\hat{s})\Big[E(D_t|D_t < \hat{s}) + \frac{1}{\psi_A(F(\beta))}\Big] + [1 - H_t(\hat{s})](1 + \gamma_t)s(\beta)\Big]. \tag{58}$$

where

$$F(\beta) = R^t \beta H_t(\hat{s}) - \frac{[1 - H_t(\hat{s})]}{H_t(\hat{s})} s(\beta). \tag{59}$$

Expanding out for $s(\beta)$ leads to an alternative expression for $F(\beta)$:

$$F(\beta) = R^t \beta - \frac{\gamma_0 - \gamma_t}{(1 + \gamma_0)(1 + \gamma_t)} \frac{1 - H_t(\hat{s})}{\psi_{H_t}(\hat{s})}. \tag{60}$$

Looking at Equation 58, note that since the strike price is strictly above the bid when credit constraints are present, the reservation price is strictly above that of the lease auction. However, as we saw in the direct mechanism, the actual type for which this bid corresponds is strictly below the threshold type in the original auction. Thus, even though at first glance the option contract appears less efficient, credit constraints are actually improving first period efficiency while decreasing efficiency in the second period. ∎

7.2 Proofs from Main Text

THEOREM 1: This result stems directly from Myerson's optimal mechanism (Myerson (1981)). Let $\phi(F^i) = F^i - M + \frac{1}{\psi_A(F^i + M)}$ be the virtual valuation for buyer i. The optimal mechanism (Q, T) is an allocation rule Q and payment rule T such that:

$$Q_i = \begin{cases} 1 & if \, \phi(F^i) > \max_{j \neq i} \phi(F^j) \; and \, \phi(F^i) > \phi(D_1) \\ 0 & otherwise \end{cases} \tag{61}$$
$$T_i = max\{\phi^{-1}(D_1), max_{j \neq i} F^j\}$$

An English auction with reservation price $P = D_1 - M + \frac{1}{\psi_A(P+M)}$ has the same allocation rule as the optimal auction and thus by the revenue equivalence theorem is optimal. It also does not disclose the true valuation of the highest bidder in each period preventing this information from being used in future auctions.

THEOREM 2: With no credit constraints, the marginal utility of money is constant over time and thus the country is indifferent to the periods in which the contract generates payment. Leases with an English auction are surplus maximizing for the home country. Since the reservation prices for the option contract differs, the option contract can not be optimal. The difference between the optimal lease and the optimal option is that under options, contracting is done before the home country knows its valuation D_t. This can generate

situations in which the option price results in no trade in future periods even though, upon realization of D_t, trade would be optimal.

THEOREM 3: Since the future valuations of the objects are known, the reservation price of the option contract can replicate those of the lease auction perfectly. Further, since $\gamma_0 > \gamma_t$ for all t, the option contract dominates the lease auction by guaranteeing that all payments are received in period 0.

THEOREM 4: Without constraints, and assuming no preemptive sales by the government, a generation that is reached without a corrupt official that is serviced by a benevolent official gets expected value

$$max[P, E[D_t]] = [1 - H(P)][E(D_t|D_t \geq P)] + H(P)P), \tag{62}$$

where H is the CDF of possible home valuations. The NPV of an object with a free market is:

$$\frac{1}{1 - \delta(1 - \epsilon)}\big[[1 - H(P)][E(D_t|D_t \geq P)] + H(P)P\big]. \tag{63}$$

The NPV of an export ban is

$$\frac{1 - \delta\epsilon}{1 - \delta}[E(D_t)]. \tag{64}$$

The home country prefers an export ban if Equation 63 is less than equation 64. This condition is equivalent to requiring that

$$P \leq E(D_t|D_t \leq P) + \frac{\delta^2\epsilon(1 - \epsilon)}{1 - \delta}\frac{[E(D_t)]}{H(P)} \tag{65}$$

or

$$\underbrace{\big[H(P)P + [1 - H(P)]E(D_t|D_t \geq P - E(D_t)\big]}_{PerPeriodGainFromFlexibility} \leq \delta \underbrace{\frac{\delta\epsilon(1 - \epsilon)}{1 - \delta}[E(D_t)]}_{\substack{PerPeriodExpectedLoss \\ FromOneBadDictator}}. \tag{66}$$

At $\epsilon = 0$, the RHS of (65) is $E(D_t|D_t \leq P)$ which is less than P for $H(P) > 0$. Thus, with no corruption, free trade is optimal. As $\delta \to 1$, for $\epsilon \in (0, 1)$ the right hand side of (66) goes to infinity implying that an export ban is always optimal. Thus, there exists an arbitrarily small ϵ^* such that an export ban is superior to free trade with no preemption. Intuitively, the more patient a country is, the more it values the losses that occur if an object is stolen. As $\delta \to 1$ the losses that occur if an object is ever stolen weighs heavily in making a decision. This leads to a larger set of ϵ for which an export ban is optimal.

Under free trade, the period zero official also has the option to sell an object in order to preempt future corrupt officials from doing the same. Preemption generates a total surplus of $\frac{1}{1-\delta}P$. As $\epsilon \to 1$, the value of an export ban converges to $E[D_0] - M < \frac{1}{1-\delta}P$. Since $P < E[D_t]$, there exists a positive ϵ for which an export ban is better than preemption. Thus, as $\delta \to 1$, there exists an $\tilde{\epsilon}$ such that for $\epsilon < \tilde{\epsilon}$, an export ban is preferred to preemption. Since ϵ^* is arbitrarily close to zero, $\epsilon^* < \tilde{\epsilon}$ and thus there exists a range of corruption levels for which an export ban is preferred.

References

Akinade, O. (1999), 'Illicit traffic in cultural property in *N*igeria: Aftermaths and antidotes', *African Study Monographs* **20**(2), 99–107.

Bagli, C. (1993), 'Hot frieze, missing since 1989, found in madison's fortuna', N.Y. Observer, Aug. 16.

Bator, P. (1982), 'An essay on the international trade of art', *Stanford Law Review* **34**(2), 275–384.

Beech, H. (2003), 'Spirited away', Time, Oct. 20.

Benabou, R. & Tirole, J. (2007), Identity, dignity and taboos: Beliefs as assets, CEPR Discussion Papers 6123.

Boehn, M. (2005), 'New blockbusters: Traveling exhibits.', NPR: Talk of the Nation.

Borodkin, L. (1995), 'The economics of antiquities looting and a propsosed legal alternative.', *Columbia Law Review* **95**(2), 377–417.

Bresler, J. & Lerner, R. E. (2004), *Art Law: The Guide for Collectors, Investors, Dealers, and Artists*, Practicing law Institute, New York.

Butcher, K. & Gill, D. (1990), 'Mischievous pastime or historical science', *Antiquity* **64**, 946–50.

Coggins, C. (1972), 'Archeology and the art market.', *Science* **175**(4019), 262–266.

Dewatripont, M. (1989), 'Renegotiation and information revelation over time: The case of optimal labor contracts.', *Quarterly Journal of Economics* **104**, 589–619.

Erdem, S. (1993), 'A new trojan war.', Reuters, Oct. 13.

Gerstenblith, P. (2001), 'The public interest in the restitution of cultural objects (symposium, ownership and protection of heritage: Cultural property rights for the 21st century)', *Connecticut Journal of International Law* **16**, 197–246.

Gul, Sonnenschein & Wilson (1986), 'Foundations of dynamic monopoly and the coase conjecture.', *Journal of Economic Theory* **39**, 155–190.

Hart, O. & Tirole, J. (1988), 'Contract renegotiation and coasian dynamics.', *Review of Economic Studies* **55**, 509–540.

Kremer, M. & Jayachandran, S. (2006), 'Odious debt.', *American Economic Review* **96**(1), 82–92.

McAfee, P. & Vincent, D. (1997), 'Sequentially optimal auctions.', *Games and Economic Behavior* **18**(1), 246–376.

Myerson, R. (1981), 'Optimal auction design', *Mathematics of Operations Research* **6**, 58–73.

Pogge, T. (2001), 'Achieving democracy.', *Ethics and International Affairs* **15**(1), 3–23.

Prott, L. & O'Keefe, P. (1990), *Law and Cultural Heritage.*, Professional Books Limitied, England.

Ross, D. (1995), 'Disturbing history: Protecting mali's cultural heritage.', *African Arts* **28**(4), 1–10.

Roth, A. E. (2007), 'Repugnance as a constraint on markets.', *Journal of Economic Perspectives* **21**(3), 37–58.

Shyloon, F. (2000), The recovery of cultural objects by african states through the unesco and unidroit conventions and the role of arbitration., UNIDROIT Paper 2a-2000, Uniform Law Review / Revue de droit uniforme.

Wendel, P. T. (2007), 'Protecting newly discovered antiquities: Thinking outside the "fee simple" box.', *Fordham Law Review* **76**, 1016–1062.