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

Michael Kremer* Tom Wilkening†

February 14, 2025

*Kenneth C. Griffin Department of Economics, University of Chicago, 1126 E. 59th St., Chicago, IL 60637. E-mail: kremermr@uchicago.edu

†Department of Economics, University of Melbourne, FBE 328, VIC 3010 Australia. E-mail: tom.wilkening@unimelb.edu.au

1 Appendix

As highlighted in the main paper, antiquity preservation is complicated by the fact that sites and antiquities may be fully unknown to the government, may be known by the governments and fully under its control, or may be known to the government but imperfectly protected. This appendix provides a formal game theoretic model for the first two of these cases. Section 2 analyzes the first case where an unexcavated antiquity exists in an unknown site or where the government is unaware of antiquities which have been illegally excavated but remain in the source country. Section 3 then explores the second case where antiquities are in the hands of the government, but where the officials appointed to oversee antiquities may be corrupt. All formal proofs are collected in Section 4.

2 Antiquities Unknown to the Government

We treat antiquities as durable resources that are either unexcavated or excavated and in private hands. Unless there is an explicit need to differentiate between the two cases, we refer to an individual who has private information about a site or who is holding an antiquity as an "informed citizen" and refer to the site or antiquity in their possession as an "antiquity."

As a central concern in the antiquity market is the preservation of antiquities, we consider situations in which the preservation of an antiquity requires a payment of M at the beginning of each period by the owner for *maintenance*. For antiquities that are already excavated, this could involve proper storage that controls for heat, humidity, and sunlight and that mitigates the risk of damage from fire, flood, vandalism, or theft. For unexcavated antiquities, this could be the opportunity cost of not using the land and the cost of protecting the site from vandals or other potential looters. We consider M to be a reduced form parameter that includes the cost of preventing damage and theft by looters. For convenience, rather than modeling a continuous and stochastic relationship between effort and damage, we assume that M is binary and that if it is not paid, the antiquity or site is immediately destroyed.

To allow for some potential heterogeneity in valuation, including the existence of outright forgeries, we consider an environment with high (H) and low (L) quality antiquities.[1] We assume that at least a portion of citizens may value having antiquities revealed, maintained, and in the country of origin. High- and low-quality antiquities that are revealed and maintained generate a domestic externality of d_t^H and d_t^L respectively in period t. For excavated antiquities, this externality includes the amenity value of having the antiquity in the country of origin, its curatorial value to domestic museums, and information on the location of active looting. For unexcavated antiquities, the externality includes the scientific and historical value generated from proper excavation along with the amenity and curatorial value of antiquities recovered from the site.

We study the problem from the perspective of a government that is trying to maximize social utility taking into consideration the domestic externality. Relative to the size of the total government budget, the value of this externality is assumed to be small. As such, we simplify the government's objective by assuming a linear tradeoff in each period between antiquity usage and government expenditures on non-antiquity related programs. In particular, we assume

$$u(g_t, x_t) = g_t + x_t d_t^q, \tag{1}$$

where g_t is the utility of government expenditures on non-antiquity related programs, $x_t \in \{0, 1\}$ is one if the antiquity is maintained and transferred to the government and zero otherwise, and $q \in \{L, H\}$. Discounting at rate δ, the government selects policies to maximize

$$\mathbb{E}\left[\sum_{t=0}^{\infty} \delta^t u(g_t, x_t)\right] \tag{2}$$

subject to its budget. We assume that the government's overall budget is fixed in each period and that any transfers paid to secure antiquities reduce government expenditures on non-antiquity related programs one-for-one.[2] Likewise, any revenue created by selling or leasing an antiquity increases government expenditures on non-antiquity related programs one-for-one.

To highlight the issues that are unique to unexcavated objects, this section specializes to the case where the domestic externality d_t^q is constant over time.[3] A high-

[1]In the case of an unexcavated site, we assume that the value of a site is equal to the total value of antiquities that are contained within it and that sites can also be of high and low quality.

[2]This formulation treats government expenditures and transfer payments symmetrically for simplicity, but results would be qualitatively similar if taxation generated deadweight loss and the government maximized citizen welfare.

[3]As the value to the government is in expectations and we only care about the overall NPV of a

and low-quality antiquity that is transferred in government hands therefore generates a domestic benefit with a net present value (NPV) of $\frac{1}{1-\delta}d^H$ and $\frac{1}{1-\delta}d^L$, respectively. We consider the more general case in Section 3 where we focus on antiquities that are in the hands of the state.

We assume two informational inefficiencies that limit the policies that can be employed by the government. First, while we are considering the case in which the government has nationalized antiquities and is the *de jure* owner of all antiquities, we assume "informed citizens" have antiquities in their possession or know the location of unexcavated sites.

Second, we assume that whether antiquities are of high or low quality is not perfectly observable and can only be assessed by experts. These experts are either foreign collectors or bureaucrats in the home country who may be corrupt. If an antiquity is revealed to the government, a bureaucrat can perfectly estimate the antiquity's value and deter forgeries, but some proportion b of bureaucrats are corrupt and can report a low-quality antiquity as a high-quality antiquity in exchange for a bribe B.[4] We assume that the informed citizen does not know the type of official she will be assigned to before making the decision to reveal her antiquity.

Informed citizens in our model have some potential of meeting a smuggler in each period and thus have private incentives to keep antiquities undisclosed. To study how optimal policy is likely to change with income, we also allow informed citizens to receive private benefits v^q, $q \in \{L, H\}$, at the end of each period that their antiquity is undisclosed and in their possession. In a low-income context with unexcavated antiquities, v^L and v^H are likely to be small and close to zero. We also consider the case where low-quality antiquities are forgeries and where (i) v^H may differ from v^L and (ii) $d^L = 0$. In all cases, we assume that the informed citizen knows whether their antiquity is of high or low value.[5]

Finally, we assume that if an antiquity is put up for sale internationally, there exists a foreign collector with per-period valuation $\overline{a}^q$ who is willing to pay $\frac{\overline{a}^q-\delta M}{1-\delta}$ in total

revealed antiquity, there is little change to the model in this section if we allow the usage value of antiquities to vary over time.

[4]Our model can easily accommodate the case where bureaucrats can also hold up informed citizens who report high-quality antiquities by threatening to report these antiquities as low quality unless a bribe is paid. We discuss how such hold up can impact revelation payment programs in footnote 19.

[5]The model can easily be extended to the case where the informed citizens have imperfect signals about the quality of their antiquities.

for the antiquity.[6] We consider two cases of our model that vary in the relationship between $\overline{a}^q$ and d^q. In the first case, $d^q > \overline{a}^q$ for $q \in \{H, L\}$ and the government would like to retain all antiquities. We view this case as the environment envisioned by cultural nationalists and others who view the value of domestic usage as very high. Second, we consider the case where $d^H > \overline{a}^H$ but where $d^L = 0$ and $\overline{a}^L = M$. In this case, low-quality antiquities can be thought of as forgeries which can be produced by citizens in the domestic country.

We will assume throughout the appendix that it is not possible to enforce a negative penalty on domestic citizens whose objects are detected beyond confiscation. This limited liability assumption reflects the view that it is likely difficult to prove that domestic citizens both knew about the location of objects and had an intent to sell them illegally. We also assume that it is not possible to enforce a negative penalty when a forgery is detected. The literature on forgery networks suggests that the forgery production process is highly mediated to protect primary forgery producers from direct prosecution (Sotiriou 2018).

The timing of our game, shown in Figure 1, is as follows: in an initial law-writing phase, the government passes laws regarding the way in which antiquities that are disclosed to the government are processed. We initially assume that the government may allow for free trade or pass an export ban. We assume that under free trade, the informed citizen sells her antiquity to the foreign buyer (or the government) at price $\frac{\overline{a}^q - \delta M}{1-\delta}$. Under export bans, antiquities that are disclosed or detected by the government are confiscated.

We then consider policies that combine export bans with systems that reward public disclosure of antiquities and sites. We first consider a discretionary payment system where objects revealed to the government are assessed by bureaucrats and where rewards are conditioned on the bureaucrats reports. Under this policy objects that are disclosed to the government are randomly assigned to bureaucrats. If an informed citizen is assigned to a corrupt bureaucrat, the informed citizen chooses whether to offer a bribe to certify that an antiquity is of a particular quality. The bureaucrats then

[6] This price can be generated more formally as follows. Let there be $i \in \{1, \ldots, N\}$ foreign collectors who are potentially interested in using a legally procured antiquity. Each foreign collector has a private per-period value for art consumption of a_i^q bounded between $\underline{a}^q$ and $\overline{a}^q$ and distributed according to the time-invariant cdf $F^q(.)$ with associated pdf $f^q(.)$. Without loss of generality, we assume that the buyers are ordered in ascending value. Thus a_N^q and a_{N-1}^q represent the highest and second highest values respectively. We also assume that $N \to \infty$ so that $a_N^q = a_{N-1}^q = \overline{a}^q$. Any efficient auction will now generate returns of $\overline{a}^q$ for the current period and $\overline{a}^q - M$ for all subsequent periods.

generate their reports and the governments incentive mechanism is implemented.

Finally, we consider a lease system where the government can choose to lease antiquities that are revealed to them for t periods and pay the proceeds of these leases to the informed citizen. Antiquities are retained by the government at the end of the lease.

Following the initial law writing phase, informed citizens make a series of decisions regarding the maintenance and revelation of their antiquity. For each time $t \in \{0, \ldots, \infty\}$, an informed citizen holding an antiquity must pay M in order to prevent the antiquity from being destroyed. If the antiquity is preserved, the informed citizens must decide whether to publicly disclose their antiquities or not disclose their antiquity and wait for a potential smuggler. Disclosed antiquities are processed according to the country's laws.

If informed citizens elect not to disclose their antiquities, they are matched with smugglers with probability $\alpha(e)$. Smugglers pay the informed citizen a proportion $\pi^q(e)$ of the amount that the informed citizen could receive under a free market. The government detects and confiscates antiquities that have not been smuggled with probability $\beta(e)$. The likelihood of each of these outcomes is determined by an exogenous enforcement level e. Greater enforcement reduces the probability $\alpha(e)$ that an informed citizen who has chosen not to disclose an antiquity is matched with an intermediary or smuggler. Greater enforcement also reduces $\pi^q(e)$.[7] Finally, greater enforcement increases the probability $\beta(e)$ that antiquities that are not sold are detected by the government and are either excavated or confiscated. We concentrate on the case where $\frac{\pi^q(e)[\overline{a}^q - \delta M]}{1-\delta} > \frac{(1-\beta(e))[v^q - \delta M]}{1-\delta}$ as this is the case where informed citizens sell antiquities to smugglers when given the chance.[8]

2.1 A Welfare Comparison of Free Trade and Export Bans

We first compare free trade and export bans without the possibility of providing information rents in the first case of our model where $d^q > \overline{a}^q$ for $q \in \{L, H\}$. As it is an

[7] While we have treated $\pi^q(e)$ as exogenous, it is likely to be the outcome of a bargaining process where the smuggler has significant bargaining power. Greater enforcement is likely to increase a smugglers costs and is thus likely to lower $\pi^q(e)$.

[8] If $\pi^q(e)[\overline{a}^q - \delta M] < (1 - \beta(e))[v^q - \delta M]$, informed citizens hold antiquities instead of selling them to the smugglers. Since smuggling will never occur, the analysis of this case is identical to our standard model with $\alpha(e) = 0$. Note that for unexcavated sites v^q is close to zero and this case is unlikely to occur.

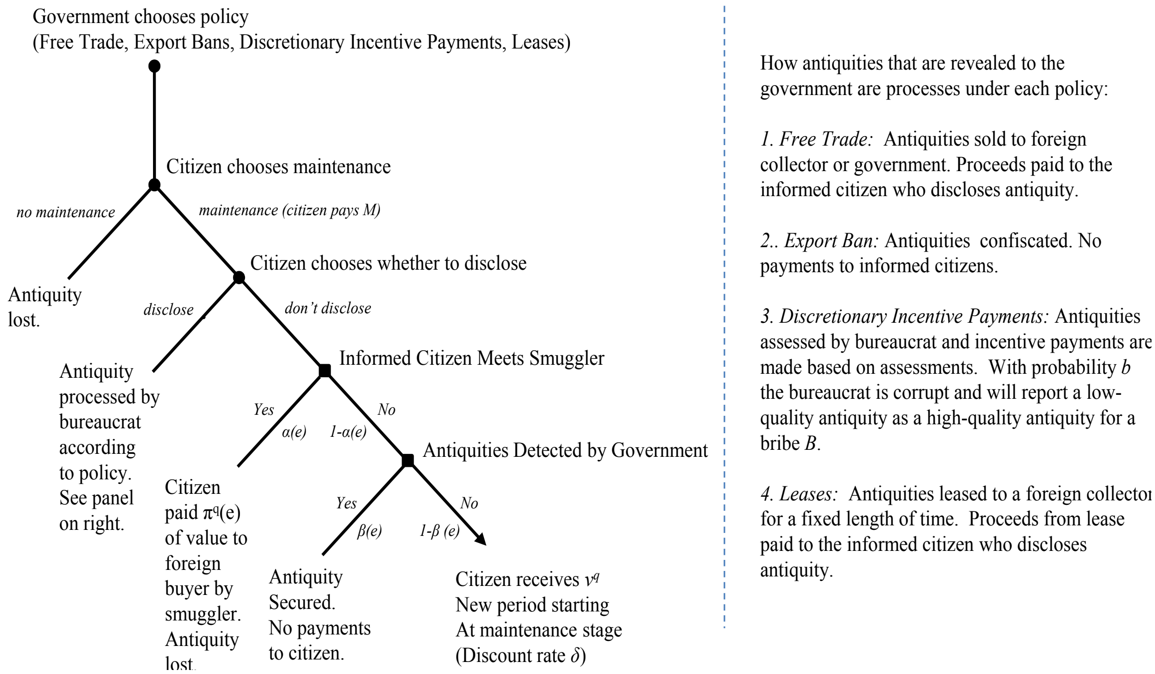

Figure 1: Timing chart

easily comparable measure that captures all welfare effects associated with antiquities, we report the government's net payoff from each antiquity: the difference in expected utility that the government receives for a given antiquity under the policy and the utility the government receives under a policy where the government expends no money but the antiquity is destroyed.

Under an export ban, the informed citizen will invest in maintenance only if the expected return is higher than the maintenance cost, or $\alpha(e)\pi^q(e)\frac{\overline{a}^q-\delta M}{1-\delta}+(1-\alpha(e))(1-\beta(e))v^q > M$. If the informed citizen maintains the antiquity or site, the government detects with probability $\beta(e)$ each period, and receives an expected net present value of

$$S^{Ban}(e) = \frac{(1-\alpha(e))\beta(e)}{1-\delta[(1-\alpha(e))(1-\beta(e))]}\frac{d^q-\delta M}{1-\delta} \tag{3}$$

per antiquity. The proportion $\alpha(e)[1-(1-\alpha(e))(1-\beta(e))]^{-1}$ of antiquities are lost to smuggling.

Increasing $\beta(e)$, the probability of detection, through tougher enforcement will increase what the government recovers, but there is a limit to what the government can recover. If enforcement is toughened and the expected return of holding the antiquity falls below M, individuals lose their incentive to protect and maintain antiquities, leading to their destruction. As $\pi^q(e)$ is likely to be very small, a policy based purely on enforcement (as opposed to one that also rewards for revelation of antiquities) may generate fewer incentives for protection and ultimately lead to inefficient social outcomes.

Based on our model, export bans are likely to lead to a large proportion of antiquities lost to smuggling in environments where there is limited enforcement and may lead to destruction in environments where the maintenance cost is high and the private benefits for antiquities are small. We view this to be the case in environments where citizens are poor and where antiquities are unexcavated.

One can also examine the consequences of allowing informed citizens to sell antiquities abroad, with the government either having the right to bid on the antiquities or purchasing them back afterwards. As discussed above, we focus on the case where $d^q > \overline{a}^q$ so it is efficient for the antiquities to stay in the country. Note that such procedures could be vulnerable to collusion and corruption that could lead the government to overpay for antiquities, but even in the absence of these factors the government and foreign collector would end up bargaining to a price between $\frac{\overline{a}^q - \delta M}{1-\delta}$ and $\frac{d^q - \delta M}{1-\delta}$ per antiquity. Thus, in the absolute best case for free trade, the government would need to pay $\frac{\overline{a}^q - \delta M}{1-\delta}$ per antiquity it purchases. If $d^q > \overline{a}^q$, the government will purchase all antiquities of quality q that are put up for auction, leading to a net payoff of

$$S^{Free} = \frac{d^q - \overline{a}^q}{1-\delta} \tag{4}$$

per antiquity. As $\overline{a}^q > M$, all antiquities are preserved under this scheme. However, the additional payments made in recovering antiquities may lead the government to prefer export bans and enforcement.

2.2 Incentives For Revealing and Maintaining Antiquities

The preceding discussion suggests that augmenting an export ban policy with explicit incentives for revealing the location of antiquities may improve social welfare. Payments for revelation may not only resolve the information asymmetry but also provide incentives for informed citizens to maintain their antiquities in the first place.

We consider two types of incentive programs: purchase programs which allow for discretionary incentive payments based on the quality of the antiquities and lease programs which allow informed citizens to lease antiquities abroad for a number of periods in exchange for revealing its location. We show that discretionary incentive payments are vulnerable to corruption and that the lease system leads to greater social surplus for the government than both discretionary incentive payments and the export bans considered in the previous section.

As it will be useful for simplifying notation, let

$$V^q = \max\left\{M, \frac{\alpha(e)\pi^q(e)\frac{\overline{a}^q-\delta M}{1-\delta} - (1-\alpha(e))(1-\beta(e))(\delta M - v^q)}{1-\delta[(1-\alpha(e))(1-\beta(e))]}\right\} \tag{5}$$

represent the potential outside option of an informed citizen holding an antiquity of quality q. Note that this outside option encapsulates both the case where the informed citizen has no incentive for maintenance and the case where she has incentives to maintain the antiquity in hopes of selling it to a smuggler.

Consider first discretionary incentive payments which pays quality-contingent incentives in exchange for antiquities revealed by informed citizens. As the potential values of antiquities are unknown *ex ante* and must be estimated by bureaucrats, discretionary incentive payments are vulnerable to corruption.

In the case where $d^q \geq \overline{a}^q$ for $q \in \{H, L\}$, let p be the proportion of H-quality objects. Similarly, in the case where L quality objects are forgeries, assume that the supply function for forgeries is upward sloping and if the expected value of making a forgery is bV^H, the proportion of real antiquities is p and the proportion of forgeries is $(1-p)$.[9] Then the net social surplus of both programs is as follows:

Proposition 1 *When $d^q \geq \overline{a}^q$ for $q \in \{H, L\}$, so the government would like to retain both high- and low-quality antiquities, the net payoff from combining an export ban with discretionary incentive payments for revelation and maintenance of antiquities is:*

$$S^{Discretionary} = p\left[\frac{d^H - \delta M}{1-\delta} - V^H\right] + (1-p)\left[\frac{d^L - \delta M}{1-\delta} - V^L\right] - (1-p)bB \tag{6}$$

[9] As noted above, we have assumed that the government cannot punish the citizen when a forgery is detected. It is straight forward to extend the model to allow for a positive detection probability and some punishment by introducing a scaling term, $\psi(e)$ that is decreasing in the enforcement technology and subsequently changing the expected value of the forgery to $b\psi(e)V^H$. As long as $\psi(e) > 0$, there is no substantial change to the analysis. Note also that a draconian enforcement policy on forgeries could also lead to hold-up issues in cases where bureaucrats could extract rents by threatening to report high-quality objects as forgeries. In this more general case, it would be difficult to deter forgeries through punishment without also eroding revelation and maintenance incentives.

When $d^L = 0$ and $d^H > \overline{a}^H$, so that the government would like to retain only high-quality antiquities, the net payoff is

$$S^{Discretionary} = p\left[\frac{d^H - \delta M}{1-\delta} - V^H\right] - (1-p)bV^H. \tag{7}$$

Proof: All proofs are collected at the end of the appendix.

Misreporting by bureaucrats increases the cost to the government of a program designed to incentivize citizens to reveal antiquities. In the case where the government only wants to retain high-quality antiquities, discretionary incentive payments also lead to allocation distortions. When p is small relative to $(1-p)$, the cost of this program may be very large relative to its benefit. This will be the case, for instance, if forgeries are generated endogenously and V^H is high relative to the cost of making forgeries.

By requiring evaluation by bureaucrats who can gain privately from misreporting, discretionary incentive payments leads to distortions both in the amount paid to secure antiquities and in the antiquities secured any time that $b > 0$. The advantage of a lease program is that the information rents generated by an antiquity can be linked directly to its value without relying on private assessments.

Proposition 2 *There always exists a lease program that will induce maintenance and revelation of antiquities. Let τ be the smallest integer such that*

$$\sum_{t=0}^{\tau} \delta^t(\overline{a}^q - \delta M) \geq V^q. \tag{8}$$

Then, all lease programs that allow for leases of length greater or equal to τ in exchange for future ownership rights are sufficient for generating maintenance and revelation incentives for an antiquity of quality q.

Proposition 2 states that it is always possible to find a lease contract that will induce all informed citizens to reveal their antiquities to the government. This is because the alternative of waiting to sell on the black market requires informed citizens to share rents with smugglers and exposes them to the risk that the government will confiscate an unreported antiquity before the informed citizen can match with a smuggler.

The necessary lease length depends on the value that a smuggler can provide to an informed citizen relative to the market price for legally transferred leases, as can be seen by noting that V^H is a function of the enforcement technology. The necessary lease length is shorter the greater the ability of the country to police illegal markets and the smaller the value of illicit antiquities is to licit antiquities to final purchasers. We thus see leases as a complement to enforcement policies and policies that actively reduce foreign demand for illicit material. Note also that V^H is increasing in the informed citizen's private value, v^H, and thus lease lengths will be shortest in environments where the informed citizens have little intrinsic value for their antiquities.

In cases where informed citizens are poor and maintenance incentives do not exist without the potential of smuggling, short leases are sufficient to induce maintenance and have a clear advantage over export bans and the free market. They also outperform discretionary incentive payments in cases where the government is patient and desires only high-quality objects. Comparing the outcome of leases, discretionary incentive payments, free markets and export bans without revelation incentives in these environments leads to the following proposition:

Proposition 3

1. *If $v^q < M$, there exists a $\underline{\delta} \in (0,1)$ such that for all $\delta > \underline{\delta}$ the government's net payoff of a lease is greater than the net payoff under free trade and under export bans without revelation incentives for all enforcement technologies.*
2. *If $v^q < M$, $d^L = 0$, and forgeries occur with positive probability, there exists a $\tilde{\delta} \in (0,1)$ such that for all $\delta > \tilde{\delta}$ the government's net payoff of a lease is greater than the net payoff for discretionary incentive payments for all enforcement technologies.*

Part (i) of Proposition 3 states that if the discount rate is sufficiently small[10] and the usage value to informed citizens is less than the cost of maintenance, leases will always generate greater social surplus than free markets and export bans without leases. The intuition is that the cost of the temporary distortion in the location of antiquities induced by a lease program becomes small relative to permanently losing antiquities under an export ban without revelation incentives and paying full market value of all antiquities it wishes to secure under a free market.

[10] As leases move antiquities abroad for at least one period, a very impatient source country may prefer to maintain export bans over leases because such bans allow them to capture and use at least some antiquities in the current period. However, since V^H is likely to be small relative to the overall value of the antiquity, the lower bound $\underline{\delta}$ at which a lease dominates sales markets and export bans will be relatively small.

Both leases and discretionary incentive payments must pay the informed citizen at least V^q to reveal the antiquity. However, they both have an additional inefficiency: leases can lead to objects being moved abroad for a short time where they have a higher value at home while corruption generates additional costs in programs that use discretionary incentive payments. The relative importance of these two effects is ambiguous in the case where the government wishes to secure all objects and depends on the overall patience of the government and the potential for corruption. When the government wishes to secure only high-quality objects, however, corruption leads to the purchase of some forgeries in programs that use discretionary incentive payments. The payments associated with these forgeries vastly diminish the efficacy of discretionary payment programs and a sufficiently patient government will always prefer to use leases.

2.3 Alternative Systems Based on Sales

Taxes on sales could also allow the value of antiquities to be split and could automatically link incentives for informed citizens to reveal antiquities to the antiquities' values without government discretion.[11] However, tax programs may be easier to game than leases. For example, antiquities may be broken into parts, sold in separate lots at low prices, and reassembled by a colluding foreign collector to bypass taxation.

In the absence of repurchase by the government, sales cause the antiquity to permanently leave the optimal domestic location. Repurchase programs by the government would be expensive, since foreign collectors could always demand the full value of the antiquity to the domestic government. Moreover, if there is asymmetric information on this value, then efficient repurchase transactions may not always occur, creating further inefficiencies.

In earlier versions of the paper, we also studied sales and repurchase programs from a mechanism design standpoint in settings where there was asymmetric information regarding both the value of foreign collectors and the future realization of the domestic externality. We show that in these settings, private information regarding the domestic externality may embed an inefficiency in the resale stage and cause objects to remain in the foreign collector's hands in some states of the world when it would be optimal for

[11] Another alternative way of providing information rents would be to use a lottery system where individuals who have information about the value of the good may retain the good with some probability. Like a tax or sale system, such programs do not provide an obvious way for antiquities to return. Further, under lotteries the informed citizens bear more risk.

the antiquity to return to the government. This inefficiency makes sales and repurchase programs less efficient than leases contracts or alternative sales contracts that include an explicit option contract for repurchase. Leases are shown to be optimal contracts and may dominate option contracts when the domestic externality is stochastic and its future value is unknown at the time of initial sale.

3 Antiquities in the Hands of the Government

In the previous section we examined the case of antiquities that were not in government hands. We argued that even if the social value of the antiquity at home was greater than the value to foreign collectors, it may still be optimal to allow those holding antiquites to lease them abroad as a way of providing information rents for revelation and maintenance. In this section we will consider the case of antiquities already under government control, and argue that even if the net value of an antiquity to a foreign collector might sometimes be greater than the net value domestically, so that the antiquity would move abroad in the first best, a government constrained to act through potentially corrupt bureaucrats may want to prohibit sales of antiquities and allow only fixed duration leases.

To do this, we will relax the assumption that the use value of the objects at home is fixed and greater than (i) the cost of maintenance and (ii) the value of foreign collectors. In particular, we also allow the domestic externality to change stochastically over time with a large enough support that in any given period it may be efficient for the antiquity to be either at home or abroad. Absent any agency issues, an unconstrained government would therefore allocate the antiquity to its highest value use each period.

As with the model in Section 2, we assume that the government does not directly control antiquities, but instead chooses a policy in an initial law writing stage that can constrain the actions of all future officials. We assume that the policy choice can bind future officials who will each have influence over antiquities for one period. We first consider the case where the government who is passing laws for officials who are never corrupt. We show that in this environment, a government would never want to impose export bans since these policies reduce the net present value of antiquities and reduce maintenance incentives. We then consider the problem of a government where officials in charge of antiquities may be corrupt and show that in this environment export bans may be better than sales but that leases may be better than both alternative policies.

To focus directly on the dynamic aspects of antiquity policy, we consider a situation where a single high-quality antiquity is in the hand of the government and where this antiquity may be bought or leased at the beginning of any period (prior to maintenance) at a constant per-period price $\overline{a}^H - M$. We relax the model of Section 2 by assuming that the values of the domestic externality are drawn *iid* from a single time invariant cdf $H(.)$ with bounded support on $[\underline{d}, \overline{d}]$ and where $H(\overline{a}^H) \in (0,1)$ so that it may be optimal to keep the antiquity at home in some states of the world and move it abroad in others.[12] A period in the model can be thought of as a generation.

3.1 A comparison of policies without corruption

In the simple case without corruption, an official under a free trade policy and under a lease will move objects abroad in periods where $\overline{a}^H > d_t^H$ and keep objects at home in periods where $\overline{a}^H < d_t^H$. Since $\overline{a}^H > M$, objects are always maintained in this setting. The governments net present value of an antiquity under free trade or a lease program is equal to:

$$NPV^{FT} = \sum_{t=0}^{\infty} \delta^t \mathbb{E}_d \left[\max(\overline{a}^H, d_t^H) - M \right]. \tag{9}$$

In the case of an export ban, the government is forced to keep the objects at home in each period. If the official has a low value for the antiquity today and is pessimistic about the expected value of the antiquity in the future, she may also choose not to maintain an object in a period and instead allow an object to be destroyed. Such no maintenance cases will occur if there exists a $\hat{d} \in (\underline{d}, \overline{d}]$ such that

$$\hat{d} + \sum_{t=1}^{\infty} \delta^t (1 - H(\hat{d}))^t [\mathbb{E}(d_t^H | d_t^H > \hat{d}) - M] = M. \tag{10}$$

Antiquities will be destroyed in this case any time that $d_t^H < \hat{d}$.

If there exists a $\hat{d} \in [\underline{d}, \overline{d}]$ satisfying 10, let $d^* = \hat{d}$. Otherwise, let $d^* = \underline{d}$. Then, the

[12] The model can be extended to environments where the distribution of potential values is improving over time and where $H_{t+1}(.)$ FOSD $H_t(.)$. This relaxation would push policy toward leases due to the improved maintenance incentives and the higher likelihood that antiquities will survive into the next period.

net present value of an export ban is

$$NPV^{EB} = \sum_{t=0}^{\infty} \delta^t (1 - H(d^*))^t [\mathbb{E}(d_t^H | d_t^H > d^*) - M] \tag{11}$$

Comparing the net present value of leases and export bans to the net present value of export bans yields the following proposition.

Proposition 4 *With no corruption, the net present value of leases and free markets exceeds that of an export ban. Leases and free market also lead to greater maintenance incentives than an export ban.*

3.2 A comparison of policies with corruption

We now consider a model in which there is a probability that the official who decides how to allocate the antiquity is corrupt or does not represent the citizens. A corrupt official who can sell the antiquity can appropriate its full value, while one who can only lease it can appropriate only one period's value. We show that for a large range of probabilities of corruption, laws allowing leases but not sales are optimal.

We first consider the case in which the government writing the initial policy can only decide between allowing free markets or completely prohibiting any overseas transfer of the antiquity. We then consider cases in which the government has the additional option to restrict foreign transactions to single period leases.[13] In both cases, decisions about transfers of government property are made by a sequence of officials who each have influence over the antiquity for one period. Each official (including the one at time 0) has probability $1 - \epsilon$ of being *honest* and acting as a benevolent social planner and a probability of ϵ of being *corrupt* and maximizing their own consumption with no regard for current or future generations; we assume that the types of officials are uncorrelated over time.

Corrupt officials have access to some portion of the proceeds of sales and leases via kickbacks and thus always choose to move antiquities abroad or into private hands for the maximum amount of time legally possible. In effect a corrupt official can act in collusion with a foreign buyer to expropriate the cultural patrimony of the country.[14]

[13] As noted earlier, a period in this model can be thought of as a generation.

[14] The problem is thus in some ways analogous to that studied by Pogge (2001) and Kremer & Jayachandran (2006).

For clarity, we study the stark case in which corrupt officials have access to the entire revenue from a transaction and thus consume all the proceeds from the exchange. If there are no export bans, a corrupt official sells the antiquity and consumes all future rents. Under an export ban, the corrupt official keeps the antiquity for private use for the period he is in office such that the country cannot benefit from it.[15] Finally, if foreign transactions are restricted to single period leases, the corrupt official leases the antiquity abroad and consumes the proceeds.

Assuming the potential for future corruption is not too high, an *honest official* will allow an antiquity to be used by the foreign collector in any time period when $d_t^H < \overline{a}^H$ and keeps the antiquity local otherwise.[16] Under a complete prohibition on international transfers of antiquities, honest officials simply keep the antiquity at home for domestic use.

Under *free trade*, honest officials must first decide whether to preemptively sell an antiquity today and distribute the earnings during their tenure to prevent corrupt officials from expropriating this value in the future or whether to make optimal short term decisions. The honest official will sell the antiquity abroad if the price for selling the antiquity today is greater than the expected value of optimally allocating the antiquity until the first corrupt official arrives:

$$\frac{\overline{a}^H - M}{1-\delta} > d_t^H - M + \sum_{\tau=1}^{\infty} \delta^\tau (1-\epsilon)^\tau \mathbb{E}_d \left[\max(\overline{a}^H, d_{t+\tau}^H) - M\right]. \tag{12}$$

Note that for ϵ close to zero and δ close to one, this will never be the case. However, if the chance that future officials are corrupt becomes sufficiently large, honest officials will sell the antiquity preemptively.

In the absence of preemptive sales by honest officials, the expected net present value of population welfare derived from each antiquity under free trade is:

$$NPV^{FT} = \sum_{t=0}^{\infty} \delta^t (1-\epsilon)^{t+1} \mathbb{E}_d \left[\max(\overline{a}^H, d_t^H) - M\right]. \tag{13}$$

[15]More generally, under an export ban, a corrupt official would keep the antiquity for private use if its value to the official exceeded the maintenance cost, and otherwise would not maintain the antiquity. Allowing for this possibility would make export bans less attractive relative to free trade or allowing fixed duration leases.

[16]As discussed below, if the potential for corruption is large enough, an honest official may wish to sell an antiquity today and distribute the earnings during his tenure to prevent corrupt officials from expropriating this value in the future.

Under an *export ban*, the antiquity always stays in the country resulting in a value of $\mathbb{E}[d_t^H] - M$ in each period that an honest official is in power. Under the assumption that it is always in an honest officials interest to maintain an antiquity, the expected net present value of population welfare derived from each antiquity is

$$NPV^{EB} = \sum_{t=0}^{\infty} \delta^t (1-\epsilon) \mathbb{E}_d \left[d_t^H - M \right]. \tag{14}$$

As can be seen by comparing equations (13) and (14), export bans act as a blunt tool to constrain corrupt future officials from acting in a malevolent way. To reduce the ability of future corrupt leaders to steal funds, the government also limits the ability of good officials to make welfare improving trades. This reduces the expected value in a given period to $\mathbb{E}_d(d_t^H) - M$ from the higher expected value of $\mathbb{E}_d \left[\max(\overline{a}^H, d_t^H) - M \right]$. Vice versa, the lack of control over the actions of corrupt officials leads to a lower probability that an antiquity will be preserved for the enjoyment of future generations. Thus, under free trade, the valuation of future periods is discounted by $(1-\epsilon)^{t+1}$ as opposed to $(1-\epsilon)$ as in the case of an export ban.

Leases are a way of balancing concerns about corruption with efficiency considerations. In particular, short-term leases can restrict the long-term damage by corrupt officials[17] while still giving benevolent ones the ability to make Pareto-improving short-term trades. To see this, consider the expected net present value of population welfare derive from each antiquity when only one-period leases are permitted:

$$NPV^{L} = \sum_{t=0}^{\infty} \delta^t (1-\epsilon) \mathbb{E}_d \left[\max(\overline{a}^H, d_t^H) - M \right]. \tag{15}$$

Comparing this expression to equation (14), it becomes apparent that allowing one-period leases but not sales dominates passing complete export bans as long as the external price, $\overline{a}^H$, exceeds the domestic value, d_t^H, in some state of the world.[18] Furthermore, comparing (15) to (13) reveals that one-period leases dominate free-trade as long as $\epsilon > 0$. It follows:

Proposition 5 *If the only law available to a benevolent social planner is restricted to*

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

[18]Leases also dominate preemptive sale as long as NPV^L is greater than $\frac{\overline{a}^H - M}{1-\delta}$.

an export ban or free trade, and $\overline{a}^H < \mathbb{E}[d_t^H]$*,then as* $\delta \to 1$*, there exist thresholds* $\underline{\epsilon}$ *and* $\bar{\epsilon}$ *such that if* $\epsilon \in (\underline{\epsilon}, \bar{\epsilon})$ *the government chooses an export ban. Leases dominate both export bans and free trade as long as* $\epsilon > 0$ *and there exist some states of the world for which* $d_t^H > \overline{a}^H$*.*

The model studied here can easily be modified to allow for situations in which there is an insufficient budget to protect all antiquities or there is a positive probability that the state is unable to maintain or protect antiquities in some periods. If officials are able to forecast these events, allowing leases provides honest officials tools to move antiquities abroad to protect them in times of heightened danger. In cases of armed conflict, restricting all transactions to leases also reduce incentives for combatants to search for antiquities for the purpose of selling them to fund war efforts. However, such restrictions will only be binding if they can be enforced internationally.

4 Collected Proofs

<u>Proof of Proposition 1:</u> Starting with the case where the government would like to retain all antiquities, first note that in any equilibrium where bribes exist, $B \in [0, V^H - V^L]$ depending on the bargaining power of the bureaucrat relative to the informed citizen. The individual rationality constraint for informed citizens holding high- or low-quality antiquities demand that their expected transfers (net of the bribe) weakly exceed the value of their respective outside option. Defining T^H and T^L as the transfers made to informed citizens whose antiquities are reported as high and low respectively, individual rationality requires

$$\begin{aligned} T^H &\geq V^H, && (16) \\ (1-b)T^L + b(T^H - B) &\geq V^L. && (17) \end{aligned}$$

The first equation here simply states that the transfer to a high type must exceed the informed citizen's outside option. The second equation states that the transfers paid to an informed citizen holding a low-quality antiquity when matched with an honest bureaucrat plus the additional transfers gained by the informed citizen when matched with a corrupt bureaucrat must exceed the outside option.

In the optimal purchase program, both constraints will hold with equality. Thus, rearranging equation (16) yields

$$T^L = V^L - \frac{b}{1-b}\left(V^H - V^L - B\right), \tag{18}$$

which is strictly less than V^L. The reduction in T_L is due to the possibility of a holder of an antiquity matching with a corrupt bureaucrat and receiving a positive surplus.

The expected cost for procuring each antiquity is

$$[p + (1-p)b]T^H + (1-p)(1-b)T^L, \tag{19}$$

where p is the proportion of high quality antiquities. Plugging in (16) and (18) yields an expected cost per item of:[19]

$$pV^H + (1-p)V^L + (1-p)bB. \tag{20}$$

Let us now consider the second case in which the government only wants high-quality antiquities and where low-quality antiquities are interpreted as forgeries with no domestic value. In this case, the social planner only wants to retain high-quality antiquities but, due to corruption, also ends up purchasing a proportion $(1-p)b$ of forgeries. Using (19) and noting that $T_L = 0$ in this environment, the cost of the program is

$$[p + (1-p)b]V^H \tag{21}$$

while the gross value of the high-quality antiquities is only:

$$p\left(\frac{d^H - \delta M}{1-\delta}\right). \tag{22}$$

■

<u>PROOF OF PROPOSITION 2:</u> In order to prove that a lease program can always provide incentives for revelation, we need to show that the maximum information rent that can be generated by a lease program exceeds V^q. This maximum information rent available

[19] Corrupt bureaucrats could, of course, also charge bribes to individuals with high-quality antiquities 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 increase by pbB.

from a lease, $\overline{L}^q$, is:

$$\overline{L}^q = \lim_{\tau \to \infty} \sum_{t=0}^{\infty} \delta^t [\overline{a}^q - \delta M] = \frac{[\overline{a}^q - \delta M]}{1-\delta}. \tag{23}$$

Recall that V^q is the maximum of two alternative options: the maintenance cost M and the opportunity cost associated with waiting for a smuggler. We have assumed that $\overline{a}^q \geq M$ and thus $\overline{L}^q \geq M$. As such, it is always possible to generate information rents that equal or exceed the maintenance cost.

We now compare $\overline{L}^q$ to the opportunity cost associated with waiting for a smuggler. In the case where $V^q > M$,

$$\frac{\partial V^q}{\partial a(e)} = \frac{(1-(1-\beta(e))\delta)\pi^q(e)(\overline{a}^q - \delta M) + (1-\delta)(1-\beta)(v - \delta M)}{(1-\delta)((1-(1-\beta)\delta(1-\alpha)))^2}.$$

The sign of $\frac{\partial V^q}{\partial a(e)}$ is determined by the sign of the numerator of this expression. Thus, if the numerator is always positive, the outside option will be maximized when the chance of meeting the smuggler is $\alpha(e) = 1$. We now show that this is the case.

First, suppose that $(v^q - \delta M) > 0$. In the main text, we have assumed that we are in the case where the informed citizens sell antiquities to smugglers when given the chance and that $\pi^q(e)[\overline{a}^q - \delta M] > (1-\beta(e))[v^q - \delta M]$. It follows that

$$\begin{aligned} num\left[\frac{\partial V^q}{\partial a(e)}\right] &= (1-(1-\beta(e))\delta)\pi^q(e)(\overline{a}^q - \delta M) + (1-\delta)(1-\beta(e))(v^q - \delta M) \\ &> (1-(1-\beta(e))\delta)(1-\beta(e))(v^q - \delta M)) + (1-\delta)(1-\beta(e))(v^q - \delta M) \\ &= (2(1-\delta) + \delta\beta(e)))(1-\beta(e))(v^q - \delta M) \\ &> 0. \end{aligned}$$

Likewise, when $(v^q - \delta M) \leq 0$,

$$\begin{aligned} num\left[\frac{\partial V^q}{\partial a(e)}\right] &= ((1-(1-\beta(e))\delta)\pi^H(e)(\overline{a}^q - \delta M) + (1-\delta)(1-\beta(e))(v^q - \delta M)) \\ &\geq ((1-(1-\beta(e))\delta)\pi^H(e)(\overline{a}^q - \delta M) \\ &> 0. \end{aligned}$$

Thus, the numerator is always positive and the outside option is maximized when the chance of meeting a smuggler $\alpha(e) = 1$.

Finally, note that when $\alpha(e) = 1$ and $V^q > M$, $V^q|_{\alpha(e)=1} = \frac{\pi^q(e)[\overline{a}^q - \delta M]}{1-\delta}$. It follows that

$$\overline{L}^q > \pi^q(e)\overline{L}^q = V^q|_{\alpha(e)=1}$$

and thus there always exists a lease length that will induce informed citizens to reveal their objects.

<u>Proof of Proposition 3:</u> In order to show that leases dominates the other three contracts, it is sufficient to show that the loss of a lease contract relative to the first best case of recovering all objects for free is greater than the loss under at least one alternative policy at $\delta = 0$ and the loss is less than the other policies as $\delta \to 1$. Proving the first piece is trivial: since lease contracts must always move antiquities away for one period, the surplus in this case is zero. Under export bans, $(1 - \alpha(e))\beta(e)$ antiquities are recovered in the first period.

Next, looking at the case where $\delta \to 1$, we first consider the losses associated with a lease. In general, there are two costs associated with the lease: the information rent V^q that must be paid to the informed citizen via the lease and the additional loss that occurs from the antiquity being misallocated to a foreign collector rather than being at home for the duration of the lease. Let τ^* be the amount of time the optimal lease leaves the antiquity abroad. Then, the total cost of a lease is equal to

$$Loss_{Leases} = \lim_{\delta \to 1} \left[V^q + \sum_{t=0}^{\tau^*} \delta^t [d^q - \overline{a}^q] \right].$$

Next, note that

$$V^q = \left[\frac{\alpha(e)\pi^q(e)\frac{[\overline{a}^q - \delta M]}{1-\delta} + (1 - \alpha(e))(1 - \beta(e))(v^q - \delta M)}{1 - \delta[(1 - \alpha(e))(1 - \beta(e))]} \right]$$

can be rewritten as:

$$V^q = \frac{1}{1-\delta} \left[\frac{\alpha(e)\pi^q(e)[\overline{a}^q - \delta M]}{1 - \delta[(1 - \alpha(e))(1 - \beta(e))]} + (1 - \delta)K(e) \right],$$

where

$$K(e) = \frac{(1 - \alpha(e))(1 - \beta(e))(v^q - \delta M)}{1 - \delta[(1 - \alpha(e))(1 - \beta(e))]}$$

is the portion of the information rent associated with the gains and losses of the citizen for holding the object until the first smuggler is found. This term will be negative as $\delta \to 1$ since we have assumed $v^q < M$. Further, as can be seen by the $(1-\delta)$ discount term in front of it, the importance of this term relative to the first becomes vanishingly small as the government become infinitely patient.

Next, we can write the total loss associated with the lease in the limit as:

$$Loss_{Leases} = \lim_{\delta \to 1} \frac{1}{1-\delta}\left[\frac{\alpha(e)\pi^q(e)[\overline{a}^q - \delta M]}{1-\delta[(1-\alpha(e))(1-\beta(e))]} + (1-\delta)\left(K(e) + \sum_{t=0}^{\tau^*} \delta^t[d^q - \overline{a}^q]\right)\right].$$

The last term in this equation is associated with the cost of misallocating the object to the foreign collector for the duration of the lease. Since this misallocation occurs for a fixed and finite amount of time, the overall impact of this term will again be small relative to the first term as the government becomes infinitely patient.

The loss under a free trade policy is:

$$Loss_{Free} = \lim_{\delta \to 1} \frac{1}{1-\delta}[\overline{a}^q - \delta M]. \tag{24}$$

Since this equation also has $\frac{1}{1-\delta}$ in the denominator, only the first term in the lease equation matters when comparing the losses under the two policies as $\delta \to 1$. It follows that if $\frac{\alpha(e)\pi^q(e)}{1-\delta[(1-\alpha(e))(1-\beta(e))]} < 1$ the lease contract will have a lower loss. This can be shown to be true by taking the first order condition with respect to $\alpha(e)$ and noting it is increasing over the domain of $\alpha(e) \in [0,1]$. Since the expression is equal to $\pi^q(e)$ when $\alpha(e) = 1$ and $\pi^q(e) < 1$, it is always the case that the lease will have the lower loss as $\delta \to 1$.

For the export ban, the loss is given by:

$$Loss_{Ban} = \lim_{\delta \to 1} \frac{1}{1-\delta} \frac{(\alpha(e) + (1-\delta)(1-\alpha)(1-\beta))[d^q - \delta M]}{1-\delta[(1-\alpha(e))(1-\beta(e))]} \tag{25}$$

$$\geq \lim_{\delta \to 1} \frac{1}{1-\delta} \frac{\alpha(e)[d^q - \delta M]}{1-\delta[(1-\alpha(e))(1-\beta(e))]} \tag{26}$$

By assumption it is optimal to keep the antiquity at home and thus $d^q > \overline{a}^q$. Since $\pi^q(e) < 1$, it follows that the loss on the export ban is greater than the lease as $\delta \to 1$.

Finally, in comparing leases to incentive payments, the total losses associated with leases when $\delta \to 1$ converges to pV^H from above since the losses associated with the misallocation of the antiquity over the lease length becomes vanishingly small. By contrast, the loss associated to incentive payments is given by

$$Loss_{Incentives} = \lim_{\delta \to 1} pV^H + (1-p)bV^H. \tag{27}$$

Since we have assumed $b > 0$ and $p \in (0,1)$, there will always exist a δ where leases dominate incentive payments.

Note that the proof here does not make any assumptions on e. Thus leases dominate the other contracts for a patient government even in the case where e is optimally chosen.

<u>Proposition 4:</u> Suppose first that there exists a d^* where the antiquity will be destroyed under an export ban. In this case $d^* < M$ and $\overline{a}^H \geq M$. This implies $\mathbb{E}_d[max(\overline{a}^H, d_t^H) - M] > H(d^*)[\overline{a}^H - M] + (1 - H(d^*))[\mathbb{E}(d_t^H | d_t^H < d^*) - M]$. Noting that $H(d^*)[\overline{a}^H - M]$ is positive, the net present value of a lease or free market exceeds that of an export ban. If, d^* does not exist, then the NPV of an export ban is $\Sigma_{t=0}^{\infty} \delta^t [\mathbb{E}(d_t^H) - M]$ which will be strictly less than free trade in any state where $\overline{a}^H > d_t^H$.

<u>Proposition 5:</u> Under free markets, a generation $t > 0$ that is reached without a corrupt official that is served by a benevolent official gets expected value

$$\mathbb{E}[\max\{\overline{a}^H, d_t^H\}] - M = [1 - H(\overline{a}^H)][\mathbb{E}(d_t^H | d_t^H \geq \overline{a}^H)] + H(\overline{a}^H)\overline{a}^H - M, \tag{28}$$

where H is the cdf of possible home valuations. The NPV of an antiquity with a free market is thus:

$$\frac{1-\epsilon}{1-\delta(1-\epsilon)}\big[[1 - H(\overline{a}^H)][\mathbb{E}(d_t^H | d_t^H \geq \overline{a}^H)] + H(\overline{a}^H)\overline{a}^H - M\big]. \tag{29}$$

The NPV of an export ban is

$$\frac{1-\epsilon}{1-\delta}[\mathbb{E}(d_t^H) - M]. \tag{30}$$

The home country prefers an export ban if equation (29) is less than equation (30). This condition is equivalent to requiring that

$$\overline{a}^H \leq \mathbb{E}(d_t^H | d_t^H \leq \overline{a}^H) + \frac{\delta\epsilon}{1-\delta}\frac{\mathbb{E}(d_t^H)}{H(\overline{a}^H)} + \frac{(1-\epsilon)\delta\epsilon M}{(1-\delta)(1-\delta(1-\epsilon))}. \tag{31}$$

At $\epsilon = 0$, the RHS of (31) is $\mathbb{E}(d_t^H | d_t^H \leq \overline{a}^H)$ which is less than $\overline{a}^H$ for $H(\overline{a}^H) > 0$.

Thus, with no corruption, free trade is optimal. As $\delta \to 1$, for $\epsilon \in (0,1)$ the right hand side of (31) goes to infinity implying that an export ban is always optimal. Thus, there exists an arbitrarily small $\underline{\epsilon}$ 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 antiquity is stolen. As $\delta \to 1$ the losses that occur if an antiquity 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 antiquity in order to preempt future corrupt officials from doing the same. Preemption generates a total surplus of $\frac{\overline{a}^H - M}{1-\delta}$. As $\epsilon \to 1$, the value of an export ban evaluated at the point of contracting converges to $0 < \frac{\overline{a}^H - M}{1-\delta}$. Since $\overline{a}^H < \mathbb{E}[d_t^H]$, there also exists a positive ϵ for which an export ban is better than preemption. Thus, as $\delta \to 1$, there exists an $\overline{\epsilon}$ such that for $\epsilon < \overline{\epsilon}$, an export ban is preferred to preemption. Since $\underline{\epsilon}$ is arbitrarily close to zero, $\underline{\epsilon} < \overline{\epsilon}$ and thus there exists a range of corruption levels for which an export ban is preferred.

References

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

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

Sotiriou, K.-O. (2018), 'The f words: Frauds, forgeries, and fakes in antiquities smuggling and the role of organized crime', *International Journal of Cultura Property* **25**(2), 223–236.