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

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Abstract
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 would raise revenue for the country of origin while preserving national long-term ownership rights. By putting antiquities into the hands of the highest value consumer in each period, allowing leases would generate incentives for the protection of objects.

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JEL Classifications: D02, K42, Q34, Z11

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As part of an effort to preserve their cultural heritage, 140 countries ban the export of certain antiquities. One side effect of these export bans is a black market in antiquities. Artifacts often have a greater monetary value outside their country of origin, especially if that country is poor.[2] Because of closed legal markets and weak enforcement, owners often turn to illegal markets to sell objects abroad.

Illegal trade is surreptitious, and technologies that conceal antiquity trade often destroy archeological sites, damage objects, and reduce economic value. Looters use to fast methods of excavation such as bulldozers, dynamite, and pneumatic drills. 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] When objects are traded illegally, and therefore surreptitiously, 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]

As one example, archeologists estimate that over 50 percent of archaeological sites in Mali have been severely damaged or destroyed by illegal looting.[5] 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,

[2] 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).
[3] See Coggins (1972), Bator (1981), and Prott and O'Keef (1989) for many examples.
[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).
[5] See Ross (1995).

leading to an extremely limited knowledge of the number of objects still existing from the historical civilizations of in the region.

We argue that compared to complete export bans, allowing lease markets could raise revenue for artifact-rich countries and create incentives for maintenance and preservation, while maintaining 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, leases would generate incentives for the protection of objects and funds that could be used for the legal excavation of at-risk sites or other needs. Since future ownership rights are preserved, a country could manage its cultural heritage without restricting objects from flowing to highest value use.[6,7]

For example, in 1987, the government of Turkey sued the Metropolitan Museum to recover a portion of the Lydien Horde, a collection of roughly 35,000 objects that once belonged to King Croesus and which had been illegally excavated in 1966. After a protracted legal fight, the Metropolitan Museum eventually transferred ownership back to Turkey where the collection was put on display in the Ushak Museum in 1993. Since then the museum has struggled to preserve the collection and has had trouble generating income. It can only show 5 to 10 percent of the collection at any given time and grossed only 769 visitors between 2001 and 2006.[8] In late 2006, the curator of the museum and nine others were arrested for selling objects from the collection and replacing the objects with replicas. We believe that a better scheme would have been a lease program that

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[6] See Unesco Handbook (2005).

[7] Pope Pius II declared the first export ban in 1465 in an attempt to stop objects from leaving the Papal State. See Borodkin (1995).

[8] See Arsu and Robertson (2006).

rotated a portion of the collection back, as it would have generated revenue and reduced the incentives and chances of theft.

In Section 1, we first compare the decisions of an individual owner facing either free trade or an export ban in a benchmark model in which preserving items requires investment in maintenance and property rights are private. We show that under free trade, a rich owner of an object will have incentives to use an object locally in all periods, while a poor owner may have incentives to sell the object to a foreign collector outright. For owners with a moderate level of initial wealth, the optimal policy is to share usage rights intertemporally with a foreign collector, for example through a lease contract. Under free trade, owners will invest in maintaining and preserving the object. Under export bans, owners with sufficiently low initial wealth will not invest in maintenance.

In Section 2, we consider the policy of a government that is attempting to maximize social surplus when fellow citizens receive a positive externality from the object being intact and within the nation's borders. When taxes can be imposed costlessly, it is possible to obtain Pareto optimal allocations by using subsidies to keep antiquities intact and in the country. However, when taxes are inefficient, quantity constraints that limit the amount of time an object can leave the country may be second best. Export bans may be effective at realigning incentives for wealthier countries, but may lead to inadequate maintenance, black markets, and the permanent loss of art in places where owners are poor. For poor countries, allowing intertemporal sharing through a lease contract may increase home usage relative to a pure export ban by generating income and strengthening maintenance incentives.

In Section 3, we then introduce the probability that a corrupt ruler or bureaucrat in each generation tries to extract value from antiquities by selling them abroad at the expense of future generations. We show that in this environment, constitutions or international treaties imposing export bans may be preferable to free trade. In an effort to constrain the bad types, good agents may create legislation which limits both their actions and those of future generations. For reasonable parameter values, allowing leases may be preferable to either free trade or complete export bans.

In Section 4, we examine a model with no corruption but with asymmetric information regarding the value that agents put on 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 government 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 sales with an option to repurchase 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.

Finally, we look at what happens when collectors' valuations increase after taking possession of an object.[9] When foreign collectors are loss averse, sale and resale contracts are inefficient due to changes in the buyer's reference state between the two negotiations. We argue that lease contracts may be superior to sales and repurchase

[9] See McIntosh and Schmeichel (2004).

because it leaves the home country in control of negotiations after the reference point of the buyer has adjusted.

Our work is related to a previous literature. We see a lease approach as helping to fulfill many of the goals of both cultural nationalists such as Osman (1999) and Greenfield (1996) and internationalists such as Appiah (2006). Leases preserve local ownership and avoid alienation of the object while reducing looting, helping to preserve artifacts, and allowing international access.

Writing from a legal perspective, Bator (1982), Borodkin (1995), and Bednarski (2004) advocate the use of legal markets to reduce looting in developing countries. These papers concentrate on the increased information that is revealed when markets are legal and when private individuals have private information and partial ownership claims over the location of objects still in the ground. Our paper is complementary to these analyses, focusing on a simple case in which there is no asymmetric information regarding the object and property rights are clear in order to examine the impact of international sale and lease markets on antiquities.

Lease contracts in particular have been briefly mentioned in the popular press by Asgari[10] and Gerstenblith (2001). In both of these articles, leases are proposed as a way to move objects between museums in order to demand for new pieces from foreign countries. We believe this 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.

[10] Asgari argues that ten year leases may be used between major museums to reduce incentives to purchase illicit artifacts. See Erdem (2001).

The idea that export bans can constrain dictators is related to Kremer and Jayachandran (2002) and Pogge (2001), who address the potential of dictators to expropriate wealth from future generations by entering debt contracts or selling natural resources. Our results on the optimal contract structure is related to Hart and Tirole (1988) and Dewatripont (1989), who study short- and long-term lease contracts when future valuations are known but private.

There is precedent for art being leased to cross international borders. The King Tut exhibit now circulating the United States was leased to a private company in order to generate proceeds for Egypt. Such lease agreements are typically accompanied by contracts about transportation, display, and storage conditions in order to reduce moral hazard and come with a high level of insurance.[11]

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.

Section 1: Free Trade and Export Bans in a Benchmark Model

In this section we develop a benchmark model for the decision problem faced by a private owner of an artifact who chooses whether to invest in maintaining the object and

[11] The King Tut exhibit was underwritten by AEG, a US company. 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. See Boehn (2005)

whether to sell use rights to a foreign collector. We consider only two policy environments: one with completely free markets and one with a blanket ban on exports.

In order to concentrate on the contracting side of the problem, we consider an ideal environment in which ownership rights of the individual are clear and both credit and exchange markets are perfect. One can think of this baseline problem as that of a museum or church that is in possession of a unique piece of art. The institution must expend resources to protect the art from thieves and to prevent deterioration (for example through temperature control), which draws resources away from other forms of consumption.

We will show that under free trade the owner will retain the object if wealthy enough, sell it if poor enough, and share use with the foreign collector (for example through lease contacts) if of intermediate wealth. Export bans may reduce maintenance and lead to the destruction and loss of the object. Depending on parameter values, either free trade or export bans may keep the object intact and in the country longer.

1.1: The Owner's Response to Export Bans

Assume owners have a separable utility function with period discount rate δ of the form:

$$\max_{x_t, C_t} \sum_{t=0}^{\infty} \delta^t [U(C_t) + D_O x_t], \tag{1.1}$$

where D_O is the domestic usage value of an object to the owner of art and $x_t \in \{0,1\}$ is a binary variable that is 1 when the object is held domestically.[12] As is standard, we assume the utility of non-art consumption is concave and infinitely differentiable with $U'(C) > 0, U''(C) < 0$ and that the Inada conditions $U'(0) = \infty, U'(\infty) = 0$ hold.

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 who will damage the object.[13] 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.

A foreign collector has value of P > M in each period for the artifact. The foreign collector thus is willing to pay P-M for the use of the object each period, and always maintains the object. There is a per period domestic externality from keeping the object intact and in the country, D_E, which the owner of the good does not take into account.

Let $z_t \in \{0,1\}$ denote usage rights for the foreign collector in a period and $x_t \in \{0,1\}$ denote usage for the domestic owner. If maintenance is not undertaken in a period, the object is lost and hence x_t and z_t are both zero in that period and all future periods.

The owner of an object has initial assets W_{Total} that he must draw from in every period. We will take W_{Total} as exogenous, but it is worth noting that depending on how

[12] Quasi linearity is used in this model to highlight how export bans might affect countries with varying wealth differently and to simplify the transition to models with externalities. The results here are consistent with any utility function where the demand for each piece of art increases with wealth.
[13] With minor redefinition of variables, M can also include opportunity costs such as the revenue passed up from not selling an object to a smuggler or the cost of excavation and restoration of at risk sites.

well markets function inside the country, the object may wind up in the hands of the highest value domestic owner. This will typically be someone rich.[14] It turns out that it is convenient to write the owners' budget constraint in terms of choices of x_t and z_t instead of in terms of choices of maintenance expenditure. Assuming perfect markets with constant interest rate R such that $\delta R = 1$, the owner's budget constraints are:[15]

$$\begin{aligned}&(1)\ \sum \frac{1}{R^t} C_t + \sum \frac{1}{R^t} x_t M = \sum \frac{1}{R^t} z_t [P - M] + W_{Total}, \\ &(2)\ x_t + z_t \leq 1,\ x_{t+1} + z_{t+1} \leq x_t + z_t, x_t, z_t \in \{0,1\}.\end{aligned} \tag{1.2}$$

Given that $P > M$, an owner of an object who does not use an object in a period will sell use rights to the object abroad. As such, $x_t + z_t = 1$ and the owner's optimization problem becomes:

$$\begin{aligned}&\max_{x_t, C_t} \sum \delta^t [U(C_t) + x_t D_O] \\ &\textit{Subject To}: \\ &(1)\ \sum \frac{1}{R^t} C_t + \sum \frac{1}{R^t} x_t M = \sum \frac{1}{R^t} (1 - x_t)[P - M] + W_{Total}, \\ &(2)\ x_t \in \{0,1\}.\end{aligned} \tag{1.3}$$

In the appendix we prove that for $R \leq 2$, there exists an isomorphic mapping from $x_1,\ldots,x_t$ to a such that $\sum \frac{x_t}{R^t} = a$ for any $a \in \left[0, \frac{R}{R-1}\right]$. Thus we can rewrite $\frac{R-1}{R} \sum \frac{1}{R^t} x_t P$ as π_DP where $\pi_D \in [0,1]$. We can think of π_D as the proportion of time

[14] Poor owners of unregistered art may wish to hold on to objects as a way of keeping an informational advantage over the government and increasing their chance of being able to sell an object to a smuggler moving the object overseas.

[15] When δR > 1, the owner is patient and consumes more in future periods than today. Thus, there will always exist a future period in which the marginal rate of consumption is less that the marginal value of the object and the owner would like the object to come back. Likewise, when δR < 1, the owner is impatient and will eventually sell the object.

that the object is used <u>domestically</u> after adjusting for the discount rate. Using the Euler condition along with this simplification, we can rewrite the optimization problem as:

$$\begin{aligned}&\max_{\pi_D, C_0} U(C_0) + \pi_D D_O \\ &\textit{Subject To}: \\ &(1)\ \ C_0 = \frac{R-1}{R} W_{Total} + (P-M) - \pi_D P, \\ &(2)\ \ \pi_D \in [0,1].\end{aligned} \tag{1.4}$$

Theorem 1: When δR=1. There exists wealth levels $\underline{W}_{Free}$ and $\overline{W}_{Free}$ such that if $W_{total} < \underline{W}_{Free}$ the owner sells the object; if $W_{total} > \overline{W}_{Free}$ the owner holds the object; and if $\underline{W}_{Free} < W_{total} < \overline{W}_{Free}$ the owner shares usage with the foreign collector. Let π_D^* be the solution to:

$$U'\left(\frac{R-1}{R} W_{Total} + (P-M) - \pi_D P\right) = \frac{D_O}{P}. \tag{1.5}$$

The optimal usage share for the owner is given by:

$$\pi_D^{Free} = \begin{cases} 0 & \textit{if } \pi_D^* < 0 \\ \pi_D^* & \textit{if } \pi_D^* \in [0,1]. \\ 1 & \textit{if } \pi_D^* > 1 \end{cases} \tag{1.6}$$

Proof: All proofs are in the Appendix.

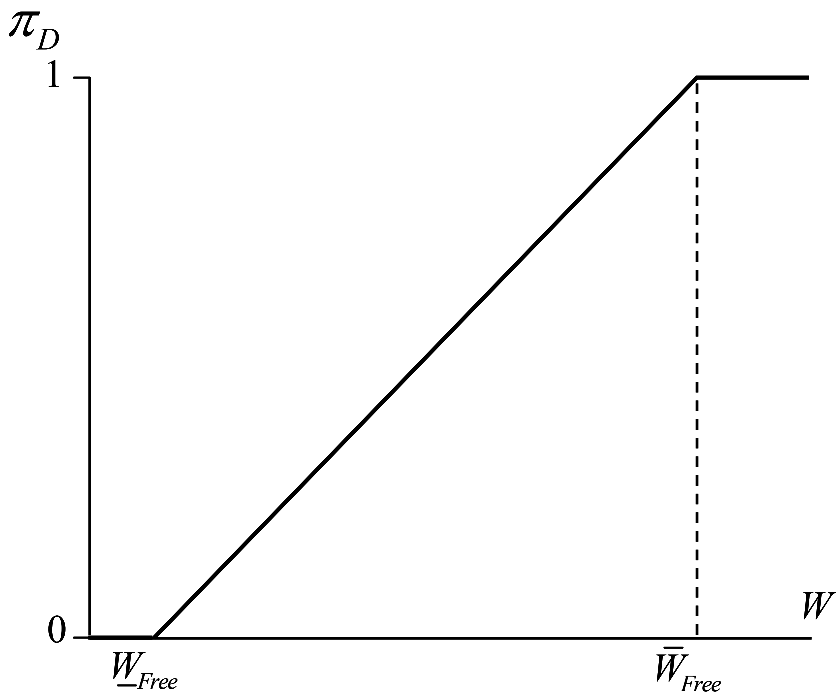

Figure 1**: Discounted Proportion of Time Object Remains Intact and In Country Under Free Markets as a Function of Owner's Wealth.**

Figure 1 shows an example of the relationship between the optimal sharing rule and total expected endowment in the case of a quadratic utility function. When the endowment is low, the owner sells the object to the foreign collector and spreads the income across all periods. As his initial endowment increases, the domestic agent's marginal utility of consumption decreases and the owner begins to trade off increased consumption for increased usage.[16]

We can think of an artifact as acting as an alternative stream of wealth. Sharing converts a portion of the artifact's inherent value into consumption. Domestic owners with extremely low (high) endowments have an incentive to sell (hold) an artifact since

[16] This tradeoff is linear since $U'(C_0)$ is equal to a constant and $C_0 = \frac{R-1}{R} W_{Total} + P - M - \pi P$ is linear in W_{Total} and π.

their marginal utility of consumption is high (low). For intermediate endowments, the domestic owner tries to balance the marginal value of use with the marginal value of consumption. Since δR = 1, the agent is indifferent in which subset of periods he rents as long as he is able to construct a π_D that solves (1.5).

We now consider how the owner's behavior is affected by an export ban. Recall that with perfect credit markets the owner faces the following set of constraints:

$$\begin{aligned}&(1)\ \sum \frac{1}{R^t} C_t + \sum \frac{1}{R^t} x_t M = \sum \frac{1}{R^t} z_t [P - M] + \sum \frac{1}{R^t} W_{Total}, \\ &(2)\ x_t + z_t \le 1,\ \mathrm{x}_{t+1} + z_{t+1} \le x_t + z_t, x_t, z_t \in \{0,1\}.\end{aligned} \tag{1.7}$$

With foreign markets closed, $z_t = 0$ for all t. The owner's maximization problem is thus:

$$\begin{aligned}&Max_{C_t, x} \ \sum \delta^t [U(C_t) + x_t D_O] \\ &\textit{Subject To}: \\ &(1)\ \sum \frac{1}{R^t} C_t + \sum \frac{1}{R^t} x_t M = W_{Total}, \\ &(2)\ x_t \le 1, x_{t+1} \le x_t, x_t \in \{0,1\}.\end{aligned} \tag{1.8}$$

As with the case without an export ban we can use the Euler conditions of this problem to simplify (1.8). Assuming δ is close to 1 so that periods are arbitrarily small and ignoring the integer problem, we let $\pi_D = \left[1 - \left(\frac{1}{R}\right)^{T^*+1}\right] + \varepsilon$ where $\pi_D \in [0,1]$.[17]

Since optimal consumption will be constant across periods, (1.8) can thus be replaced by:

$$\begin{aligned}&Max_{c_0, \pi_D} U(C_0) + \pi_D D_O \\ &ST: C_0 = W_{Total} - \pi_D M, \\ &\qquad \pi_D \in [0,1].\end{aligned} \tag{1.9}$$

[17] Alternatively, we can assume that the agent can hold the unit for part of a period – this would convexify the last period and solve the integer problem. See the Appendix for more details.

Theorem 2: When export bans exist and δR = 1, there exists $\underline{W}_{Ban}$ and $\overline{W}_{Ban}$ such that if $W_{total} < \underline{W}_{Ban}$ the owner immediately fails to maintain the object; if $W_{total} > \overline{W}_{Ban}$ the owner preserves the object; and if $\underline{W}_{Ban} < W_{total} < \overline{W}_{Ban}$ the owner maintains the object for a limited amount of time before allowing it to be lost or stolen. Let π_D^{**} be the solution to:

$$U'\left(\frac{R-1}{R}W_{Total} - \pi_D M\right) = \frac{D_O}{M}. \qquad (1.10)$$

The optimal usage share for the owner is given by:

$$\pi_D^{Ban} = \begin{cases} 0 & if\ \pi_D^{**} < 0 \\ \pi_D^{**} & if\ \pi_D^{**} \in [0,1]. \\ 1 & if\ \pi_D^{**} > 1 \end{cases} \qquad (1.11)$$

An owner faced with closed markets considers a tradeoff between preservation and consumption just as the owner facing open markets made decisions between consumption and usage. A poor owner does not invest in maintenance, allows the object to be destroyed immediately, and uses his endowment solely for consumption. For moderate endowments, the owner equates marginal consumption with the marginal utility of owning the object and then sets aside enough reserve to maintain the object for a finite time. In a more realistic setting where theft is probabilistic, we can think of this outcome as an agent exerting a lower amount of effort over time which leads to a higher probability of damage in later periods.

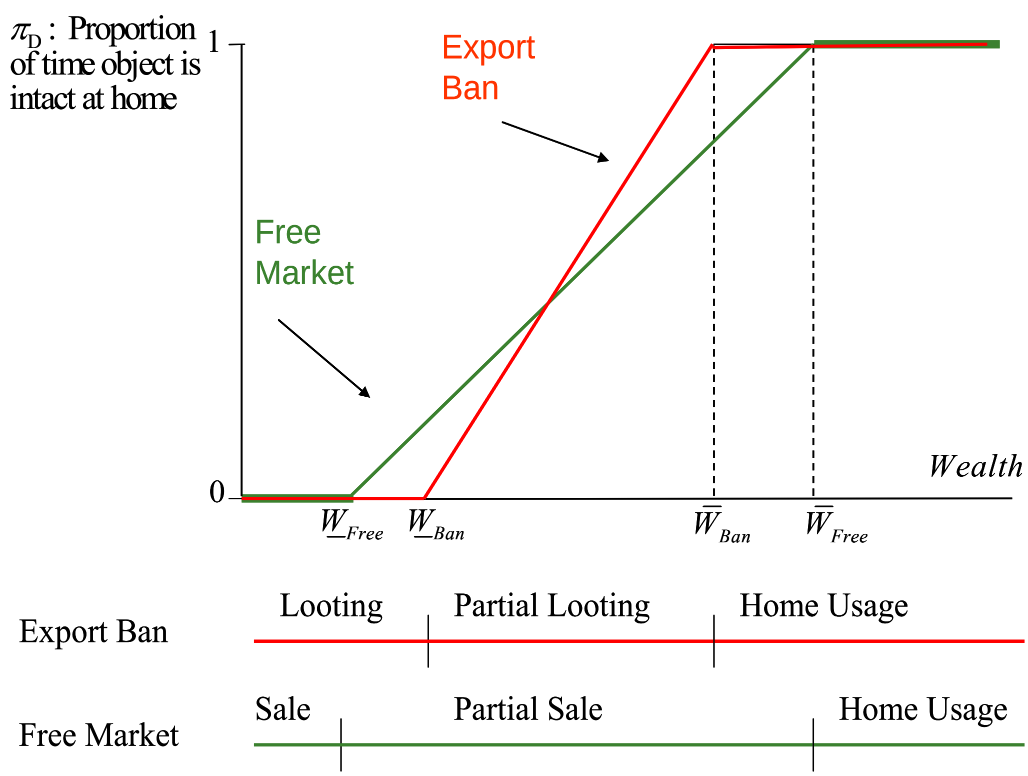

Figure 2**: Discounted Proportion of Time Object Remains Intact and In Country Under Free Markets and Export Bans as a Function of Owner's Wealth.**

Figure 2 plots the discounted proportion of time an object stays in the country as a function of the owner's wealth. Recall that the first order condition for the free market and the market with export bans are:

$$\begin{aligned} &\text{Free Market: } U'\left(\frac{R-1}{R}W_{Total} + (P-M) - \pi_D P\right) = \frac{D_O}{P}, \\ &\text{Export Ban: } U'\left(\frac{R-1}{R}W_{Total} - \pi_D M\right) = \frac{D_O}{M}. \end{aligned} \tag{1.12}$$

Since both these equations are equal to constants, a decrease in wealth in both equations leads to a linear decrease in π_D.

One reason that export bans might exist is as a way to increase the time that objects stay intact in the country of origin. Recall that $\overline{W}_{Free}$ and $\overline{W}_{Ban}$ are the wealth levels such that the first order conditions are satisfied with equality and $\pi_D = 1$. Since $P > M$, $\frac{D_O}{P} < \frac{D_O}{M}$, and by the concavity of the utility function $\overline{W}_{Ban} < \overline{W}_{Free}$. For endowments between these values, export bans keep an object in the domestic market forever while free markets lead to some level of shared usage.

Unlike the upper bounds of sharing, the ordering of the lower bounds depends on the concavity of U. Setting $\pi_D = 0$ in (1.12), $\underline{W}_{Free}$ and $\underline{W}_{Ban}$ satisfy:

$$\begin{aligned} &\text{Free Market: } U'\left(\frac{R-1}{R}\underline{W}_{Free} + (P-M)\right) = \frac{D_O}{P}, \\ &\text{Export Ban}: U'\left(\frac{R-1}{R}\underline{W}_{Ban}\right) = \frac{D_O}{M}. \end{aligned} \tag{1.13}$$

The ordering of these values varies with the concavity of the utility function and on the relative size of D, P, and M. When the difference between $\overline{W}_{Free}$ and $\overline{W}_{Ban}$ is smaller than $\frac{R[P-M]}{R-1}$, there exists at least one wealth level where the owner of the object is worse off and domestic use decreases under an export ban relative to a free market.[18]

Thus for high endowments, export bans lead to a larger amount of home usage than when there are no bans and may not lead to theft. For moderate to low endowments, export bans may lead to less domestic usage of artifacts because agents are unable to lease the object and use the proceeds for maintenance. Depending on the distribution of

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[18] $\underline{W}_{Free} - \underline{W}_{Ban} = [\overline{W}_{Free} - \overline{W}_{Ban}] - \frac{R[P-M]}{R-1}$. If this is negative, there is a point where the allocation is positive for the free market but zero for the export ban market.

wealth and initial allocation of artifacts in a country, an export ban may not only lead to the destruction of artifacts, but to a smaller fraction of objects existing in the country of origin.

An export ban may be welfare improving if it keeps the object in the country of origin for an extended period of time and if the externality for keeping the object in the country, D_E, is large. Export bans are a constraint imposed on the owner of an object. If the foreign collector places more value on the object, the constraint is binding and fundamentally reduces the possible utility of the owner. From a social perspective, an export ban will be preferable to free trade if:

$$\left(\pi_D^{Export} - \pi_D^{Free}\right)(D_O + D_E) \geq U(C_0 \mid \pi_D^{Free}) - U(C_0 \mid \pi_D^{Export})$$

where

$$U(C_0 \mid \pi_D) = U\left(\frac{R-1}{R}W + (P - M) - \pi_D P\right).$$

The above discussion suggests that export bans may have significantly different effects in rich versus poor countries. In a country such as Italy where artifacts are typically in the hands of the affluent and where the average income is high, export bans may increase the amount of time an object stays in the country without increasing the theft and destruction rate of objects. In a poor country such as Mali, however, many objects are buried in areas of high poverty with the location of objects known only by the local population. At least in the model, this combination leads to a deterioration of protection when bans are put into place in poor locales.

Section 2: The Government's Problem

In Section 1 we developed a benchmark model of the decisions of an individual who has ownership of an object. Our benchmark model resulted in four main results:

1) Export bans constrain the decision problem of the owner and may lead to a reduction in maintenance and the destruction of objects.

2) For some parameter values, export bans may increase the amount of time an object persists intact in the country of origin.

3) For some parameter values, it is privately optimal for the domestic owner to share usage between domestic and foreign usage.

4) Export bans may improve or decrease social welfare relative to free trade depending on the magnitude of the externality and the maintenance decision of the owner.

As is typical with moral hazard problems, when taxation is frictionless, a tax system that can use lump sum transfers for redistribution purposes and taxes and subsidies to resolve the externality can reach the first best. In particular, the externality can be internalized by a subsidy to the owner of D_E for every period the object remains intact and in the country. This will induce optimal maintenance and export decisions. Transfers can be used to achieve any distributional objectives. Export taxes will also achieve the first best for owners with sufficient wealth but these are inferior to subsidies for owners with low wealth, since they do not provide maintenance incentives.

In reality, governments may be reluctant to subsidize wealthy owners of antiquities, estimating the externality is difficult, and bureaucrats in charge of taxes and subsidies may be corrupt. Corruption may make a subsidy program difficult to operate. The incentive conflict model presented in the appendix considers a case in which high (H) and low (L) quality artifacts are randomly distributed across a large number of potential domestic owners and the government wants to create an incentive program for people to reveal these antiquities. If potentially corrupt bureaucrats must judge the value of revealed objects, an asymmetric information model suggests that a subsidy program may be inefficient, especially if the government might like to discriminate over what objects it keeps. Under these conditions an incentive program for people to reveal local antiquities would expand to become far larger than the optimal program size, and would be partially comprised of bribes which the government may view as wasteful. (See Appendix 2)

In this section we examine the optimal policy when taxes and subsidies are distortionary. For the sake of clarity, we assume that they are completely inefficient, but the government can regulate the proportion of time an object may be shared abroad.[19]

Recall from Section 1 that an infinite horizon model with perfect markets and a discount rate larger that ½ can be rewritten as a single period model where the discount weighted share of time an object stays in the home country is between 0 and 1. Define π_D, π_F as the proportion of time that an object is maintained domestically and leased/sold to a foreign buyer. The social planner's problem reduces to implementing a π_D that solves:

$$\max_{\pi_D} U(\frac{R-1}{R}W_{Total} + P - M - \pi_D P) + \pi_D(D_o + D_E). \tag{2.1}$$

The first best solution sets $\pi_D \in [0,1]$ such that:[20]

[19] We restrict our attention to regulation that can restrict the percentage of time an object can leave the nation but does not regulate the exact periods. Legislation that requires an object to stay in the country for a certain amount of time before export increases the reachable set of domestic usage in this simple model but suffers in more complicated environments with credit constraints, stochastic endowments, or asymmetric information.

$$U'(\frac{R-1}{R}W_{Total} + P - M - \pi_D P) = \frac{D_O + D_E}{P}. \qquad (2.2)$$

Theorem 3: When taxes and transfers are not available, the government can achieve the second best solution by setting a constraint on the amount of time an object can leave the country.

A country that cannot efficiently tax the sale of art may find it optimal to use laws forbidding foreign sale as a way of aligning owner incentives with country incentives. However, since the owner always has the option of not maintaining the object, the government must take into consideration the owners' wealth as a constraint. A policy that constrains the amount of time an object can leave the country provides some of the income generating power of the free market while inducing the substitution patterns of an export ban. The longest time that a government can induce the owner of an object to keep it is given in the next theorem.

Theorem 4: Let $\underline{\pi}$ be the solution to:

$$U'\left(\frac{R-1}{R}W_{Total} + [P-M] - \pi_D P\right) = \frac{D_o}{M}. \qquad (2.3)$$

The largest π_D reachable by a social planner when the owner's wealth is W_{Total} is:

$$\pi_D^{\text{Reach}} = \begin{cases} 0 & if\ \underline{\pi} < 0 \\ \underline{\pi} & if\ \underline{\pi} \in [0,1]. \\ 1 & if\ \underline{\pi} > 0 \end{cases}$$

[20] As before, this equality holds for intermediate values of π_D.

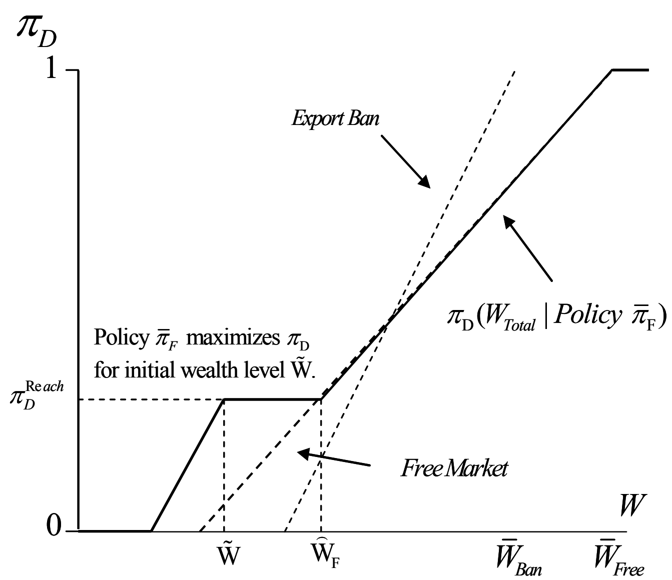

Figure 3a: Owners choice of π_D as a function of wealth under policy $\bar{\pi}_F$

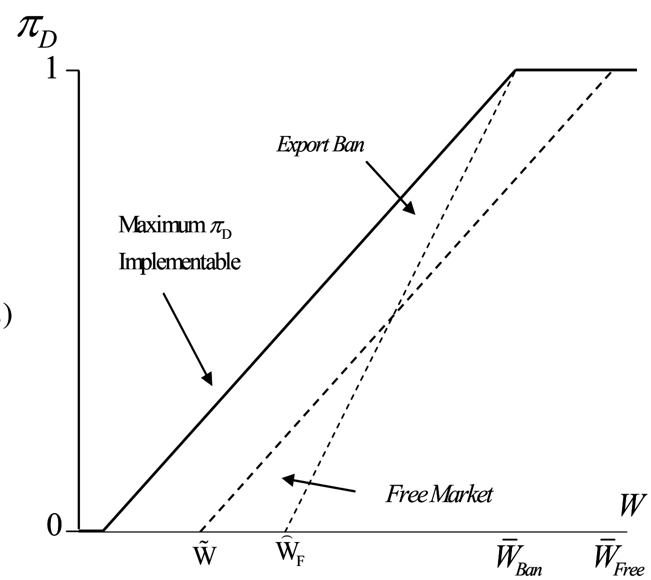

Figure 3b: Maximum Reachable π_D

Figure 3a depicts the optimal policy chosen by a government that seeks to make home usage as large as possible for an owner with initial wealth $\tilde{W}$. Under a free market, the owner of the object would like to sell a larger share of the object than is allowed by the government and thus is constrained. He first leases the object abroad up to the maximal amount of time and then makes a decision on whether to maintain the object for the time he is required to hold it at home. Given the income generated by the foreign lease, the policy that leaves the object in the home country the longest is one that makes the owner of the object just well enough off that he would choose to always maintain the object instead of letting it be stolen.

As shown in Figure 3b, tracing out this policy for any initial wealth level, we see that the maximum reachable set of home usage as a function of wealth is parallel to the free market line but shifted to the left by the distance between $\bar{W}_{Free}$ and $\bar{W}_{Ban}$. In a sense, the optimal policy leverages the income generating power of the free contract while still binding the agent as much as possible before the owner elects to shirk on maintenance. Finding the largest reachable π_D for a given wealth level thus amounts to selecting a sharing rule such that an agent with just slightly less wealth would not maintain the object in all periods.

Lemma 4a: When taxation is not possible, for a given initial wealth $\widehat{W}$ let $\underline{\pi}_D$ be the value of π that solves:

$$U'\left(\frac{R-1}{R}\widehat{W}+[P-M]-\pi P\right)=\min\left(\frac{D_o+D_E}{P},\frac{D_o}{M}\right). \tag{2.4}$$

The optimal sharing rule that is incentive compatible is given by:

$$\pi_D^{SB*}=\begin{cases}0 & \underline{\pi}_D<0\\ \underline{\pi}_D & \underline{\pi}_D\in[0,1].\\ 1 & \underline{\pi}_D>0\end{cases}$$

Wealth and the ratio of value to maintenance costs both play an important role in defining the optimal policy. In a relatively wealthy country, a straight export ban may approximate the optimal second best policy. In a developing country, D_o/M may be small and the wealth level of owners may be low. Under these circumstances, a straight export ban can lead to a much lower level of domestic usage than a policy that allows for the sharing of usage rights.

Section 3: Corruption and Intergenerational Conflict

In this section we argue that if there is a probability of a corrupt government each period which seeks to appropriate the value of the object from future generations, constitutions or international treaties restricting international art transactions may be optimal. Complete export bans can be seen a way of attempting to constrain bad agents at the cost of restricting good agents 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.

Suppose that at some initial time zero, a government run by a benevolent leader can adopt a constitution or sign an international treaty that binds itself and all future regimes. Decisions in subsequent periods are made by a leader who acts as a social planner with probability (1-ε) but who maximizes his own consumption with no regard for current or future generations with probability ε. Bad leaders will confiscate and consume all expropriable wealth in the country. If they can do so, they will export the object and consume the proceeds. (Although we model the decision maker as the leader of the country who has temporary control over all assets in the country, the analysis would be similar if the decision maker were a corrupt bureaucrat who takes a bribe in exchange for choosing too low an export tax in an environment where an optimal export tax could achieve the first best.)

We assume that the value D_E is stochastic with independent and identically distributed shocks and CDF G(.). A good leader who has no constraints on his action allows an object to be used by the foreign collector any time $D_O + D_E < P$ and keeps the object local otherwise.[21] Under an export ban, the object always stays in the country resulting in a value of $D_O + E[D_E]$.

Theorem 5: If export bans are the only policy that may be implemented by the government, as $\delta \to 1$ there exists a value $\varepsilon^* \in (0,1)$ such that if $\varepsilon < \varepsilon^*$ the government maintains a free market and if $\varepsilon \in (\varepsilon^*, 1-\varepsilon^*)$ the government passes an export ban.

In this model, export bans act as a very blunt tool to constrain bad future leaders 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 actors 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 $Max(P, D_O + D_E) - M$ each period before the first bad leader arrives. Afterwards it gets nothing. The net present value of this stream is:

$$\sum_{t=0}^{\infty} \delta^t (1-\varepsilon)^t [Max(P, D_O + D_E) - M]. \tag{3.1}$$

[21] A benevolent dictator may also sell an object and distribute the earnings during his rule to prevent future bad dictators from expropriating this value. We assume that $P < D_O + E(D_E)$ so that such preemptive distribution is always dominated by an export ban.

Under an export ban that successfully binds bad leaders, the country receives a maximum NPV of: [22]

$$\sum_{t=0}^{\infty} \delta^t (1-\varepsilon)^{\min(t,1)} [(D_O + D_E) - M]. \tag{3.2}$$

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

$$\sum_{t=0}^{\infty} \delta^t (1-\varepsilon)^{\min(t,1)} [Max(P, D_O + D_E) - M]. \tag{3.3}$$

This implies that for any positive ε, allowing leases but not sales dominates free trade. If P exceeds $D_O + D_E$ by a sufficient amount, and if ε is not too large, then allowing leases but not sales is preferable to a complete export ban.[23]

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.

Section 4: Transaction Costs and the Role of Leases

In this section we explore how asymmetric information and uncertainty about the future shape the optimal contract for sharing objects abroad. When a country is initially poor but sees the potential of wanting objects back in the future, it must decide how best

[22] We implicitly assume that bad leaders will still consume the usage value of an object in the period that they are in power but that the export ban is otherwise successful. We view this as an upper bound of social value with export bans since in reality export ban laws are typically porous.
[23] Analogous to an export ban, preemptive distribution is also dominated by leases for moderate levels of corruption.

to move the object and secure its return. When the government's future valuation for an object is unknown, sale and repurchase contracts 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 sale with an option to repurchase allows the government to exert influence on future negotiations and mitigate this hold up problem.

We present a simple case where the government owns an object initially but is uncertain about the value of the object to the home country in the future. Ownership of an object gives the owner the power to choose the mechanism through which future negotiations are conducted. With commitment power and no credit constraints, we show that lease contracts are optimal in this case and dominate both sale and repurchase contracts and option contracts. We then extend this analysis to take into account possible endowment effects by foreign buyer to highlight further inefficiencies in sale and repurchase contracts.

4.1: Asymmetric Information

We concentrate here on a situation in which the original owner of a good is a benevolent government so that the object has per period domestic value $D_t = D_{O,t} + D_{E,t}$, $t = 1, 2, \ldots$. The country is poor initially so that $D_1 = 0$. However, there is potential for it to grow rich in the future and thus it would like the option to repatriate the object in the future.

In our model, ownership of an object gives the owner the power to choose the mechanism that is used in future exchange. Thus, in the first period, the government has the power to select the mechanism by which an object is sold. If the object is sold to the foreign buyer in the initial period, that foreign seller selects the mechanism in future negotiations. We assume that both the government and foreign buyers have the power to commit to any mechanism that they choose.

In order to concentrate on transaction costs, we simplify the benchmark model for the government in two ways. First, we assume that the domestic value D_t changes between period 1 and period 2 but that all exogenous variation is resolved at this point. Let D_2 be distributed according to a bounded CDF H(.). Second, we ignore the possibility that the home country wants to split ownership in future periods.

Assume that there are N foreign collectors who share a common linear utility function:

$$V^i(C,x) = \sum_{t=1}^{\infty} \delta^{t-1}[C_t + F^i x_t]. \tag{4.1}$$

Each foreign collector has a private value for art consumption F^i independently drawn from a CDF A(.) which is constant over time, has an increasing hazard rate, and is bounded between $\underline{F}$ and $\overline{F}$. Given linear preferences, with the price of consumption normalized to 1, the value F^i is also the willingness to pay for a foreign collector who has no expectation of selling an object back to the home country. Without loss of generality, we assume that the valuation of buyers is ordered from lowest to highest. Thus F^N represents the highest valued bidder and F^{N-1} represents the second highest bidder. We avoid issues of the winner's curse by assuming that all agents share identical information about the home country's future value distribution and eliminate buyer side budget constraints by assuming that $\frac{R-1}{R}C_{Init} \geq \max(\overline{F}, \overline{D})$.

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

	Domestic	*Foreign*
Period 1	$D_1 = 0$	$F^i \sim A(.)$
Period 2+	$D_2 \sim H(.)$	F^i

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

To avoid corner solutions, we assume that H has sufficient variance such that $H(\underline{F}) < 1$ and $H(\bar{F}) > 0$. Asymmetric information surrounding the government's willingness to pay for an object is most likely more acute than foreign collectors' valuations. In most government decisions, an official is 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. In addition, a government selling an object abroad often has many potential buyers. By using an auction, the government can reduce the inefficiency surrounding the trade.

4.1.1 Sales and Repurchase Contracts

Looking first at sale and repurchase schemes, recall that ownership bestows the power to design the mechanism for future trade. Suppose that the foreign collector with the highest value F^N wins the auction in period 1 and wants to resell the object back to the home country in period 2. Since all values are constant in period 2 onward, the final offer price is simply the aggregation of identical per period offer prices. To avoid carrying discount terms, we write the analysis in terms of this single per period price. Given that the foreign collector's utility function is linear, he solves the standard monopoly problem in each period: [24]

$$\max_P \ [P-(F^N-M)][1-H(P+M)]. \tag{4.2}$$

For readability, we define

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

and designate the hazard rate of distribution H and A as:

$$\lambda_H(\tilde{P}) = \frac{h(\tilde{P})}{1-H(\tilde{P})}, \lambda_A(\tilde{P}) = \frac{a(\tilde{P})}{1-A(\tilde{P})}.$$

Taking the first order condition of equation (4.2), the solution takes on the familiar monopoly solution:

$$P^M = F^N - M + \frac{1}{\lambda_H(\tilde{P}^M)}. \tag{4.3}$$

The total utility for the foreign collector in period 2 onward is thus:

$$\frac{1}{1-\delta}\left[F^N - M + \frac{[1-H(\tilde{P}^M)]}{\lambda_H(\tilde{P}^M)}\right]. \tag{4.4}$$

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 artifact to a foreign collector with value F^i is:

[24] Solving for a single sale price is equivalent to solving for the optimal price in each period and aggregating up. Since all values are constant in period 2 onward, the final offer price is simply the time discounted per period offer prices.

$$V^i(F^i) = \frac{1}{1-\delta}\left(F^i - M\right) + \frac{\delta}{1-\delta}\left(\frac{[1-H(\tilde{P}^M)]}{\lambda_H(\tilde{P}^M)}\right). \qquad (4.5)$$

There is a one-to-one transformation from F^i into his actual purchase value $V^i(F^i)$. Thus, given independent and private values, there exists a symmetric bid function from values $V^i(F^i)$ into bids $\beta^i(V^i(F^i))$. Let V^{N-1} be the distribution of the second highest value for the artifact. If there is no reservation price in the initial auction and a first price auction is run each agent bids:

$$\beta^i(V^i) = E(V^{N-1} \mid V^{N-1} < V^i). \qquad (4.6)$$

As $\lim_{N\to\infty}$, $\beta(V^N) = V^N$ and the profits of the foreign collector 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 2. While these rents are recaptured by the domestic owner in period 1, 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:

$$P^{FB} = F^N - M.$$

In a sale and repurchase scheme, $P^M \geq P^{FB}$ and thus objects stay in foreign hands for an inefficient amount of time.

Whereas objects that leave the country in the future stay in foreign hands too long, inefficiency may also cause the home country to block sales in the initial period. As a simple example, assume that $N \to \infty$ so that $F^N = \overline{F}$. Comparing the revenue that the home country expects to receive in period 2 onward when it has control of the auction mechanism versus when it does not, the home country expected future loss from a sale is:

$$\underbrace{\frac{\delta}{1-\delta}}_{\substack{Discount \\ Multiplier}} \underbrace{\left[H(\tilde{P}^M)-H(\bar{F})\right]}_{\substack{\text{Probability of} \\ \text{Inefficient Trade}}} \underbrace{\left[E(D_2 \mid \bar{F} \le D_2 \le \tilde{P}^M)-\bar{F}\right]}_{\text{Expected Loss}}. \tag{4.7}$$

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. Given the compound nature of this expected loss, the magnitude of this inefficiency may be greater than $\bar{F}$, the gains generated from trade in the first period. In such cases, the home country has incentives to hold the object until uncertainty is resolved resulting in an inefficient first period allocation.

4.1.2 Leases

At its core, the problem with a sale and repurchase scheme 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 buyers' valuations. Consider a lease auction in which the government leases the object to the foreign agent in the first period but retains future ownership rights. As is well known from the auction literature, an agent running multiple auctions cannot improve his final outcome by using information about the winning bid from the first auction in later auctions. We thus assume the agent 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 identity of this bidder 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:

$$a^N(F) = \begin{cases} \dfrac{a(F)}{1 - A(F^{N-1})} & F > F^{N-1} \\ 0 & otherwise \end{cases}. \tag{4.8}$$

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

$$\max_P [1 - A^N(\tilde{P})]P + A^N(\tilde{P})[D_2 - M]. \tag{4.9}$$

Noting that since:

$$A^N(\tilde{P}) = \frac{\mathrm{A}(\tilde{P}) \text{ - } \mathrm{A}(F^{N-1})}{\text{1-}\mathrm{A}(F^{N-1})}, \tag{4.10}$$

$\mathrm{A}(F^{N-1})$ drops out of the FOC leaving an optimal sale price of:

$$P = \max\left(D_2 + \frac{1}{\lambda_A(\tilde{P})}, F^{N-1}\right) - M. \tag{4.11}$$

What is most interesting with this result is that the optimal pricing rule from (4.11) 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 6: When the government's utility function is linear and buyers' valuations are independent and identically distributed, the optimal allocation mechanism is to lease objects each period using an anonymous English auction with reservation price:

$$P_t^{RES} = D_t + \frac{1}{\lambda_A(\tilde{P})}.$$

4.1.3 Option Contracts

An alternative to leases is to sell an object to the foreign buyer with an option to repurchase the object in the future at a fixed price r. As in 4.1.1, let D_2 be the value of the object to the home country in the second period. As before, assume that there are N foreign collectors with a value F^i in both the first and second period.

Determining the optimal reserve price in period 2 is complicated by the fact that the actual value of the object is unknown ex ante. The home country has two instruments – the reserve price P_t^{RES} and the option price r_2 at which it could repurchase the object in period 2. In order to constrain itself from exercising contracts for arbitrage purchases, the option price of an object must be greater than or equal to its price. Thus $r_t \geq P_t$ and we have the following theorem:

Theorem 7: When the government's utility function is linear and buyers' valuations are independent and identically distributed, the optimal mechanism using a sale and option to repurchase is an English auction that sells ownership rights for each period independently with a reservation price of:

$$P_t^{RES} = \delta^t \left[E(D_t \mid D_t < \tilde{P}_t^{RES}) + \frac{1}{\lambda_A(\tilde{P}_t^{RES})} - M \right]. \tag{4.12}$$

The optimal option price in this contract is to set the option price equal to the sale price in each period adjusted by the rate of return.

Option auctions differ from lease auctions in that they can generate a much larger surplus in the initial period for consumption. In an option contract, the object is sold in the first period, allowing a country the ability to consume more than F^{N-1} in period 1. In cases where the government is credit constrained, the flexibility in consumption that option auctions allow may be advantageous.

Option auctions also differ from lease auctions because negotiation about future states is done ex ante. In a model where valuations are private but known to all agents, ex ante negotiation may be advantageous because it prevents information from one auction from being used in a second auction. Here, however, because the future valuation of an object is unknown to all parties, ex ante negotiation leads to a change in the optimal reserve price and potentially time inconsistency. Upon realization of D_2, the government may have incentives to exercise the contract and offer to resell the object back to the foreign buyer. Such actions reintroduce problems with information propagation.

In an environment in which there is no corruption and the government knows its future valuation, the efficiency of the lease and option contracts are the same. In this case, where there is no corruption but credit concerns exist, an option contract dominates both the lease and a sales and repurchase contract. However, in the case where future valuations are unknown and credit constraints do not exist, leases dominate both option contracts and sale and repurchase contracts.

Theorem 8: 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.

4.2: Loss Aversion- Exogenous Reference Points

The social psychology literature suggests that many collectors' valuations of an object increase after taking possession of it. Such attachment creates inefficiencies any time the owner and private collector renegotiate display rights with changed ownership.

We model the attachment effect as stemming from loss aversion. Assume that there exists a foreign collector who is loss averse with a reference dependent utility function that values art consumption x_t and non art consumption C_t in each period. Following Kosegi and Rabin (2004, 2006) we assume that the foreign collector's utility function is composed of two separable parts: the pure consumption utility of a bundle and a reference dependent gain-loss value of a bundle: [25]

$$U(C, x \mid r_C, r_x) = \sum_{t=0}^{\infty} \delta^t v(C_t, x_t \mid r_{C_t}, r_{x_t}),$$

where

[25] We again choose a linear pure consumption utility function for simplicity. Using the linear-log utility of the first section does not significantly affect our results.

$$v(C_t, x_t \mid r_{C_t}, r_{x_t}) = \underbrace{C_t + x_t F}_{Consumption\ Utility} + \underbrace{\mu[C_t - r_{C_t}] + \mu[Fx_t - Fr_{x_t}]}_{Gain-Loss\ Utility}.$$

Define $\mu(x)$ as a "universal gain-loss function" with the following properties[26]:

$$\begin{aligned}
&(1): \ \mu(\text{x}) \text{ is continuous for all x, twice differentiable for x} \neq 0 \text{ and } \mu(0) = 0\\
&(2): \ \mu(\text{x}) \text{ is strictly increasing.}\\
&(3): \ \mu''(x) = 0 \text{ for all x} \neq 0\\
&(4): \text{ if } y > x > 0 \text{ then } \mu(y) + \mu(\text{-}y) < \mu(x) + \mu(\text{-}x)\\
&(5): \ \mu'_-(0) / \mu'_+(0) \equiv \lambda > 1
\end{aligned} \qquad (4.13)$$

$\mu(x)$ is linear for positive and negative values of x but has a steeper slope for losses than gains. Let $\mu(x) = \eta x$ for $x > 0$. By (3) and (5), this implies that when $x < 0$, $\mu(x) = \lambda \eta x$ with $\lambda > 1$. Agents who internalize a loss in one consumption dimension and a gain in the other will be reluctant to move away from the reference point even if consumption utility remains constant.

Consider first the case in which an agent's reference point is based on his initial state. When an agent does not own the object, as in figure 5a, his reference point is $r_1 = (C_{Init}, 0)$. A reduction in non art consumption to C in exchange for an increase in art consumption to x yields to a change of utility of:

$$v(C, x \mid r_1) - v(r_1 \mid r_1) = (1 + \lambda\eta)[C - C_{Init}] + (1 + \eta)Fx.$$

[26] The universal gain-loss functions are identical to Bowman, Minehart, and Rabin (1999) where the gain-loss function is assumed to be linear in sensitivity. See also Tversky and Kahneman (1979) and Kahneman and Tversky (1991).

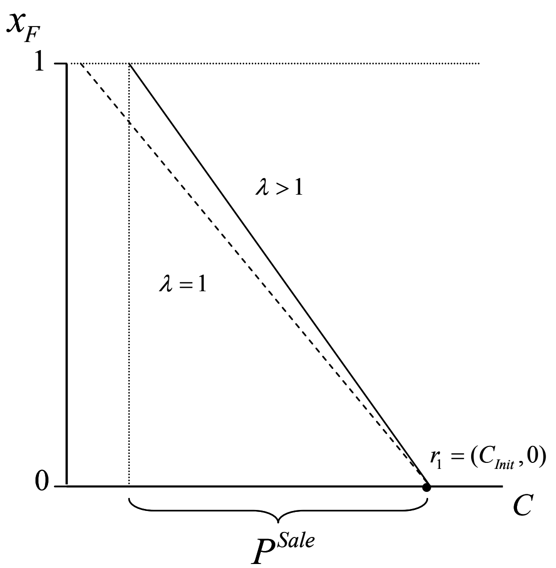

Figure 5a : Indifference curve with reference at r_1 for $\lambda = 1$ and $\lambda > 1$

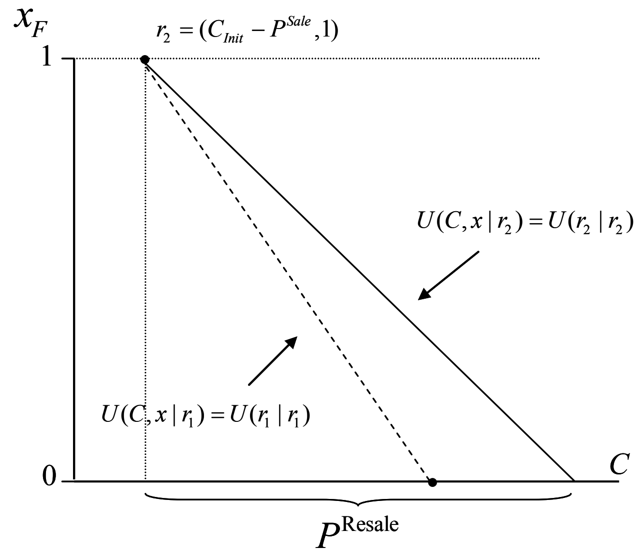

Figure 5b : Willingness to Pay and Willingness to Buy

A loss averse agents indifference curve passing through the reference point r_1 is all (C,x) pairs such that:

$$\frac{1+\eta}{1+\eta\lambda} Fx + C = C_{Init}.$$

If the agent is loss neutral $(\lambda = 1)$, a foreign collector's utility function reduces to the simple utility function. As loss aversion increases, the agent requires a larger change in ownership to compensate for the losses felt in consumption. This drives down the price a foreign collector is willing to pay to buy an object.

Conversely, an agent who owns the object and has a reference point equal to the status quo $r_2 = (C_{Init} - P^{Sale}, 1)$ will be averse to moving away from owning the object. As in figure 5b, the indifference curve from r_2 is all points such that:

$$C - \frac{(1+\eta\lambda)}{(1+\eta)} Fx = C_{Init} + \frac{(1+\eta\lambda)}{(1+\eta)} F.$$

As λ increases, the level of C necessary to compensate for the lost art consumption x increases. This drives up the price that the domestic owner must pay to repurchase the object from the foreign collector.

In the case of sale and repurchase contracts, negotiations in the sale and resale phase are likely to occur at two 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 mitigate the effect of loss aversion by fixing the repurchase agreement in the original reference state.

4.3: Loss Aversion with Endogenous Reference Points

While the initial exploration of loss aversion in trading was framed with the reference point being the status quo, new experiments have indicated that reference states may be better modeled as an agent's expectation just prior to an event.[27] In a field experiment of baseball card traders, List (2003) finds that experienced traders are less likely to have endowment effects relative to inexperienced traders. This would suggest that experienced traders who expect to trade a card they have received are more likely to be willing to trade it than inexperienced traders who expect to keep most cards that they receive.

Continuing to follow Kosegi and Rabin, we make the strong assumption that the reference point is based on expectations in the recent past. Recall that $U(c \mid r)$ is an agent's riskless utility with consumption path $c = (C_0, ..., C_K, x_0, .., x_K)$ and reference

[27] See Thaler and Kahneman (1980), Plott and Zeiler (2004), Mellers, Schwartz, and Ritov (1999), Bedvec, Madey, and Gilovich (1995), and Novemsky and Kahneman (2005).

consumption $r = (r_{C_0}, ..., r_{C_K}, r_{x_0}, .., r_{x_K})$. When c is drawn from distribution F and reference point r is drawn from distribution G:

$$\mathbf{U}(F \mid G) = \iint U(c \mid r) dG(r) dF(c)$$

4.3.1 Sale and Repurchase Contracts

As in section 4.1, we assume that there are N foreign collectors who share the same utility function and risk aversion parameter λ but differ in their value for art consumption F^i. Given the structure of the endowment scheme, each of the N bidders faces three possible outcomes: [28]

Table 1

Outcome	Probability	Outcome
Lose Auction	$1 - A(F)^{N-1}$	$\begin{cases} \text{Period 1: } (C_{\text{Init}}, 0) \\ \text{Period 2+: } (C_{\text{Init}}, 0) \end{cases}$
Win Aucton, Resell	$A(F)^{N-1}[1 - H(\tilde{P}(F))]$	$\begin{cases} \text{Period 1: } (C_{\text{Init}} - \beta(F), 1) \\ \text{Period 2+: } (C_{\text{Init}} - \beta(F) + P(F), 0) \end{cases}$
Win Auction, Hold	$A(F)^{N-1} H(\tilde{P}(F))$	$\begin{cases} \text{Period 1: } (C_{\text{Init}} - \beta(F), 1) \\ \text{Period 2+: } (C_{\text{Init}} - \beta(F), 1) \end{cases}$

As with the exogenous loss aversion model, we are primarily concerned with the winning bid and the price at which the object is offered for repurchase. A foreign collector who has purchased an object from auction has a high probability of keeping the object in period 2 and thus has a reference point near $c_t = (C_{Init} - \beta(F), 1)$ for all t. This pushes the price of the object up and exacerbates the information inefficiency inherent in the second stage bargain. Conversely, an agent bidding in the first stage has a high

[28] Loss aversion elongates the willingness to pay distribution but preserves ordering. Since the allocation mechanism is unchanged with loss aversion, there continues to exist a symmetric bid function and most standard auction results hold.

probability of losing the auction. Since the expectation of winning is low, this pushes the reference point toward $c_t = (C_{Init}, 0)$ leading to a reduction in utility from winning.

Starting with the repurchase stage, we assume that a foreign collector with value F^N has won the initial auction. If the foreign buyer offers to resell the object back to the home country at price P, the foreign collector has a probability of $H(\tilde{P})$ of keeping the object. Thus, in period 1 onward his reference point is:

$$r_t = (C_{init} - \beta(F^N) + [1 - H(\tilde{P})]P, H(\tilde{P}))$$

A foreign collector with reference point r_t maximizes his per period consumption by solving:

$$\max_p [1 - H(\tilde{P})]v(C_{Init} - \beta(F) + P, 0 \mid r_t) + H(\tilde{P})v(C_{Init} - \beta(F), 1 \mid r_t)$$

Plugging this in with our reference dependent utility function from section 4.2 yields:

$$\max_p \underbrace{[1 - H(\tilde{P})]P + H(\tilde{P})(F^N - M)}_{Consumption\ Utility} - \underbrace{\mu(\lambda - 1)H(\tilde{P})[1 - H(\tilde{P})][P + (F^N - M)]}_{Gain-Loss\ Utility} \quad (4.14)$$

The first two terms of this maximand are identical to a simple monopoly pricing model with reservation price $(F^N - M)$. The last term is the loss of utility due to loss aversion. As the probability of changing hands moves toward ½, loss aversion has a stronger effect since there the agent feels a strong loss both when the object is sold and held.

Theorem 9: A foreign buyer with loss aversion parameter $\lambda \geq 1$ sets:

$$\begin{aligned} P^{\mathrm{LA}} &= (D_F^N - M) + \frac{1}{\lambda_H(P^{LA})} \\ &\quad + \mu(\lambda - 1)\left[[2H(\tilde{P}^{LA}) - 1][P^{LA} + (F^N - M)] - \frac{H(\tilde{P}^{LA})}{\lambda_H(\tilde{P}^{LA})}\right] \end{aligned} \quad (4.15)$$

This price is increasing in λ if the last term is positive:

The first two terms on the right hand side of (4.15) are the standard optimal pricing optimum in the case of a monopolist with reservation price $F^N - M$ who faces asymmetric information and can set only one price for all consumers. The last term in equation (4.15) can be thought of as the increase in price generated by loss aversion. As long as the foreign buyer reasonably expects to keep an object, attachment for the object will drive the repurchase offer upward.

As a simple example assume that $D_2 \sim U[0,1]$. A foreign buyer will increase prices due to loss aversion any time $F \geq .2613$. For prices to be decreasing in λ, the future expected value of the object to the home country would need to be approximately double that of the foreign buyer.

While the price offered back is pushed up by both asymmetric information and loss aversion, the price paid at the auction may decrease when the foreign collectors are loss averse. Looking at Table 1, a foreign collector with value F^i bidding on the auction has a difference in reference point before and after winning an object. This gap does not improve as N increases since the probability of winning for a given value F^i falls at a faster rate than $E[F^N]$ grows.

4.3.2 Leases Contracts

The trade mechanism in a sale and repurchase contract was inefficient for three main reasons:

1) The reference state prior to the first auction incorporated the uncertainty of losing the auction to all future states, depressing the prices paid by the agents.

2) The foreign collector had bargaining power in the second stage which created inefficiency as he tried to extract surplus from the domestic owner.

3) The foreign collector was loss averse in the resale phase leading to a higher offer price and an exacerbation of asymmetric information.

Leases are likely to improve upon sales and repurchase plans for all three reasons. In a lease contract, bargaining in the second stage onward occurs before the discovery that the agent is the highest bidder is realized. This depressed the reference point of the agent leading to a reduction in bids from all agents. By contrast, in a lease auction the identity of the highest bidder is known prior to the second stage negotiation. This increases his willingness to pay.

Unlike the resale case in which the loss averse agent is making take it or leave it offers, loss aversion may mitigate the effects of asymmetric information when it is on the responder side of the market. A government attempting to extract money from the foreign buyer by setting a reservation price in subsequent auctions must take into account how this affects the expectations that the foreign collector has about keeping the object. Provided that the foreign buyer correctly predicts the distribution of prices and her behavioral reaction to these prices, the foreign buyer's willingness to pay is decreasing as the offer distribution shifts upward.

Finally, if the home country is also loss averse and has expectations of keeping an object in the future, leases remove future considerations from current ones. By retaining an option to repatriate the object in the future, the reservation price imposed on objects can be reduced increasing short-run allocation efficiency.

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 many of the potential rationales for export bans—externalities from keeping the object intact and within the country, the possibility that corrupt rulers or bureaucrats will expropriate the value of the national patrimony, and the difficulty of repurchasing objects once sold—leases or sales with options to repurchase may perform as well or better than export bans while generating more revenue for the country and improving maintenance incentives.

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.[29]. 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.

Third, we focus on the case when the government knows the object exists and where it is. The appendix discusses a case in which the government needs to create incentives for citizens to reveal the existence of objects and argues that offering them

[29] See Benabou and Tirole, 2006.

lease rights for a set number of years could create such an incentive and may be robust to corruption problems in valuing objects that might make a cash reward system untenable.

It is 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.

We have noted that leases are likely to be preferable in the presence of corruption or asymmetric information. Our analysis does not incorporate credit constraints. These are likely to be important for many countries and may make option contracts attractive relative to leases. We plan to model this more formally in the future.

We have not modeled the optimal length of leases. 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.

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 4 may help explain other patterns of asset ownership.

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Appendix:

<u>Theorem 1:</u>

Step 1: Solving the Kuhn Tucker Problem w/o integer constraints:

Consider the relaxed problem of (1.3) with the integer constraints replaced by $x_t \geq 0, x_t \leq 1,$. Let μ_t and λ_t be the Lagrangian multipliers for these constraints and ν be the Lagrangian multiplier for the budget constraint. Taking the FOC yields:

$$\begin{aligned}
&(1)\quad \partial C_t : \delta^t U'(C_t) - \frac{\nu}{R^t} = 0, \\
&(2)\quad \partial x_t : \delta^t D - \upsilon \frac{1}{R^t} P - \lambda_t + \mu_t = 0, \\
&(3)\quad \partial \lambda_t : x_t \leq 1, \lambda_t \geq 0, \lambda_t[1 - x_t] = 0, \text{ and} \\
&(4)\quad \partial \mu_t : x_t \geq 0, \mu_t \geq 0, x_t \mu_t = 0.
\end{aligned} \tag{5.1}$$

Substitution for ν in (1) yields the familiar Euler conditions:

$$U'(C_t) = \delta R U'(C_{t+1}). \tag{5.2}$$

With perfect capital markets and δR = 1, the Euler condition implies that consumption is constant across periods.[30] Substitution for ν in (2) above yields:

$$D - U'(C_0)P + R_t[\mu_t - \lambda_t] = 0. \tag{5.3}$$

Since $C_0 = C_t$ for all t, we can simplify the budget constraint to find:

$$C_0 = [P - M] - \frac{R-1}{R} \sum \frac{1}{R^t} x_t P + \frac{R-1}{R} W_{Total}. \tag{5.4}$$

Step 2: Prove For $R \in [0,2]$, $\exists$ $x_1, \ldots, x_t$ such that $\sum \frac{x_t}{R^t} = a$ for any $a \in \left[0, \frac{R}{R-1}\right]$:

Proof: Let a be an arbitrary value in $\left[0, \frac{R}{R-1}\right]$ and consider the following algorithm.

Define:

$$S_0 = \begin{cases} 1 & a > \frac{1}{R} \\ 0 & Otherwise \end{cases},$$
$$S_N = \begin{cases} S_{N-1} + \left(\frac{1}{R}\right)^N & a - S_N > \left(\frac{1}{R}\right)^N \\ S_{N-1} & Otherwise \end{cases} \tag{5.5}$$

When $0 \le a - s_N \le \frac{1}{R-1}\left(\frac{1}{R}\right)^N$ this implies that $0 \le a - s_{N+1} \le \frac{1}{R-1}\left(\frac{1}{R}\right)^{N+1}$ since $\left(\frac{1}{R}\right)^N \le \frac{R}{R-1}\left(\frac{1}{R}\right)^{N+1}$ when $R \in (1,2]$. Thus by induction, $S_N \to a$ since $\frac{1}{R-1}\left(\frac{1}{R}\right)^{N+1}$ converges to zero.

Simplifying the Allocation Space: $(x_1,...,x_t) \in \{0,1\} \to \pi_D \in [0,1]$**:**

Using the coefficients of S to construct $x_1,\ldots,x_t$ such that $\sum \frac{x_t}{R^t} = a$ for any $a \in \left[0, \frac{R}{R-1}\right]$, We can rewrite $\frac{R-1}{R}\sum \frac{1}{R^t} x_t P$ as π_DP where $\pi_D \in [0,1]$. We can think of π_D as the percentage of time that the object is used domestically after adjusting for the discount rate. Substituting (5.4) into (5.3) yields:

$$D - PU'\left(\frac{R-1}{R} W_{Total} + (P - M) - \pi_D P\right) + R_t[\mu_t - \lambda_t] = 0. \tag{5.6}$$

Step 3: Existence of the Upper and Lower Cutoffs: Assume that $\pi_D = 0$. Let $\underline{W}_{Free}$ be the value that solves:

$$\frac{D}{P} = U'\left(\frac{R-1}{R}\underline{W}_{Free} + P - M\right). \tag{5.7}$$

For $W \leq \underline{W}_{Free}$, $\frac{D}{P} - U'\left(\frac{R-1}{R}W + (P-M)\right) < 0$. Thus $\mu_t > 0$ and the $x_t = 0$ constraint is binding for all t. Likewise let $\bar{W}_{Free}$ be the value that solves:

$$\frac{D}{P} = U'\left(\frac{R-1}{R}\bar{W}_{Free} - M\right). \tag{5.8}$$

When $W_{Total} > \bar{W}_{Free}$, $\lambda_t > 0$ and thus $x_t=1$ for all t. Finally when $\underline{W}_{Free} < W_{Total} < \bar{W}_{Free}$ there exists a π_D such that

$$\frac{D}{P} = U'\left(\frac{R-1}{R}W_{Total} + (P-M) - \pi_D P\right). \tag{5.9}$$

Since π_D is determined by setting a subset of x_i to 1, the owner will share ownership rights with the foreign collector. □

<u>Theorem 2:</u>

Step 1: Solving for T without the Integer Constraint

Since $x_{t+1} \leq x_t$, There is at most one point T where the owner changes from owning an object to not owning an object. We consider the relaxed problem:

$$Max_{c_t,T}\left[\sum \delta^t U(C_t)\right] + \frac{1}{1-\delta}\left[1-\delta^{T+1}\right]D$$

Subject To: (5.10)

$$(1)\ \sum \frac{1}{R^t}C_t = W_{Total} - \frac{R}{R-1}\left[1-\left(\frac{1}{R}\right)^{T+1}\right]M$$

$$(2)\ T \in R^1$$

When $\delta R = 1$, the Euler conditions imply $C_0 = C_t$ for all t. Thus:

$$C_0 = \frac{R-1}{R} W_{Total} - \left[1 - \left(\frac{1}{R}\right)^{T+1}\right] M. \tag{5.11}$$

Identical to Theorem 1, when $\delta R = 1$, there exists a $\underline{W}_{Ban}$ and $\overline{W}_{Ban}$ such that:

$$\frac{D}{M} = U'\left(\frac{R-1}{R}\underline{W}_{Ban}\right) \text{ and } \frac{\mathrm{D}}{\mathrm{M}} = U'\left(\frac{R-1}{R}\overline{W}_{Ban} - M\right). \tag{5.12}$$

For $W_{total} < \underline{W}_{Ban}$, the owner will allow the object to be stolen immediately while for $W_{total} > \overline{W}_{Ban}$ the owner will never let the object be lost.

Step 2: Finding the optimal T* from T in the interior:

For $\underline{W}_{Ban} < W_{total} < \overline{W}_{Ban}$ note that the optimal T* will be the integer either above or below the value of T that solves

$$\frac{D}{M} = U'\left(\frac{R-1}{R} W_{Total} - \left[1 - \left(\frac{1}{R}\right)^{T^*+1}\right] M\right). \tag{5.13}$$

The owner of the object can not perfectly equate the marginal value of consumption with the marginal value of usage but can get close by choosing to hold the object for a length of time and then discarding it. As $\delta \to 1$, the difference in utility between the integer above and below T^* becomes arbitrarily close. For future problems, we will assume δ is close to 1 so that periods are arbitrarily small so that we can ignore the integer problem.

Instead we will use the approximation $\pi_D = \left[1-\left(\frac{1}{R}\right)^{T^*+1}\right]+\varepsilon$ where $\pi_D \in [0,1]$.[31] (5.10)

can then be replaced by:

$$\begin{aligned}&Max_{c_0,\pi_D} U(C_0)+\pi_D D\\&ST: C_0 = W_{Total}-\pi_D M,\ \pi_D \in [0,1].\end{aligned} \tag{5.14}$$

This problem can be solved in an identical way as that of theorem 1 and we get back an identical FOC as the one in (5.13) □

Theorem 3:

Let $T(\pi_F)$ be a (possibly nonlinear) penalty imposed on the owner of an object based on the amount of time he legally leases an object out of the country. This penalty is completely wasteful and any money taken from the owner is destroyed. The owner solves:

$$\begin{aligned}&Max_{\pi_D,\pi_F} U(C_0)+\pi_D D_0\\&Subject\,To:\\&(1)\ \ C_0=\frac{R-1}{R}W_{Total}+\pi_F[P-M]-\pi_D M-T(\pi_F),\\&(2)\ \ \pi_F+\pi_D \le 1.\end{aligned} \tag{5.15}$$

Define:

$$\dot{w}(\pi_F)=f(w(\pi_F),T(\pi_F)).$$

[31] Alternatively, we can assume that the agent can hold the unit for part of a period – this would convexify the last period and solve the integer problem.

In this problem, $\dot{w}(\pi_F)$ has the greatest slope when $T(\pi_F)=0$ but has a jump of $\overline{W}_{Free}-\overline{W}_{Ban}$ when $T(\pi_F)=\infty$. Thus the largest w for a given $\overline{\pi}_F$ that is reachable comes from a tax policy of the form:

$$T(\overline{\pi}_F)=\begin{matrix} 0 & \pi_F \geq \overline{\pi}_F \\ \infty & otherwise \end{matrix}.$$

Theorem 4:

When an owner faces a penalty policy of

$$T(\overline{\pi}_F)=\begin{matrix} 0 & \pi_F \geq \overline{\pi}_F \\ \infty & otherwise \end{matrix},$$

$T(\overline{\pi}_F)$ acts as a constraint on π_F and thus the owner solves:

$$\begin{aligned} &Max_{\pi_D,\pi_F} U\left(\frac{R-1}{R}\widehat{W}+\pi_F[P-M]-\pi_D M\right)+\pi_D D_0 \\ &Subject\,To: \pi_F+\pi_D \leq 1, \pi_F \leq \overline{\pi}_F, \pi_F, \pi_D \in [0,1]. \end{aligned} \tag{5.16}$$

Ignoring the boundary conditions and taking the derivative with respect to π_D, π_F yields:

$$\begin{aligned} &\frac{\partial}{\partial \pi_F}:\ [P-M]U'\left(\frac{R-1}{R}\widehat{W}+\pi_F[P-M]-\pi_D M\right)=\lambda_{\overline{\pi}_F}+\lambda_{1-(\pi_F+\pi_D)}, \\ &\frac{\partial}{\partial \pi_F}:\ [M]U'\left(\frac{R-1}{R}\widehat{W}+\pi_F[P-M]-\pi_D M\right)=-\lambda_{1-(\pi_F+\pi_D)}+D_o. \end{aligned} \tag{5.17}$$

Substitution for $\lambda_{1-(\pi_F+\pi_D)}$ yields:

$$[P-M+M]U'\left(\frac{R-1}{R}\widehat{W}+\pi_F[P-M]-\pi_D M\right)=\lambda_{\overline{\pi}_F}+D_o. \tag{5.18}$$

When the constraint $\pi_F=\overline{\pi}_F$ binds, the shadow cost is

$$\lambda_{\overline{\pi}_F}=[P-M]U'\left(\frac{R-1}{R}\widehat{W}+\pi_F[P-M]-\pi_D M\right)-\lambda_{1-(\pi_F+\pi_D)}. \tag{5.19}$$

Thus if $\pi_F=\overline{\pi}_F$ binds:

$$(1)\ U'\left(\frac{R-1}{R}\widehat{W}+\overline{\pi}_F[P-M]-\pi_H M\right)=\frac{D_o}{M}-\lambda_{1-(\pi_F+\pi_D)} \tag{5.20}$$

Otherwise, since with no binding constraint we know that $\pi_F + \pi_D = 1$,

$$(2)\ U'\left(\frac{R-1}{R}\widehat{W}+\pi_F[P-M]-(1-\pi_F)M\right)=\frac{D_o}{P}. \tag{5.21}$$

Looking for the largest possible π_D, $\pi_F = \overline{\pi}_F$ must bind since $\frac{D_o}{P} < \frac{D_o}{M}$ and U is concave. If $\overline{\pi}_F + \pi_D < 1$, $\lambda_{1-(\pi_F+\pi_D)} > 0$ and thus increasing $\overline{\pi}_F$ by $\varepsilon[P-M]^{-1}$ will increase π_D by at least εM^{-1}. Thus $\overline{\pi}_F + \pi_D = 1$. Substitution of $\overline{\pi}_F = 1-\pi_D$ yields:

$$U'\left(\frac{R-1}{R}\widehat{W}+[P-M]-\pi_D M\right)=\frac{D_o}{M}. \tag{5.22}$$

□

Lemma 4a:

If $\frac{D_o + D_E}{P} \in \left[\frac{D_o}{P}, \frac{D_o}{M}\right]$ the first best is reachable and thus can be implemented. Otherwise, the optimal contract is the contract where π_D is as large as possible. From Theorem 3, the maximum reachable element is π^* from theorem 4. □

Theorem 5:

Without constraints, a generation that is reached without a bad leader that is serviced by a good leader gets expected value:

$$\max[P, D_O + E[D_E]] = [1-G(\hat{P})][D_O + E(D_E \mid D_E \geq \hat{P})] + G(\hat{P})P$$

where $\hat{P} = P - D_O$, The home country prefers an export ban if:

$$\hat{P} \le E(D_E \mid D_E \le \hat{P})] + \frac{\delta^2 \varepsilon(1-\varepsilon)}{(1-\delta)} \frac{1}{G(\hat{P})}[D_0 + E(D_E)] \tag{5.23}$$

or equivalently if:

$$\frac{1}{1-\delta}\underbrace{\left[G(\hat{P})\hat{P} + [1-G(\hat{P})]E(D_E \mid D_E \ge \hat{P})] - E(D_E)\right]}_{\text{Per Period Gain from Flexibility}} \le \frac{\delta}{1-\delta}\underbrace{\frac{\delta\varepsilon(1-\varepsilon)}{(1-\delta)}[D_0 + E(D_E)]}_{\text{Per Period Expected Loss from One Bad Dictator}}. \tag{5.24}$$

At ε = 0, the RHS of (5.23) is $E(D_E \mid D_E \le \hat{P})$ which is lower than P for $G(\hat{P}) > 0$. As $\delta \to 1$, for $\varepsilon \in (0,1)$ the RHS of (5.24) grows toward infinity suggesting that an export ban is always optimal. 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 leading to a larger set of ε for which an export ban is optimal. □

Theorem 6:

Let $\psi(x_i) = x_i - \frac{1}{\lambda_A(x_i)}$. The optimal mechanism (Q,M) is an allocation Q and payment rule M such that:

$$Q_i(x) = \begin{cases} 1 & \text{if } \psi(x_i) > \max_{j \ne i} \psi(x_j) \text{ and } \psi(x_i) > 0 \\ 0 & \textit{otherwise} \end{cases}$$
$$M_i(x) = \max\{\, \psi^{-i}(0), \max_{j \ne i} x_j\} \tag{5.25}$$

Since this is the allocation and payment rule of the English auction with reservation price $\tilde{P} = D_2 + \frac{1}{\lambda_A(\tilde{P})}$, the lease auction is optimal.

Theorem 7:

$$\max_{p_{res}, r} [1 - A(\tilde{P}^{RES})][(1 - H(\tilde{r}))(E(D_2 \mid D_2 > \tilde{r}) - r - M + P^{RES}) + H(\tilde{r})P^{RES}] + A(\tilde{P}_{res})[E(D_2) - M]$$
$$\textit{Subject To}: \ \mathrm{r} \ge P^{RES}$$

Taking the FOC with respect to the option price r and the inequality constraint we have:

$$\frac{\partial L}{\partial r}:[1-A(\tilde{P}^{RES})]\left\{-h(\tilde{r})[E(D_2\mid D_2>\tilde{r})-\tilde{r}]+(1-H(\tilde{r}))[\frac{d}{dr}(E(D_2\mid D_2>r)-r)]+\frac{\lambda}{1-A(\tilde{P}^{RES})}\right\}=0,$$

$$\frac{\partial L}{\partial \lambda}:(r-P^{RES})\geq 0,\lambda\geq 0,\lambda(r-P^{RES})=0.$$

(5.26)

$[-h(\tilde{r})[E(D_2\mid D_2>\tilde{r})-\tilde{r}]+(1-H(\tilde{r}))[\frac{d}{dr}(E(D_2\mid D_2>\tilde{r})=0$ and thus (5.26) reduces to:

$$-[1-A(\tilde{P}^{RES})][1-H(\tilde{r})]+\lambda=0. \qquad (5.27)$$

Since $a(\tilde{r})>0$, the SOC of $A(\tilde{r})-1$ is positive so that $r=\infty$ is a global minimum. Thus $\lambda>0$ and $r=P^{RES}$. The home country doesn't gain anything in leaving a separation in the price that it sells an object to a foreign collector and the price that it can rebuy the object in the future. The home countries problem thus reduces to:

$$\max_{P_{res}}[1-A(\tilde{P}^{RES})][(1-H(\tilde{P}^{RES}))(E(D_2\mid D_2>\tilde{P}^{RES})-M)+H(\tilde{P}^{RES})P^{RES}]$$
$$+A(\tilde{P}^{RES})[E(D_2)-M].$$

Taking the FOC and using the same simplification as above, we find:

$$\frac{[1-A(\tilde{P}^{RES})]}{a(\tilde{P}^{RES})}=\tilde{P}^{RES}+\frac{[(1-H(\tilde{P}^{RES}))(E(D_2\mid D_2>\tilde{P}^{RES}))]-E(D_2)}{H(\tilde{P}^{RES})}. \qquad (5.28)$$

Noting that $E(D_2)=E(D_2\mid D_2>\tilde{P}^{RES})[1-H(\tilde{P}^{RES})]+E(D_2\mid D_2<\tilde{P}^{RES})H(\tilde{P}^{RES})$ this reduces to:

$$Period\ 2: P^{RES}=E(D_2\mid D_2<\tilde{P}^{RES})+\frac{[1-A(\tilde{P}^{RES})]}{A(\tilde{P}^{RES})}-M. \qquad (5.29)$$

<u>Theorem 8:</u>

The lease auction is optimal and the other two mechanisms differ in allocation rule. Thus they must be dominated.

Theorem 9:

This follows from the FOC of (4.14).

Incentive Conflict Model

We consider an economy with high (H) and low (L) quality objects which are distributed randomly across a large number of potential domestic owners. Each owner in the economy has no intrinsic value for her object $\mathrm{D}_{\mathrm{O}}^{\mathrm{H}} = \mathrm{D}_{\mathrm{O}}^{\mathrm{L}} = 0$ but is in contact with a smuggler who will pay $\frac{\delta}{1-\delta}V^H$ or $\frac{\delta}{1-\delta}V^L$ in exchange for a high or low quality object. For simplicity, we assume that $u(c_t) = c_t$ so that each owner maximizes the expected value of her action.

The government accurately estimates the proportion (p) of high quality objects in the economy and the externality to its constituents for domestic use $\frac{\delta}{1-\delta}D_E^H$ and $\frac{\delta}{1-\delta}D_E^L$. 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 can not distinguish between H and L 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 government would like to design an incentive mechanism that creates incentives for individuals to report their goods but is hampered by the inefficiencies that are generated by using bureaucrats as a part of their mechanism. Reliance on bureaucrats to carry out interim action may make the cost of a program prohibitively expensive or lead to allocation inefficiencies that may swamp the actual value of the program.

The timing of the game is as follows:

- Stage 0: The government decides upon an incentive mechanism and purchase rule.
- Stage 1: Individual owners decide whether to publicly disclose their object or sell them to the smuggler.
- Stage 2: Publicly disclosed objects are randomly assigned to bureaucrats
- Stage 3: If an individual owner is assigned to a corrupt bureaucrat, the owner chooses whether to offer a bribe
- Stage 4: Bureaucrats generate their reports and the governments incentive mechanism is implemented.

Suppose that $\mathrm{D}_{\mathrm{E}}^{\mathrm{H}} \geq V^{H}$ and $D_{E}^{L} \geq V^{L}$. In this case, the government would like to retain all objects for home use and thus must create an incentive structure that induces all agents to reveal their objects. 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

$$T^H = \frac{\delta}{1-\delta} V^H$$
$$(1-b)T^L + bT^G - B = \frac{\delta}{1-\delta} V^L$$

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

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

The total cost of a project that purchases both high and low quality goods is

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

Plugging in for T^H and T^L yields:

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

In our initial case with $D_E^H \geq V^H$ and $D_E^L \geq V^L$ the possibility of bribes reduces the cost to providing incentives for low quality objects which reduces the cost of the overall program. Bribery generates additional transfers to bureaucrats which must ultimately be paid by the government. Such bribes may make the total cost of the program prohibitive, especially in cases in which the government views bribes as a form of pure waste in the economy.

The effect of bribery is exacerbated in the more likely case where $D_E^H \geq V^H$ and $D_E^L < V^L$. Here, 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. The net allocation gain for the program is $\delta/_{1-\delta}$ times

$$p[D_H^E - V^H] - (1-p)b[V^L - D_E^L]$$

If p is small, the overall efficiency gain for the program may be negative. The gross cost for the program is $\delta/_{1-\delta}$ times

$$[p + (1-p)b]V^H$$

with $(1-p)bB$ of these proceeds going to pay for bribes to intermediaries. This program size is potentially far larger than the optimal program and is partially comprised of bribes which the government may view as wasteful.

Note that creating an incentive for revelation of objects by assigning rights to lease the object for some fixed time can help overcome these problems.