Slavery and Freedom

Reasons and Consequences of the Use of Rewards

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Abstract

In ancient Rome, masters often used expensive "carrots" (rewards) instead of "sticks" (physical punishments) in order to induce their slaves to work. In turn, the use of carrots allowed some slaves to buy their own freedom and acquire substantial wealth and influence as freedmen. There was a correlation between the choice of carrots versus sticks and the type of tasks performed by the slave: simple material tasks were usually accompanied by sticks, while more complex tasks requiring thinking and initiative where usually followed by carrots. Building on previous literature, I explain this pattern by modeling the master-slave relationship as a principal-agent interaction in which the principal (master) receives noisy signals about the agent's (slave's) effort. Uninformative signals create two problems in connection with sticks: first, the magnitude of the punishment needs to increase to compensate for the noise of the signal and, second, the punishment is applied more often as a result of errors. Sticks (physical punishment), especially if large and frequently applied, are costly for the master, as they impair (temporarily or permanently) the investment that the master has made in the slave. Thus, when the signal is particularly uninformative and the master has invested in the slave, the master might find it more convenient to use carrots rather than sticks. This perspective offers insights on three important issues in ancient history: the different treatment of different types of slaves and the reasons behind the concession of freedom; the emergence and decline of classical slavery and its relation to earlier and later forms of exploitation; the open character of classical slavery, where slavery and freedom were contiguous statuses in contrast with more other forms of slavery based on ethnicity, color or gender.

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"Slavery […] dishonors labor; it introduces idleness into society and therewith ignorance and pride, poverty and luxury"

Alexis de Tocqueville, *Democracy in America*

"Freedom is slavery
Ignorance is strength"

George Orwell, *1984*

1. Introduction

In ancient Rome, it routinely happened that slaves were rewarded; at times, slaves were very generously rewarded. The use of carrots (rewards)—next to the more common sticks (physical punishments)—allowed many slaves to obtain or buy freedom and enabled some of them to acquire substantial wealth and influence as freedmen. The use of carrots was selective: it was correlated with the type of tasks performed by the slave. Simple material tasks were usually accompanied by sticks, while more complex tasks requiring thinking and initiative often went hand in hand with carrots (Fenoaltea, 1984, p. 673; Harris, 2007, p. 527). In turn, these features gave Roman classical slavery a unique "open" character, where the boundary between slavery and freedom was permeable, some slaves could become free and, vice versa, some freemen chose to become slaves. This open character is neither to be found in other periods of Roman history (at least, not to the same extent) nor in other instantiations of slavery, modern and ancient alike, that I was able to examine (Finley, 1973; Giardina and Schiavone, 1981; Duncan-Jones, 1982).

The use of carrots raises three sets of fundamental questions about the slave system in ancient Rome: (1) How can we explain the pattern of selective use of often very large rewards? (2) How can we explain the emergence of Roman classical slavery with its reward system around the third century BC and its decline around the third century AD? (3) In general, how can we explain the open character of classical slavery in ancient Rome?

Concerning the first question, carrots pose a first-order puzzle. Slavery is a parasitic activity whereby masters exploit slave labor to their own advantage.[1] By paying out rewards, the master redistributes part of his gains to the slave, thus defeating the very purpose of slavery. Therefore, the use of carrots in the master-slave relationship calls for an explanation. Moreover, since carrots were applied selectively and were at times very large, an explanation for the use of carrots should also account for the selection criterion and for the variation in the magnitude of the rewards.

Extant literature has suggested that the concession of benefits and freedom could have been motivated by philanthropy or self-interest (Hopkins, 1978, pp. 118 and 127-128). The

[1] In the American antebellum South this advantage has been quantified as a productivity increase of up to 70% over free labor, very high returns to investment, and thriving economic growth; see Conrad and Meyer (1964); Fogel and Egerman (1974); Temin and David (1979); Fogel (2003, pp. 36 and 45-46).

philanthropy explanation is challenged by the harsh living conditions of the vast majority of slaves. Masters clearly exercised philanthropy in a selective way and never felt it so strongly as to envisage the abolition of slavery (Hopkins, 1978. pp. 122-123; Thébert, 1989, p. 171; Bradley, 1994, pp. 81 ff.). In turn, the selective application of philanthropy is a plausible but incomplete explanation, absent a parallel explanation for the selection criterion.

The self-interest explanation points to an array of more specific objectives: preventing revolts, ostentation of wealth, increasing one's ranks of business and political supporters (*clientes*), or obtaining a price for freedom. All of these explanations have clear merits but leave some questions unanswered. The former two explanations cannot account for the fact that the slaves most likely to be rewarded or freed were those with high human capital and little propensity to revolt (Hopkins, 1978, pp. 117-118). Moreover, the display of wealth does not require selective rewards; rather, one could display his wealth by lavish, indiscriminate gifts, which need not be connected with the behavior of those who receive them. Thus, the selection criterion for the concession of rewards remains unexplained. In turn, the latter two justifications—increasing one's ranks of business and political supporters (*clientes*) and obtaining a price for freedom—do not explain why rewards were at times so large as to allow some former slaves to become richer than senators.[2] If the master was simply seeking to expand his network of clients, manumissions did not have to be accompanied by large endowments. Moreover, since the slave's possessions were legally the master's property, the master could have taken them from the slave directly rather than acquiring them as a price for freedom.

Within the self-interest hypothesis, it has also been noted that rewards produced incentives (Hopkins, 1978, pp. 126-128). Along these lines, Fenoaltea (1984) focuses on the slave's motivation to exert effort and divides the tasks to which slaves were assigned into two categories: activities that require physical effort and activities that require some form of care. In turn, physical punishments are inappropriate with care-intensive actitivities, because the prospect of pain induces anxiety and hence carelessness; better motivation to work can be provided by rewards. Unlike the other incentive-based theories, this explanation accounts for the selective use of rewards. In this paper, I propose a model that, differentely from Fenoaltea (1984), describes the choice between carrots and sticks as a matter of information rather than motivation. In addition to the insights offered by Fenoaltea (1984), the model proposed here also aims at explaining the great variation in the magnitude of rewards and the cohexistence of rewards and physical punishments even in care-intensive activities.

[2] Pliny, *Naturalis Historia* 7.129.

I examine the choice between carrots and sticks by modeling the master-slave relationship as a principal-agent interaction in which the principal (master) receives noisy signals about the agent's (slave's) effort. Depending on the slave's tasks, the signal that the master receives can be more of less informative. Simple tasks are those in which the signal is relatively informative—the master can easily understand if the slave has exerted effort—and, vice versa, complex tasks are those characterized by relatively uninformative signals—the master often makes errors when assessing whether the slave has exerted effort.

If the slave task is simple, masters prefer sticks over carrots. The reason is that, if a threat to punish is followed by compliance, the punishment does not actually need to be applied in equilibrium. Thus, using threats turns out to be a rather inexpensive mechanism for the master. Since rewards need to be paid upon compliance, carrots would come at a greater cost for the master than sticks (Dari-Mattiacci and De Geest, 2010). In contrast, uninformative signals create two problems in connection with sticks: first, the magnitude of the punishment needs to increase to compensate for the noise of the signal and, second, the punishment is applied more often as a result of errors. Sticks (physical punishments), especially if large and frequently applied are costly for the master, as they impair temporarily or permanently (by torture or execution) the investment that the master has made in the slave. Thus, when the signal is particularly uninformative and the master has made a large investment in the slave, the master may find it convenient to switch to carrots.

This argument accounts for the use of carrots in ancient Rome. This model has two implications. One should observe carrots in connection with complex slaves' tasks and large master's investments, both in terms of the costs incurred to purchase or train the slave and in terms of the value of the business activities managed by the slave. Moreover, the magnitude of the rewards is a function of the complexity of the task. The more complex the task is, the larger the carrot needs to be, in order to compensate for the errors made due to the relatively low quality of the signal.

A second step of the analysis connects complex slave tasks with the conditions of the Roman economy. Since many slaves were captured in war, the supply of slaves with high human capital was fostered by the Roman expansion into territories rich in culture and with a high degree of urbanization and decreased as the empire consolidated within its borders. In turn, the demand for slaves with high human capital came from sectors of the economy, such as commerce and entrepreneurship, that involve the delegation of complex tasks, while traditional, small-scale agricultural activities were chatacterized by simple tasks. From a diachronic perspective, the

model predicts that one should observe carrots in periods when complex commercial and entrepreneurial activities played an important role in the economy and could be profitably delegated to slaves endowed with high human capital. Transitions between different types of exploitation occurred in the third century BC—with the gradual transformation from patriarchal slavery into classical slavery—and in the third century AD—with the decline of classical slavery and the emergence of different forms of serfdom (*colonatus*). These two periods of transition correspond to the lower and upper boundaries of the period considered in this paper and can be explained with reference to the supply of and demand for slaves with high human capital. The pattern of expansion of the Roman Empire offers an indication of the supply of slaves. From the third century BC, as Rome expanded, the enlargement concerned territories rich in culture, often more urbanized and developed, in many ways, than Rome itself. One example should suffice to illustrate this point: when the Roman army entered the Sicilian city of Syracuse in 212 BC, they found Archimedes at work.[3] Throughout the Hellenistic world, finely cultivated slaves were brought to Rome to be employed according to their skills. At the same time, commerce flourished along with entrepreneurial activities, fuelling the first phase of transition (Rostovtseff, 1957, ch 1; Harris, 2007; Morel, 2007).

As the Roman dominion consolidated at the turn of the millennium, and the frontiers moved outwards, armies had to defend rather than conquer and, even when they entered into new territories, they found them rich in natural resources but relatively poor in human capital. The supply of high-quality slaves dried up as a consequence. Likewise, the demand for high quality slaves, which was connected to commercial and entrepreneurial activities, slowly wilted from the second century AD onwards, following two major plagues, barbaric invasions, and the consequent population contraction and economic crisis (Giardina, 2007; Jongman, 2007). As the economy reverted to agriculture, also the type of tasks that could be delegated to slaves reverted back to simple occupations, which could be easily incentivized with sticks.

The third and last step of the analysis addresses the broader question why the Roman world during the six centuries considered in this paper had a unique osmotic character in relation to social mobility. While it was certainly easier to pass from freedom into slavery than vice versa, a nontrivial number of slaves made it back to freedom and sometimes to economic and social success.[4] These freedmen were an important and active part of the Roman society. During this time period, some freemen also voluntarily sold themselves into slavery, which was likely due to

[3] Livy, *Ab urbe condita*, XXV.31; Valerius Maximus, *Factorum et dictorum memorabilium*, VIII.7.7; Plutarch, *Marcellus*.
[4] Note that many of those who eventually acquired freedom were born slaves.

the pervasive use of carrots. The approach proposed here implies that the open character of classical slavery was the necessary consequence of the use of carrots to incentivize slaves. In turn, carrots had advantages over sticks that were particularly felt when slave tasks were complex and the master's investments in his slave's activity were relevant. Finally, this situation is typical of an economy were two things simultaneously happen: economic activities are such that they involve the delegation of complex tasks and there is a large supply of slaves endowed with the sufficient human capital to carry out these tasks. Ultimately, without denying the importance of other factors, the openess that uniquely characterized the Roman classical slave system was to a large extent the result of the economic conditions in which the Roman world versed.

These findings provide a number of testable implications with diachronic and synchronic ramifications. On the one hand, the model presented here suggests that there is a causal relationship between the economy and the treatment of slaves, which can be tested in other ancient and modern slave societies. On the other hand, slavery is just one form of exploitation and insights from slavery can be used to investigate the inner workings of analogous relationships. Phenomena such as wage-slavery,[5] feudalism, colonialism, and imperialism, which involve the exploitation of an individual or a group by another individual or group, could be investigated using a similar framework. This analysis ultimately suggests that the most hideous forms of exploitation—those based on violence, brutality, and threats—are more likely to emerge when exploitation concerns low-skill tasks. It also follows from the analysis that there is a natural limit to the use of sticks in exploitative relationships and that such limit is mobile and depends on the monitoring technology available to the master: the less effectively the master can monitor a his slave, the more frequently he will resort to carrots.

This paper is organized as follows. Section 2 describes the institutional and socio-economic background against which slavery operated in ancient Rome. Section 3 presents a formal model of the master-slave relationship and derives the conditions under which the master will choose carrots over sticks. Section 4 analyzes the implications of the model, connects supply and demand of slaves with slaves' tasks and, in turn, with incentives in the master-slave relationship, and studies the characteristics and evolution of slavery in ancient Rome. Section 5 explores the broader implications of this analysis, draws from it some testable hypotheses, and discusses avenues for future research.

[5] Fenoaltea (1984).

2. Background: Slavery in ancient Rome

Of the five main slave societies—classical Greece, ancient Rome, the United States, Brazil and the Caribbean (Finley, 1980, p. 9)—Rome offers the richest material for the study of incentives. Slaves were not identified by racial, sexual, religious and ethnical traits or any other idiosyncratic characteristic. Slavery was an accident. Slaves (*servi*) were principally those who, having fallen in the hands of their enemy, had been spared (*servati*)[6]—the prospect of a life in slavery being a possibly sweeter alternative to brutal slaughter—and those who were born to a slave woman (*ancilla*).[7] In addition, some freemen sold themselves into slavery to obtain remunerative assignments (*ad actum gerendum*).

Roman law accounted for this situation by carefully defining slavery as a distinct status from freedom. However, even though the *status libertatis*—the condition of being either free or slave—provided for the most fundamental divide among individuals,[8] it was in fact a permeable boundary that allowed for transitions from freedom to slavery and vice versa (Buckland 1970; Finely, 1987; Dumont, 1987; Watson, 1987). This osmotic character distinguishes Roman-style slavery from other instantiations of slavery, modern and ancient alike. As in natural osmotic processes, the boundary separating slavery from freedom was differentially permeable, so that transitions in one direction (a freeman becoming a slave) were easier and more frequent than in the opposite direction (a slave becoming a freedman and, possibly, a citizen).

In a millennium, the Romans enslaved more than 100 million people (Scheidel, *forthcoming*). These slaves were part of the Roman society, although generally at the very bottom of it. They did not form a separate social class; rather they mixed with freedmen (*liberti*) and freemen in the hustle and bustle of the streets of the Roman world. In a letter to a friend, Cicero complained about the fact that his slave librarian Dyonisius had run away to Narona in Dalmatia and got away with telling people he had been given freedom by his master. He seemed to be doing well; in 44 BC, two years after his escape, the slave had not been recaptured yet. Other slaves were less fortunate. Apuleius describes slaves as starved, covered in rags, beaten, and fire-marked.[9]

Although, according to the law, all slaves were things rather than human beings, their living conditions were in fact extremely variable. It was this heterogeneity that most visibly characterized Roman slavery. Indeed, when slaves revolted, they did so in account of "the reality

[6] Digest, 1.5.4.2-3. See also Patterson, 1982, p. 5.
[7] Digest, 1.5.5.
[8] Gaius, *Institutiones* I, 9.
[9] Cicero, *Fam xiii*.77; Apuleius, *Metamorphosis* 9.12-14.

of slavery and the material conditions it imposed" rather than as a form of organized protest against the institution of slavery as such (Bradley, 1989, pp. xii and 43). In this attempt to escape from misery, slaves often sided with the poorest cohorts of the Roman freemen, suggesting that likeness of material conditions might bridge the legal divide (Pareti, 1953, p. 690).

2.1. Rise and decline of slavery in the Roman Empire

The period of Roman history offering the richest material for the study of incentives in the master-slave relationship extends from the Punic wars to the economic crisis. This period covers six centuries, from the third century BC to the third century AD, during which the Roman economy describes a parabola from expansion to stagnation. Roughly, expansion took place in the first half of this period (from the third century until the end of the first century BC), during which Republican institutions slowly gave way to the Principate under Augustus, while a slow-down and eventually a crisis characterized the second half of the period (from the first until the third century AD).

The period before the third century BC was characterized by patriarchal slavery, concerning a small number of slaves captured in nearby regions and employed in agriculture, in close contact with other members of the family. In this period, slaves where mainly war prisoners of nearby populations—hence culturally and ethnically affine to the Romans—and were treated not very differently from other members of the family such as sons.[10]

In the third and even more so in the second century BC, with a series of sweeping victories in Italy and the territories surrounding the Mediterranean Sea—for instance, Spain in 206 BC, Macedonia in 148 BC, Africa[11] and Greece in 146 BC—Rome rapidly acquired a predominance over what they called *Mare Nostrum* (Our Sea). The Roman dominion was to climax in AD 117 at the death of the emperor Trajan. The total population subject to Roman rule grew very quickly from the hundreds of thousands in the beginning of the third century BC to over 40 millions at the turn of the millennium, and eventually reached 60 to 70 million at the end of the second century AD (Scheidel, 2007, p. 48). The city of Rome hosted then well over a million inhabitants, a size that remained unmatched during the Middle Ages and the Renaissance until the nineteenth century. Over the same period, Roman power swelled up from the city of Rome into an area of 3.8 million square kilometers and produced a national income that was higher than any European state could achieve up till the industrial revolution (Jongman, 2007, p. 596). Studies on

[10] Both slaves and sons were subject to the authority (*patria potestas*) of the father (*paterfamilia*) but, while sons became independent (*sui iuris*) once the father died, slaves remained slaves (Talamanca, 1990, p. 78).
[11] Modern Tunisia.

Greenland's lead deposits (a proxy for the extent of mining activities; Wilson, 2002, pp. 25-29; Kehoe, 2007, p. 542), shipwrecks (a proxy for the intensity of Mediterranean trade; Hopkins, 1980, pp. 105-106; Morley, 2007, p. 572) and mammal bones deposits (a proxy for meat production and consumption; Jongman, 2007, pp. 613-614) suggest that economic activities and living standards peaked at the turn of the millennium, during the late Republic and the early Empire (Temin, 2001 and 2006).

Due to the expansion, war prisoners from the frontiers began to flock into the Roman world in rising numbers. Ancient sources report numbers as high as 30,000 from Tarentum in the south of Italy in 209 BC (Livy, 27.16), 55,000 from Hannibal's Carthage in 146 BC (Orosius, 4.23), 150,000 from Epirus in 167 BC (Livy, 45.34), and 1,000,000 from Gaul, conquered by Caesar in 58-51 BC (Plutarch, *Caes.* 15).[12] The trend toward economic and military expansion continued unfailingly up to the first century BC, and increasing numbers of slaves continued to fatten the Roman economy. It has been estimated that the proportion of slaves in the total population of the Roman world oscillated somewhere between 10% and 30%, varying in time and place and with relevant differences between urban areas and countryside (Scheidel, *forthcoming*). It is to be considered that such relative proportion is sensitive to two countering forces: expansion produces an increase in both the numerator (number of slaves) and the denominator (population size). The upper bound (30%) is found in Bradley's (1989, p. 19) estimate of the slave population in Italy around 225 BC. The lower bound (10%) is proposed by Harris (1999a, p. 65) and refers to Egypt in the second half of the second century AD, just before the Antonine plague.[13] Even if one adopts a conservative posture, these figures suggest nevertheless a massive influx of slaves. These slaves were welcomed into the Roman world in a very different way than the slaves in the previous period (Talamanca, 1990, pp. 79-80). They provided labor input into virtually all economic activities, and many of them were educated and could offer intellectual services besides manual labor.

From the third century AD to the end of the Roman Empire things began to look much bleaker. In the West, the Roman Empire formally ended in AD 476 at the hands of the Germanic chieftain Odoacer, who deposed the last emperor Romulus Augustus, ironically carrying the names of both the mythical founder of Rome and its *princeps*. The East resisted for roughly another one thousand years in the form of the Byzantine Empire, until it was also brought down in 1453 by the Ottoman sultan Mehmed II The Conqueror. The beginning of the end

[12] Livy, 27.16; Orosius, 4.23; Livy, 45.34; Plutarch, *Caes.* 15. See Scheidel (1996a) for the cautions to be used in interpreting figures reported in ancient texts.
[13] See Scheidel (2007) for a very recent study on demography in the ancient world.

approximately coincided with the Antonine plague of AD 165-180—which claimed the life of emperors and peasants alike (Duncan-Jones, 1996)—and a series of incursions that brought destruction and demographic contraction. Emperors needed a constant influx of tax revenues to continue fuelling the armies and prevent insurrections. To keep tax revenues up they needed to assure that land was cultivated and hence tried to counter the flight of peasants from the countryside.

Fewer wars of conquest brought fewer slaves and traditional chattel slavery lost its economic importance both in urban areas and in the countryside. While Roman citizenship was extended to the entire Empire by the *Constitutio Antoniniana* in AD 212, the distribution of wealth became more unequal, with a richer and smaller elite enjoying most of the surplus produced by a poorer mass of peasants (Jongman, 2006, p. 249). Quite telling is the fact that, in legal texts, the traditional distinction between freemen and slaves is replaced by the dichotomy between *honestiores* and *humiliores*, that is, between the elite and the masses—the latter composed by both free individuals and slaves.

In this context and through a complex process of transition, in the second century AD slavery began to loose a great part of its prominence in the Roman economy and gave way to different forms of exploitation, mainly the *colonatus*.[14] Land was partially nationalized and peasants were obliged to stay on the farms. Tenants (*coloni*) were formally free but could not abandon their land and move elsewhere. While the law had given them freemen status, they in fact lived as slaves. In contrast to the previous period, they were no longer attached to a master, but rather to a parcel of land (Giardina, 2007, p. 753 ff.). Most importantly and somewhat ironically, since they were not slaves, they could not be freed.

2.2. Slavery in the law

2.2.I. Status

Roman law recognized three statuses to individuals. The *status libertatis* pertained to the distinction between the free (*ingenui*, born free, and *liberti*, freed slaves) and the slaves (*servi*). In the second century AD, the jurist Gaius referred to this distinction as the *summa divisio*

[14] The c*olonus* is a figure that emerges around the third century AD. A *colonus* cannot leave the land and cannot be removed from the land by his master. From the legal point of view it was more complex to define the *colonatus* than slavery: a *colonus* who runs away ca be chained and obliged to go back to his tasks, which he performs as a freeman (*Cod. Theod. 5.17.1* and *Cod. Just. 11.52*), but yet it was illegal to enslave a *colonus* (Giardina, 2007, pp. 751-752).

personarum,[15] the most important distinction amongst individuals. The *status civitatis* referred to whether a free individual was a Roman citizen or a foreigner. The *status familiae* determined whether a free citizen was independent (*sui iuris*) or subject to another individual. The slave lacked the first status, and hence all of the others. Some individuals were born slaves, while others lost their *status libertatis* later—an event called *capitis deminutio maxima*.[16]

The principal causes of slavery were birth from an *ancilla* (a slave woman, even if the father was free)[17] and imprisonment in war (prisoners initially belonged to the individual soldier and later to the state). In addition to that, slavery could be administered as a criminal punishment or as a prerequisite for another criminal punishment, which could not be administered to freemen. Thus, in the case of execution, *damnatio ad metalla* (forced labor in the mines for life), or *damnatio ad bestias* (death in the circus by wild animals), *capitis deminutio* of the convicted criminal preceded the actual punishmen. Finally, voluntary slavery *ad actum administrandum* or *gerendum*[18] provided for an additional, albeit plausibly infrequent, source of slaves.

Furthermore, Roman law allowed some forms of semi-servile conditions, close but not formally equivalent to slavery. Such cases concerned ungrateful freedman subjected to *revocatio in servitutem*, abandoned children, children sold by their father and insolvent debtors. There was a natural tendency to consider the enslavement of Roman citizens in Rome as unacceptable, and these individuals retained their *status libertatis* with the rights attached to it or, as in the case of abandoned children, they could be ransomed (Andreau, 1989, p. 200).

In Roman law, contrary to other legal systems, the slave is regarded as a thing (*res*) rather than an individual.[19] Therefore, the slave could not be the subject of any juridical act or relationship, thus he could not legally own property, enter into a contract, stand in court, marry, bequeath, or devise. As any other thing, he could be bought, sold, or leased. The slave was totally subject to his master's power, which extended to his life and to his death (*ius vitae ac necis*). Up to the first century BC there were no legal limits to a master's power over his slaves. In contrast, starting in the first century AD, some limits were introduced as concerning the criminal liability of owners who unjustly killed a slave and forced sale of slaves unjustly tortured (*sevitiae*; Talamanca, 1990, p. 80).

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[15] See note 8.

[16] The *capitis deminutio minima* and *media* referred to the loss of the *status familiae* and *civitatis*, respectively.

[17] There are some exceptions due to the fact that a free woman could lose the *libertas* following a criminal conviction; if the born baby was conceived within a regular marriage, then he fell under the *patria potestas* of the father. Later, the *favor libertatis* required that the son be free if the mother had been free at any point between conception and birth.

[18] In order to obtain certain managerial positions. See Thébert (1989, p. 166) Crook (1967); Petronius *Sat*. 57.4; Clem Rom 1.55.2; Papinian in *Dig*. 41.3.44.*pr*.; Dio. Chrys. 15.23; Ulpian in *Dig.* 21.1.17.12, 28.3.6.5.

[19] Aristotle, *Politics* 1.2.5; Thébert (1989, p. 144).

2.2.II. Criminal law

Being a slave was considered a punishment in itself. In addition, some atrocious punishments could only be administered to slaves; thus, these punishments could be extended to freemen only after *capitis deminutio maxima* (Section 2.2.I). In addition to that, the same crime (*crimen*) triggered differential punishments to slaves and freemen. During the Republic, torture was only applicable to slaves (Aubert, 2002, p. 103).[20] Evidence from the imperial period shows that fustigation was executed with a whip (*flagellum*) for slaves and with a stick (*fustis*) for freemen; likewise, the capital punishment was carried out by crucifixion, fire, beasts, or forced labor in the mines for slaves, while freemen could be beheaded or deported (Santalucia, 1989, p. 117-120; Aubert, 2002, pp. 100-105).[21] Loyalty to the master was paramount. In 10 AD, the *Senatusconsultum Silanianum* introduced the rule that, in case the master was murdered, all cohabiting slaves were to be questioned under torture and put to death unless they could prove they had done everything they could to save their master. Under Nero, in one occasion 400 slaves were put to death (Thébert 1989, p. 182).

2.2.III. Tort and contract

From the origin to the third century BC, status had no separate relevance. In torts (*delicta*) the punishments were usually physical, thus they could be administered to slaves. In contract, the slave lacked capacity and hence could not create contractual obligations for his owner. However, the slave's contractual activity was valid if it advantaged his master—and one could plausibly presume his agreement to such exchanges. On the victim's side, in the XII Tables both harm to a slave and to a freeman are qualified as *injuria*, although the punishment is double in the case of harm to a freeman.

Starting in the third century BC, we observe two changes in apparently opposite directions. On the one hand, the *Lex Aquilia*[22] downgraded harm to a slave to property damage and likened it to harm to cattle; punishments tended to become monetary so that the master was given a choice whether to pay for harm caused by his slave or hand him over to the injured party (*noxae deditio*). On the other hand, the praetor developed remedies (*actiones adiecticiae qualitatis*) that made it *de facto* possible for slaves to enter into enforceable contracts under certain circumstances.

[20] Torture was extended even to *decuriones* under Constantine (*Cod. Theod. 9.19.1*).

[21] Note that during the empire a distinction between *humiliores* and *honestiores* tends to replace that between slaves freemen. The main difference is that lower-class freemen were considered *humiliores* along with the slaves. *Ulp. 9 de off. Proc., D. 48,22,5*; *Call. 6 cogn., D. 48,19,7*; *D. 48,19,28,2-5*; *Macer 2 de publ. iud., D. 48,19,10 pr*; *Paul sent. 5, 29, 1 i.f; Paul sent. 5, 23, 1.*

[22] Digest 9.2.2.pr.

Technically, the slave could not own anything; therefore, the *peculium* was and remained throughout property of the master, hence protected from obligations contracted by the slave under the traditional *ius civile*. The new rules expanded the liability of the master for obligations contracted by the slave, within the scope of the master's instructions or within the limited resources that the master had originally assigned to the slave (the *peculium*).[23] This evolution was clearly in the interest of masters, who were thereby enabled to run businesses through their slaves (Talamanca, 1990, pp. 87-89).

2.3. Slave trade

According to Strabo (14.5.2) the slave market in Delos traded 10,000 slaves every single day. Although this number might well be symbolic, it certainly means a very high volume of trade. Situated in the middle of the Aegean Sea, Delos was made a trading post for Italian traders in 166 BC and was fully operational until 69 BC (Morel 2007, p. 504). The slave market of Delos was probably the most prominent of the time among many similar trading areas disseminated throughout the Roman Empire, including in the city of Rome. Scheidel (*forthcoming*) estimates the volume of the slave trade in the Roman world at between 100,000 and 1,000,000 slaves a year.

The slave trader (*mango*, *venalicius*, or *venaliciarius*) would put his merchandise on display on a podium. Slaves could be undressed and examined; they wore placards (*tituli*) around their neck, specifying their origin, age, abilities, health, and possible defects. Some of them were branded on their forehead—*fug* for runaway slaves and *fur* for thieves—while others wore special caps (*pillei*) signifying that the seller did not offer any guarantee (Scheidel, *forthcoming*). Buying a slave must have been perceived as akin to buying a commodity: a slave working in agriculture was defined as *instrumentum vocale*, while an animal was an *instrumentum semivocale* as it could produce some sounds but could not articulate words.

Slaves were supplied in various ways to the slave markets. Military campaigns were of course a main source of supply, at least in the last two centuries BC. Slaves could be sold directly (including the possibility for locals to ransom their relatives), or brought back to Rome to be shown in triumph by a successful general and then sold, or distributed to the soldiers. Slave traders at times followed the armies and made business directly in the combat zones. Brigands

[23] The *actio exercitoria* (for maritime business) and the *actio institoria* (for terrestrial business) made the master liable for obligations contracted by the slave within the scope of the appointment. The a*ctio de peculio*, the *actio de in rem verso*, and the a*ctio tributoria* concerned the liability of the master in case he had assigned a certain amount of assets (the *peculium*) to the slave so that he could autonomously run a business. See Abatino, Dari-Mattiacci, and Perotti (2011).

and pirates were another source of supply, as well as local leaders who at times sold their own people into slavery. Penal slavery, debt-bondage, and abandonment of children provided for additional sources of slavery, to which forms of voluntary slavery need to be added. Finally, owners of many slaves could sell their slaves' children on the market.

The relative importance of these different forms of supply is debated and so are slave prices. Although some indications on prices might come from the penalties for injuring a slave (Lindgren, 1995), the Delphi manumission records (Hopkins, 1978, pp. 158 ff.), Diocletian's price edict in AD 301, and literary sources, the prices at which slaves were traded are largely unknown. Nevertheless, there is little doubt that prices were sensitive to the characteristics of the slave as advertised on the *tituli*, especially to idiosyncratic skills, and that slave prices declined in the third century AD (Jongman, 2007; Scheidel, *forthcoming*).

2.4. Acquisition of freedom

The slave could be freed by his master through a formal act of *manumissio*. Following manumission, the slave acquired both freedom (*status libertatis*) and citizenship (*status civitatis*) with all the connected rights under private and public law, including the right to vote. There were three traditional ways in which the manumission could be orchestrated: with a formal procedure before a magistrate (*manumissio vindicta*), in a will (*manumissio testamento*) or through registration in the census (*manumissio censu*).[24] Special cases are freedom given by law and freedom as a sanction for the owner (e.g. for the abandonment of a sick slave). Other procedures were added by the praetor. The *manumissiones praetoriae* were performed without specific formalities by the master who announced his determination to free the slave in a letter (*manumissio per epistulam*), during a conversation with friends (*manumissio inter amicos*) or by inviting the slave participate in a dinner (*manumissio per mensae adhibitiones*). In these cases, the slave acquired freedom without citizenship.[25]

With the emperor Augustus, some laws were issued which regulated manumissions: *lex Fufia Canina* in 2 BC, *Aelia Setia* in AD 4 and *Iunia Norbana* in AD 19. As a consequence of these laws, the *manumissio testamenti* was limited to a regressive proportion of the slaves owned and the number of slaves that could be freed was capped at 100. The slaves to be freed had to be

[24] This form disappeared together with the census at the end of the Republican period.

[25] According to the *lex Iulia Norbana*, the slaves freed in this way became *Latini Iuliani*: they had no *connubium* (the right to marry a citizen) and no right to inherit or bequeath. When the slave died, the former master acquired the assets of the ex slave *iure peculi*—as if it were a *peculium* and not as a succession *mortis causa*—and hence liabilities contracted by the slave were limited to the assets the master received from the deceased slave and did not extend to the master's patrimony.

indicated by name (*nominatim*) and were freed in the order in which they were mentioned up to the maximum allowed by law. Slaves younger than 30 could only be freed by *manumissio vindicta* and with an authorization of the *praetor* or provincial governor; otherwise, the slave only acquired freedom without citizenship.[26] Masters younger than 20 could only free slaves by *manumissio vindicta* and with an authorization of the *praetor* or provincial governor; acts of manumission were otherwise invalid. Manumissions were forbidden if they disadvantaged creditors or a *patronus*. Slaves that had committed certain crimes could only acquire freedom without citizenship and they had to stay at a distance of at least 100 Roman miles (about 148 kilometers or 92 miles) from Rome.

2.5. Freedmen

Freedmen (*liberti* or *libertini*; Andreau, 1989, p. 211) were an important part of the Roman society (Rostovtseff, 1957; Andreau, 1989). Freedmen differed from freemen in that they had not been born free; nevertheless, their children would be.[27] Probably, the most famous *libertus* of whom we have notice is the character Trimalchio in Petronius' *Satyricon*. Trimalchio was a very wealthy freedman who had sold his land in Campania to focus on trade. Integration into the Roman society was slower and more difficult than acquiring riches and probably took a couple of generations or a strategic choice of spouse. In fact, slaves freed in a formal manner acquired, together with citizenship, the *connubium*, the right to marry a Roman citizen (Veyne, 1961; Andreau, 1989, pp. 196-197).

Notwithstanding the formal equivalence in status with freemen, freedmen were subject to some limitations concerning access to public offices during, which were lifted during the empire, the right to marry members to the senatorial class, and the relationship of patronage with their former master. With respect to the latter, a freeman was not allowed to bring his former master to court. In addition to that, the former master had some claims on a deceased freedman's wealth: he inherited half of the freedman's wealth if the latter had died without children[28] and all of it if the freedman had died without a will; if the slave had been freed by a *manumisio praetoria*, the former master acquired the deceased freedman's wealth *de iure peculi*, that is, his liability was limited to the assets acquired. Moreover, the freedman had to keep a deferential behavior (*obsequium*) towards the former master and, if he had formally promised to do so, he was obliged

[26] See note 25.
[27] Gaius, *Institutiones* 1.10.11.
[28] Gaius, *Institutiones*, 3.39-76. With Augustus these rules became more complicated, establishing what portion of the wealth of the freedman would go to the former master or his descendants as a function of the number of children the freedman had.

to render services; such services could have economic value (*operae fabriciales*) or be of another nature (*operae officiales*). For instance, Varus (D.38.1.26) reports that a doctor could prohibit his freedmen the exercise of the medical profession in competition with him. Finally, the former master could inflict punishments on the freeman—although he did not retain the *ius vitae ac necis*—and possibly act in *revocatio libertatem*, thereby imposing on the freedmen a form of forced labor in retribution for his ungratefulness (*lex Aelia Sentia*, AD 4).

3. Model

Slavery is usually seen as a relationship based on the master's coercive power. However, although coercion probably offers the most obvious paradigm for the analysis of a master-slave relationship,[29] it regards the slave's effort as an automatic reaction to the master's whip and draws a veil over two important aspects of the problem. First, the slave, although subject to the master's legal and material power, can in principle withhold labor if he is willing to bear the costs of doing so. Second, the master's reaction—punish or deny a reward to the slave—crucially depends on whether the master has information on the slave's behavior. To account for these two aspects, the master-slave relationship can be modeled as a principal-agent relationship with asymmetric information, where the principal (master) cannot directly observe the agent's (slave's) effort. Typically, the slave's effort has to be inferred from some observable signals, such as how many hours the slave works, the yields of a field, or the volume of sales, which are imperfectly correlated with effort. Therefore, the master can condition the application of punishments or rewards on the (observable) signals of effort rather than on the (unobservable) effort.[30] These features are embedded in a formal model.

The model considers a stilized interaction between a representative master and one of his slaves.[31] The slave decides whether to exert effort e or not: we write $e = 1$ if the slave exerts effort and $e = 0$ otherwise. Since effort is costly, the slave prefers not to exert effort. The value of the slave's effort to the master is v. In order to induce the slave to exert effort, the master can choose

[29] See Chwe (1990) modelling the master-slave relationship as a principal-agent problem where the choice between carrots and sticks is driven by the agent's reservation utility. Here we hold the agent reservation utility constant and let the informativeness of the signal and the principal's costs vary.

[30] A caveat is in order. In practice, even if signals are informative some punishments may be administered for reasons different from those examined. This might be the case because the actual application of punishments makes the threat to punish credible or because of compliance errors by the slave. These factors apply equally *mutatis mutandis* to rewards, hence do not bear on the choice between carrots and sticks and can be set aside, although they do affect the average life conditions of slaves.

[31] For simplicity, we assume that both the master and the slave are risk-neutral. The main results would not qualitatively change if we considered other risk preferences.

between a carrot c or a stick s. The interaction between the master and the slave will be examined at three points in time: at time 1, the master decides between use carrots and sticks and chooses their magnitude; at time 2, the slave reacts to the incentives provided by the master and decides whether to exert effort or not; at time 3, the master receives a signal r about the slave's effort and applies the carrot or the stick accordingly.[32]

The analysis proceeds backwards from time 3 to time 1, as follows. First, in section 3.1 we will analyze the master's problem of determining whether the slave has exerted effort when effort is not directly observable and the master has to rely on imperfect signals. Second, in section 3.2 we will study the slave's decision whether to exert effort both under sticks and under carrots, given that he knows the master might make errors in punishing or rewarding him. Third, in section 3.3 we will examine the master's choice between carrots and sticks and we will show that this choice depends on the quality of the signals of effort—that is, on the degree of information asymmetry between the master and the slave—and on the relative cost of applying carrots and sticks.[33]

Table 1: Relationship between effort and signals

	Slave exerted effort ($e = 1$)	Slave exerted no effort ($e = 0$)
Signal indicating effort ($r = 1$)	q	$1 - q$
Signal indicating no effort ($r = 0$)	$1 - q$	q

3.1. The master infers effort from imperfect signals

Typically, the master cannot directly observe the effort exerted by the slave. Thus, he will have to infer whether the slave has exerted effort from an imperfect signal r. One may think of the signal as the information the master obtains by looking at the results of the slave's effort. Signals are

[32] The model is constructed on the assumtion that, at time 3, the master applies the carrot or the stick as announced at time 1. This assumption may at times be unrealistic, but captures nevertheless an important aspect of the real world: the slave will exert effort to the extent that he expects to be punished or rewarded. Punishments or rewards that come completely unexpected cannot, by hypothesis, produce any incentive ex ante. Therefore, it is instructive to confine the analysis to punishments and rewards that the slave expects to receive.

[33] The model is robust to three important extensions which would enrich the analysis without changing the basic results. We assume that the signal is free; that is, we do not explicitly consider the cost of monitoring the slave or otherwise acquiring information on his behavior, such as the appointment of a supervisor or the drawing of accounts. We assume that type-I and type-II errors occur with the same probability and we do not allow for false positives to be more or less likely than false negatives (on the effect of type-I and type-II errors on incentives, see Png, 1986). Finally, we assume that the master punishes or rewards with probability equal to one once he has seen the signal. One could relax these assumptions without altering the mains results.

imperfectly correlated with effort, so that four situations can materialize. Table 1 gives the conditional probabilities Prob($r|e$) for the master to observe a signal indicating effort or a signal indicating no effort given the choice of effort by the slave.

As illustrated in Table 1, a signal is truthful when it correctly indicates whether the slave has exerted effort, which happens when $r = e$. More specifically, we have two cases: the slave has exerted effort ($e = 1$) and the master sees a signal indicating effort ($r = 1$), or the slave has not exerted effort ($e = 0$) and the master receives a signal indicating no effort ($r = 0$). The quality (informativeness) of the signal is measured by q, which is the probability that the signal is truthful. However, it could also happen that the signal is incorrect, which also occurs in two cases: punishing (or refusing to reward) an "innocent" slave (a type-I error, false positive) and failing to punish (or rewarding) a "guilty" slave (a type-II error, false negative). On the one hand, although the slave has exerted effort ($e = 1$), the signal might incorrectly indicate to the master that he has not exerted effort ($r = 0$). On the other hand, although the slave has not exerted effort ($e = 0$), the signal might incorrectly indicate that the slave has exerted effort ($r = 1$). In both cases, $1 - q$ is the probability that a signal is incorrect. Summing up, if the master relies on the signal, he will be correct about the slave's real effort level in a portion q of the cases and mistaken in the remaing portion ($1 - q$) of the cases. Note that the quality of the signal can take any value between two boundaries: $\frac{1}{2} \leq q \leq 1$.[34]

Figure 1 illustrates what we mean by informative and uninformative signals and depicts four representative cases with signals of different quality. In all pictures in Figure 1, the left-hand half of the square represents those cases in which the slave does not exert effort (which is unobservable), while the right-hand half of the square represents those cases in which the slave exerts effort. The same square in divided into two regions by a second line—which is vertical in Figure 1.a, diagonal in Figures 1.b and 1.c., and horizontal in Figure 1.d. This line separates the area in which the (observable) signal indicates effort from the area in which the signal indicates no effort. The degree to which the signal is informative depends on how much the partition of the rectangle made by the signal overlaps with effort.

Figure 1.a depicts a signal of quality $q = 1$; the signal is perfectly overlapping with effort and is hence perfectly informative. This may be the case when a slave is performing a very simple, material task, which can be easily monitored.[35] In this case, the master makes no mistake.

[34] The probability of errors cannot be greater than ½. It that were the case, the master would be better-off tossing a coin rather than relying on the signal. Thus, a signal can be used to infor effort only if it is correct in more than half of the cases.

[35] Most slaves in the *familia rustica*—those slaves who worked the fields in the many *villae* owned by the Roman

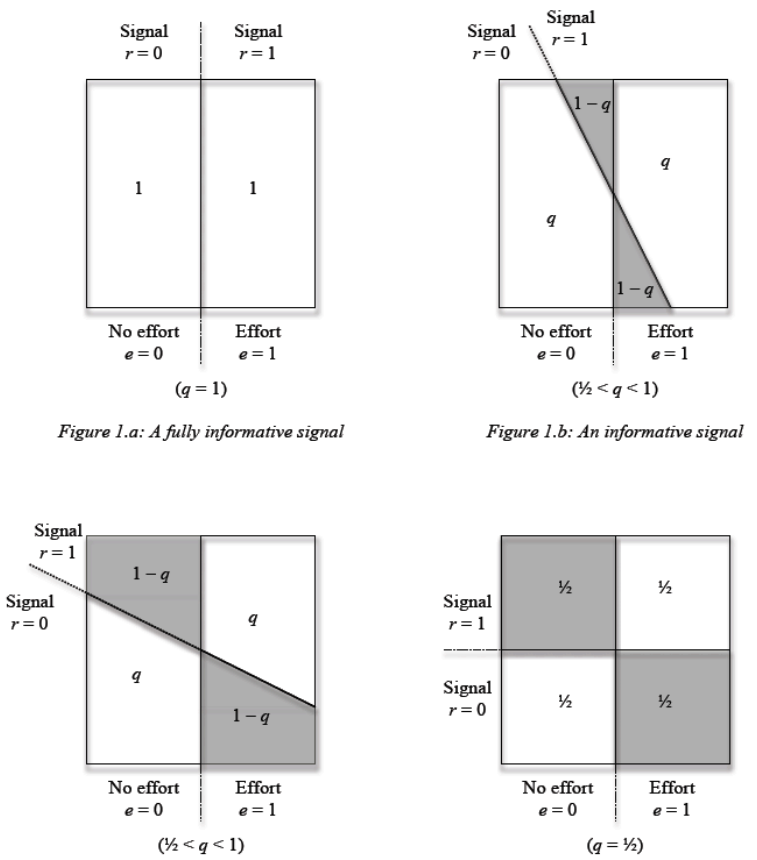

Figure 1.a: A fully informative signal *Figure 1.b: An informative signal*

Figure 1.c: A not very informative signal *Figure 1.d: An uninformative signal*

Figure 1: Four signals with different degrees of informativeness

In Figure 1.b, signal and effort are imperfectly overlapping ($½ < q < 1$), suggesting that if the slave has exerted effort, then in most cases (more precisely, in a fraction q of the cases) the signal correctly indicates effort. In a small residual portion $(1 - q)$ of the cases, although the slave has exerted effort the signal gives the wrong indication. Similarly, if the slave has not exerted effort, in most cases (in q of the cases) the signal will correctly indicate no effort, while it will wrongly indicate effort in relatively few $(1 - q)$ instances. Figure 1.c presents a different case with a lower q, in which the signal is much less reliable and errors occur with a higher probability. Finally, Figure 1.d depicts the case of a completely uninformative signal ($q = ½$), which is totally unrelated with effort. In this case, the master cannot infer anything about the slave's behavior from the simple observation of the signal. This could be the case when the slave is performing a

elite—performed these sorts of activities. The number of hours each slave worked was a relatively good signal of the effort they were making and could be used as a measure of performance with very small margins of error.

highly complex and risky commercial operation on which the master has very little control.[36]

3.2. The slave decides whether to exert effort

Typically, signals are not perfectly informative; thus, the slave anticipates that he might be unjustly punished or rewarded and factors in this possibility when deciding whether to exert effort. The slave compares his payoff when exerting effort with his payoff when not exerting effort and chooses the action that gives him the largest payoff. We start with carrots. Under carrots, a slave that exerts effort is rewarded with probability q; thus, his payoff is $qc - e$.[37] If the slave does not exert effort he also has a probability $1 - q$ of being mistakenly rewarded without incurring any cost, his payoff in this case is $(1 - q)c$.[38] The slave will choose the action that yields the highest payoff; that is, the slave will exert effort if $qc - e \geq (1 - q)c$, which can be rewritten as

$$e \leq (2q - 1)c \tag{1}$$

In the case of sticks, the slave's decision whether to exert effort is similar to the former one. If the slave does not exert effort he is punished with a probability equal to q; thus, his negative payoff is qs.[39] Instead, if the slave exerts effort, he will correctly be exempted from punishment in a fraction q of the cases but will be erroneously subjected to punishment in the remaining $1 - q$ cases. Hence, the slave's negative payoff when he exerts effort is $e + (1 - q)s$. The slave will choose the action yielding the smallest negative payoff; that is, the slave will exert effort if $e + (1 - q)s \leq qs$, which can be rewritten as

$$e \leq (2q - 1)s \tag{2}$$

The conditions that govern the slave's decision whether to exert effort under carrots and under sticks are analogous. This implies that a carrot and a stick of the same magnitude ($c = s$) have the same incentive effects. The right-hand side of inequalities (1) and (2) above provides the incentive value of a carrot (or stick), which is given by the magnitude of the carrot c (or stick s) discounted by a factor $(2q - 1)$ indicating the effect of errors. Note that if the signal is perfectly

[36] The tasks performed by the *vilicus*—the slave who managed the *villa* for his master—were more complex than those assigned to the ordinary field workers. The activity of the *vilicus* may have involved decisions pertaining to seeding, harvesting, monitoring other slaves, or caring for the livestock, which were to a large extent imponderable by the master. The appropriateness of such decisions was imperfectly correlated with profits, which also depended on accidental events. Thus, the signals the master observes concerning the activity of the *vilicus* were relatively less informative than for field workers, and therefore involved larger margins of error.

[37] With probability $1 - q$ an error of type I is made and the master wrongly denies the reward to his slave.

[38] With probability q the master correctly infers that the slave has not exerted effort and hence gives him no reward.

[39] In the remaining $1 - q$ cases, the master will erroneously infer that the slave has exerted effort and hence will fail to punish him even though the slave has not exerted effort.

informative (q = 1), this factor is equal to 1, meaning that the carrot (or the stick) has a full incentive effect on the slave. With signals of quality lower than 1, this factor will also be less than 1, so that in order to produce the same incentives, the master will have to apply a bigger carrot (or stick) if the quality q of the signal is lower. In other words, if a signal is of low quality, errors are frequent and dilute the incentive effects of a carrot or a stick. Thus, the master needs to compensate for the effect of errors by increasing the magnitude of the carrot or the stick.[40]

3.3. The master chooses between carrots and sticks

Rewarding the slave is obviously costly to the master. An amount of money (including money given for the purpose of later buying freedom), an improvement in the slave's living conditions, or the concession of freedom are expensive for the master. However, the cost of a reward for the master might be different from the value of the same reward for the slave. For instance, the concession of freedom has a cost for the master—including the market value of the slave, the idiosyncratic value of his services, the value of future servises of the slave as a freedman and so forth—which is most likely very different from the value that the slave himself attaches to freedom. Thus, with $k_c c$ we indicate the cost of a carrot for the master; k_c may be greater or less than 1, depending on whether the cost of the reward to the master is greater or less than the value of the same reward to the slave.

Likewise, sticks are costly both to the slave and to the master. Punishing a slave will in general hinder his productivity; harsher punishments (up to the capital punishment) are bound to destroy the value of the investment—including the purchase price and the cost of training—that the master has made in the slave. It is reasonable to assume that the slave values his own personal integrity and ultimately his own life more than the master values his slave's life. However, for the sake of generality, we also allow for the cost to the master to be greater than the cost to the slave, in order to accout for situations—however unlikely—where a relatively small punishment for the slave (think of temporary confinement inside the house) has a large cost for the master (interruption of a profitable business). Thus, with $k_s s$ we indicate the cost of a stick for the master, where k_s may be greater or less than 1, depending on whether the cost of the punishment to the master is greater or less than the cost of the same punishment to the slave.

The master chooses whether to apply carrots or sticks depending on the benefits minus the

[40] Note that in the worst case scenario, with q = ½, we have $2q - 1 = 0$, implying that the slave will not exert effort no matter how serious the punishment or how attractive the reward. This result can be easily understood by noticing that with q = ½, the application of rewards and punishments is totally random and does not depend on effort. Thus, exerting effort does not reduce the probability of being punished nor it increases the probability of being rewarded.

costs involved. With sticks, the net benefits for the master are equal to the value of the slave's effort minus the costs incurred when punishing a non-performing slave:

$$v - p_s k_s s \tag{3}$$

Note that the cost of punishing slaves is only incurred when the slave is (rightly or wrongly) punished. Therefore, the cost of punishing is incurred only with probability $p_s < 1$. If the slave always exerted effort and no errors were made, punishments would never be administered; thus, p_s would be zero. In contrast, punishment might result from the fact that the slave does not exert effort or from errors made by the master. Therefore, the frequency of punishment depends on two factors: the quality of the signals and the magnitude of the stick, which in turn also determine if the slave will exert effort.

For the master it is advantageous to set the stick just high enough so that the slave exerts effort.[41] If the stick is too severe, the master might incur more costs without obtaining more effort. The minimum stick necessary to induce the slave to exert effort is such that $e = (2q - 1)s$ (compare expression (2)), or equivalently $s = e / (2q - 1)$. Under these conditions, the slave will exert effort for sure, but there will be a probability $p_s = 1 - q$ that he will be punished by mistake. We can now substitute these values for s and p_s into the master's net benefits in (3) and obtain:[42]

$$v - (1 - q)k_s e / (2q - 1) \tag{4}$$

With carrots we can make a similar analysis. The net benefits for the master are:

$$v - p_c k_c c \tag{5}$$

The minimum carrot necessary to induce the slave to exert effort is such that $e = (2q - 1)c$ (compare expression (1)), or equivalently $c = e / (2q - 1)$. Under these conditions, the slave will exert effort for sure, but there will be a probability $1 - q$ that he will be denied a reward by mistake; thus, the master will reward the slave with probability $p_c = q$. We can now substitute these values for c and p_c into the master's net benefits in (5) and obtain:[43]

[41] Here we are implicitly assuming, without loss of generality, that v is large enough so that it is optimal for the master to induce the slave to exert effort.

[42] The cost of punishing (the right-hand part of expression (4)) increases if q decreases; we have: $d((1 - q) / (2q - 1)) / dq = - 1 / (2q - 1)^2 < 0$. This is due to two effects: with relatively uniformative signals, the punishment needs to be relatively large in order to compensate for the possibility of errors. Moreover, the master will make many mistakes and often punish innocent slaves. The combined effect is that the master will administer large punishments relatively often when signals are of low quality. In contrast, if signals are informative, punishments are smaller and more rarely administered, generating very small costs for the master and for the slave.

[43] Unlike with sticks, with carrots we have two countervailing effects: if the signal is of lower quality, the magnitude of the carrot needs to increase in order to compensate for the probability of errors; however, the probability of administering the carrot decreases if errors are frequent. Thus, if the signal is of lower quality, fewer slaves are rewarded but the rewards are larger. However, the former effect prevails over the latter: the expected costs of using

$$v - qk_c e / (2q - 1) \tag{6}$$

The different effects that errors have on the costs of carrots and sticks[44] leave the master some room to decide whether to incentivize his slave with carrots or rely on more traditional forms of enforcement with sticks. Essentially, the master will prefer carrots if using carrots yields larger net benefits than implementing sticks, that is if $v - qk_c e / (2q - 1) \geq v - (1 - q)k_s e / (2q - 1)$. After some simple manipulations, we can simplify the former inequality as follows:

$$k_c / k_s \leq (1 - q) / q \tag{7}$$

If the above condition holds strictly, then carrots yield larger net benefits than sticks and the master will emply carrots.[45] Otherwise, the master will prefer sticks.

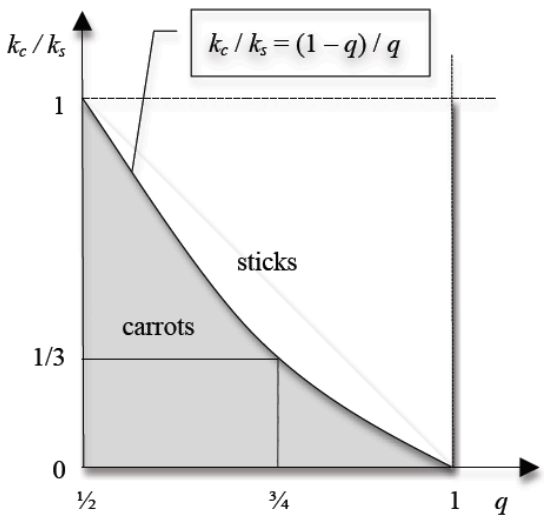

Figure 2: The choice between carrots and sticks

Figure 2 provides a graphical illustration of the choice between carrots and sticks. The signal quality q is indicated along the horizontal axis, while the ratio of the cost of carrots to the cost of sticks k_c / k_s for the master is depicted on the vertical axis. The gray area is the region where the master will prefer employing carrots rather than sticks. This region is characterized by relatively uninformative signals (low values of q) and relatively low cost ratio (carrots are relatively less

carrots for the master decreases if the quality of the signal improves; we have: $d(q / (2q - 1)) / dq = - 1 / (2q - 1)^2 < 0$.

[44] Note that only if $k_c = k_s$ do the master's costs of applying carrots and sticks decrease in the same way as the quality of the signal improves (compare notes 42 and 43). If these costs are different, a variation in the quality of the signal has different marginal effect on the costs of carrots and sticks for the master.

[45] While in Fenoaltea's (1984) model carrots enhance the value of the slave's effort for the master, in the model proposed here, carrots reduce the cost of enforcement, given the same value.

expensive to the master than sticks). Conversely, with informative signals (large q) and higher cost ratios, sticks will be preferred. The downward-sloping curve $(1 - q) / q$ in Figure 2 indicates the boundary between the grey region—in which carrots are preferred—and the white region—in which sticks are preferred.

These results have two main implications. First, keeping the cost ratio constant, we should observe that masters employ carrots when slaves are assigned to complex activities, for which the quality of the signal is relatively low. Second, keeping the quality of the signal constant, we should observe that masters emply carrots when the slave has a high market value or when he is the fulcrum of a profitable activity that would not continue with the same returns without him, which makes sticks costly to apply relavite to carrots. The following section will explore the ramifications of these two implications of the formal model.

4. Analysis

The apparently homogeneous legal framework that supported the master-slave relationship in ancient Rome actually allowed for a myriad of very variable factual arrangements. With an average expected "serving time" of about 20 years (Scheidel, *forthcoming*), slavery could be both the least desirable human condition and something that some individuals voluntarily choose. It all depended on whether the master chose sticks or carrots as an incentive devise. This choice was not at all arbitrary. Rather, the master's choice between carrots and sticks was a function of the tasks assigned to the slave and the investment made in him. Cicero's *pro Roscio* (10, 28) provides an instructive example of one of the many ways in which master could invest in their (or in other people's) slaves. Roscius had trained a slave of Fannius to be an actor. The slave earned them huge profits which they shared until the slave was killed. Cicero says: *Quid erat enim Fanni? Corpus. Quid Rosci? Disciplina*, arguing that Roscius has lost the investment he had made in the slave as a concequence of the killing, and hence he should also be compensated.

The tasks assigned to the slave depended on the supply-side and demand-side characteristics of slavery. Slave tasks featuring informative signals were usually simple tasks that could be performed by unskilled or low-skilled labor. Agriculture, mining, and some public services are sectors of the economy that support demand for such types of slaves. Supply of unskilled labor is also easily met, as it is probably easier to adapt skilled slaves to unskilled labor than vice-versa. This point is supported by the observation that slave prices increased in slave skill (Scheidel, *forcoming*).

Slave tasks characterized by uninformative signals were typical of sectors of the economy related to commerce and entrepreneurship, specific domestic functions, or some functions within the public administration. Demand for these types of slaves depended on how active such economic sectors were. An additional but not secondary aspect is the degree of delegation in the carrying out of economic activities. The more wealth is concentrated, the more delegation from the master to his subordinates becomes important, simply because the master has more capital than he can directly invest and manage.

In turn, highly skilled slaves needed to be supplied by the market in order to meet demand. Thus supply of skilled slaves depended on training, capture of already educated adult individuals, and voluntary slavery. Capture is related to wars and expansions into territories inhabited by developed populations. Expanding into an uninhabited territory or into a territory inhabited by primitive populations does not supply the market with skilled slaves. Most likely, skilled slaves resulted from the conquest of big cities, as the degree of urbanization is usually a good proxy of development in ancient economies.

The latter source of supply, voluntary slavery, depends on the availability of educated freeman with relatively little prospects of enrichment in the labor market as compared to slavery. The latter can be attractive only if it offers substantially higher expected gains than free labor as to balance the risks associated with enslavement. The expected gains in turn depend on the returns to slave activities. Similarly training is a function of the returns one expects to obtainfrom it. In the following, I will examine some features of the Roman economy, and extrapolate the characteristics of the supply and demand for slaves. I will connect these characteristics with tasks assigned to slaves, which will be linked to the choice of carrots versus sticks. Lastly, I will discuss the implications on the social mobility of slaves and the idiosyncratic characteristics of the Roman society in a diachronic perspective, accounting for changes over time.

4.1. The rise of classical slavery

The changes that Rome underwent in the third and second centuries BC were prominently characterized by expansion into well-developed areas. The south of Italy, Hellenistic Greece, the Middle East and the North of Africa featured florid civilizations with highly developed cultures. Slaves captured during these wars were well educated and may often have been better educated than their Roman masters. At the same time, expansion fostered peace in the Mediterranean Sea and the Roman infrastructures (harbors and roads) stimulated commerce.

There are several elements of this dynamics that are relevant for our analysis. On the supply

side, slaves entering the Roman economy from the third century BC on were of superior skills than their predecessors. In addition, the numbers of this influx were impressive and grew rapidly in the initial period of expansion. On the demand side, the war effort made many male adults leave their agricultural occupations to join the Roman army, making some land available for purchase by the Roman elite. The concentration of extensive estates in the hands of the elite made it possible for them to structure production more intensively, for which growing markets provided an outlet. *Villae* and *latifundia* emerged in this period (Morel, 2007, p. 507).

The economic activities generated by commerce included manufacturing, shipping, and some financial services such as lending, which became very remunerative for the emerging equestrian class. Such activities required a degree of delegation and specialization (Bradley, 1994, p. 26), which was not necessarily the case in the previous, small-scale agricultural production. In turn, delegation generates asymmetric information. Normally, wealth accumulated in other economic activities was reinvested in landed estates in Italy and the provinces, further exacerbating the asymmetric information problem between principals and their agents managing those estates.

During the third and the second century BC the influx of slaves caused a crisis as they competed with freemen (Morel, 2007, p. 505). This brought to the revolts of the plebs under the Gracchi and the subsequent social tension but did not arrest the development of the slave economy. The conditions of the Roman plebs improved (Thébert, 1989, p. 143), while slaves were more systematically exploited in a variety tasks that virtually covered the whole range of economic activities flourishing in this period.

The change from patriarchal slavery to classical slavery was due to a change in the supply and demand for slavery. From prominently agricultural tasks related to a subsistence economy, where slaves were under the direct supervision of the master, the expansion of the Roman Empire broadened the range of tasks assigned to slaves, their specialization, and the extent delegation of important decisions. Direct monitoring was substituted with a complex system of incentives and delegated control that we examine in the following. Ultimately, the change in the tasks to which the slaves were assigned brought along a new system of incentives much more frequently based on carrots.

4.2. The characteristics of classical slavery

From the third century BC to the third century AD, slaves were at the core of the economic engine pushing Rome forward.

4.2.I. Occupations

In general, the variety of tasks performed by slaves in the Roman economy in the classical period can be distinguished on the basis of their information characteristics. Andreau (2001, pp. 125 ff.) identifies three main sets of tasks: the slave worker, the slave manager, and the slave entrepreneur. The slave worker (Andreau, 2001, p. 126) was a slave working under the master's (or a delegate's) instructions; such slaves usually took no initiative. The slave manager (Andreau, 2001, p. 128) was a slave who managed a shop or a workshop, which he did not buy or equip. Often the slave manager received a salary but all gains of the activity accrued directly to the master, who was liable (*in solidum*) within the scope of the appointment (*praepositio*). At times, the slave had a small patrimony (the *peculium*) but this was not meant for the management of the workshop; rather, it allowed the slave to run some activity on the side. Finally, the slave entrepreneur (Andreau, 2001, p. 139) was a slave who has received a *peculium* that he could autonomously manage; he bought and equiped a workshop himself and operated without the master being involved in his dealings.[46] The master was not liable *in solidum* but only within the limits of the *peculium*. The *peculium* was a sort of long-term credit. The owner did not receive payments as long as the slave ran his business—which makes sense if the business was risky and profits variable. Accounts and gains were calculated at the moment of the acquisition of freedom. At times a sort of pension could be paid by the master to the *libertus* or vice versa.

Those categories can be arranged along a line of increasing asymmetric information from the slave worker to the slave entrepreneur. Correspondingly, sticks dominated the incentive structure of slave workers while carrots were often used for slave managers and even more so for slave entrepreneurs. An examination of certain specific slave tasks yields some more nuanced insights into the incentives used.

In the vast estates of the Roman elite (*villae* in central Italy and *latifundia* in the south and in Sicily; Thébert, 1989, pp. 154-155) discipline was akin to that in a military camp. Slaves working the fields or operating the mills were probably dressed in rags (Jongman, 2007, pp. 609-610) and treated no better than livestock. Tellingly, the denomination of the quarters where the slaves lived, the *ergastolum*, is now used in Italian as to mean life imprisonment ("ergastolo"). Those slave workers where unskilled, assigned to simple tasks, kept at subsistence level, subject to sticks, and controlled not directly by the master but by other slaves. In contrast, the *vilicum*, the slave in charge for the management of the *villa*, had more autonomy, better living conditions—

[46] For instance, the pope Callistus was—before being elected pope—a slave with *peculium* ("Hippolitus of Rome". *Refut. Omn. Haer. 9,12,1-12*).

among which separate living quarters and a partner, the *vilica*—and enjoyed some remuneration (Hopkins, 1978, p. 126; Harris, 2007, p. 527).

A part from the *vilicus*, life in the Roman *villa* is described by various sources as quite harsh and it is these slaves who join the slave revolts between 140 BC and 70 BC, culminating in the famous upraise led by Spartacus (Bradley, 1989). Thébert (1989, p. 149) suggests that this was due to better living conditions for the *familia urbana*.[47] Those were slaves living in the house together with their master and his family; they enjoyed better standards of living including better clothing (Jongman, 2007, pp. 609-610). By necessity, these slaves had to be given more freedom of movement and had to be trusted more than the slaves living in the *villa* as the potential for theft or escape was larger in the city.[48]

In the *domus* of a rich Roman there could be many slaves. When the prefect Pedanius Secundus was killed, all his domestic slaves where killed as well according to the law. Tacitus reports that he had 400 slaves (Jongman, 2007, p. 610).[49] Modern counts for the year 31 BC suggest that in Italy, out of a population 12 million people, there were 2 million domestic servants, that is, an average of one domestic slave every five freemen (Harris, 2007, p. 527). These slaves were assigned to a myriad of different tasks: there were carriers of *sella*, *lectica*, or *chiramaxium* (sits of various size on which the slave carried the master or members of his family around the city), waiters (*ministratores*), headwaiters (*structores*), barbers, specialists in make-up and haircutting, teachers, personal secretaries (*nomenclatores*) whose task was also to retain information on other people (names, positions, gossips) and inform his master, readers (*lectores*), cooks, and butlers (*lanternarii*), who would wait at the entrance of the house for the owner to come back at night, with a lamp in his hands. Slaves would also accompany their masters to the baths (they entered for free) and often were their masters' sexual companions.[50]

Elsewhere in Rome, slaves worked in the *insulae*—the apartment buildings of ordinary

[47] Often in letters a friend would ask news of the family including the slaves, but this is not related to affection for the slaves but rather as a concern for the prosperity of their master. The position of slaves is and remains subordinate; Thébert (1989, p. 152).

[48] For instance, the *arcarius* was a cashier; he kept the safe and had little involvement in financial operations; gratifications by the master could be granted but he made no big personal gains. The *dispensator* administered the house; he was in charge of the house supply dealt with payments and bookkeeping and was able to make personal gains thanks to rewards by their master (*Gaius, Inst. 1,22*). A *dispensator* of Nero was able to buy his freedom for 13.000.000 sesterces. Tiberius insisted to be present at payments in order to avoid the frauds he thought occurred under Augustus. If they received a *peculium* they were able to run licit businesses on the side, such as lending money. The a*ctor* ran shops or small workshops or took care of the entire wealth of their masters; he was in a similar position as the *dispensator* (Pliny, *Naturalis Historia* 7.129.; Dio Cass. 57.10.4).

[49] Tacitus, *Annales*, 14.42-45. But this as well are other number reported in ancient sources could be symbolic. Nevertheless, it must have meant a big number.

[50] See list of professions in Apuleius *Metamorfosis* 1.2, 2.2, 2.19, 9.2, and 10.13.

Romans, not rich enough to own a *domus*—bringing water up to the upper floors (*acquarii*),[51] working as doormen (*ostiarii*), cleaners (*scoparii*) or managers (*insularii*). Workshops were also common and conditions depended on the tasks also here. We can go from the *amanuensi* (slaves who copied books) to slaves who ran their own business and lived in a separate house from the master. Often slave traders where slaves themselves.[52] Likewise, slave managers and slave entrepreneurs often owned other slaves (*vicarii*) and the *vicarii* could also own their own slaves.[53]

Also the state owned slaves (*servi publici*), especially during the empire, when the public administration grew in size and Republican institutions lost their importance. These slaves worked in the Coliseum, in the baths, or in the mines. At the time of Augustus, for instance, 150.000 slaves worked in public gold and silver mines (Goldsmith, 1987, pp. 39-40; Patterson, 1982, p. 225). Evidence from Pompei shows that local public officials were assigned a number of public slaves that depended on their rank (Staccioli, 1992, pp. 35-37). There is consensus on the fact that the conditions of slaves were very variable, with a very miserable average but also peaks far above the living conditions of some freemen (Talamanca, 1990, p. 79).[54]

4.2.II. The concession of freedom

There is a political ad found in via Consolare in Pompei in which the *libertus* Fabius Eupor invites to vote for the Cuspium Pansam candidate for the office of *aediles*: *Cuspium Pansam aedi(lem) Fabius Eupor princeps libertinorum*.[55] Fabius Eupor was a rich wine merchant and there was a known Greek wine bearing his name; he qualified himself as *princeps libertinorum*, the most important of the freedmen of his master (Staccioli, 1992, p. 143). Such examples of freedmen who accumulated vast patrimonies and climbed the social ladder are not infrequent; to some accounts they could be as rich as senators. The *sagarius* (cloak-merchant) Sabbio had a magnificent residence at Capua, excavated not long ago (Pagano and Rougetet, 1987; Harris, 2007, pp. 525-526). The occupations of freedmen where varied: teachers, doctors, architects, writers, actors, painters, sculptors, brick producers,[56] and bankers (*argentarii, nummularii, coactores argentarii, coactores*; Andreau, 1989, pp. 191 and 204). The central head administrator

[51] The *acquriuus* was also the official responsible for the aqueducts.
[52] Thébert (1989, p. 169).
[53] Recall that the slave cannot legally own property. So slaves *vicarii* are technically the property of the master, even if the slave has bought them with money taken from his *peculium*.
[54] According to Ulpian and Paulus, slaves must be treated *secundum ordinem et digitatem* (Thébert, 1989, p. 152).
[55] CIL IV, 117.
[56] Kohoe (2007, p. 562): *liberti* could work as *officinatores* (brick producers) using the clay extracted from the quarry of the former master, as is the case for Cn. Domitius Lucanus and Cn. Domitius Tullius who employed their freedmen as subcontractors. Usually, though, brick production was carried out by independent freemen of good social status.

of the imperial finances (*a rationibus*) was originally an imperial freedman (Lo Cascio, 2007, p. 642).

There are various freedmen who made it into history books: Epittetus was a famous rhetoric teacher of senators and important men (Andreau, 1989, p. 191); Crisippus was librarian for Quintus Cicero (Andreau, 1989, p. 191). Quintus Aremnius Palemon was a famous *grammaticus* mentioned by Pliny the Elder and Suetonius (Andreau, 1989, p. 192); Cicero says *preadiorum nullam esse gentem* (there are no dynasties in property), referring to property in Tusculum that had been owned by Metellus, then by the *libertus* Marius Sotericus, to be later bought by Crassus; Lucius Ceius Serapio was a banker (Andreau, 1989. p. 204); Callistus, a *libertus* of Caligola and then Claudius, had an important job in the public administration and took revenge on his old owner by letting him wait; the future pope *Callistus* was a slave of Carpophorus during the reign of Commodus (AD 177-192); Caius Sulpicius Faustus, Caius Sulpicius Cinnamus, Caius Sulpicius Eutychus and Caius Sulpicius Onirus were *liberti* or *ingenui* sons of *liberti* (Cinnamus was a *libertus* of Faustus, while Onirus was an *ingenuus* son of the *libertus* Caius Sulpicius Heraclida), important businessmen landing big sums of money (Camodeca, 1990; Andreau, 2001, p. 141), whose businesses are recorded in a series of *tabulae* found in a villa in Murecine, close to the Vesuvius.[57] Freedom was a reward in itself and the possibility to buy freedom depended on some degree of independence in running businesses and in retaining a share in the profits. It is consistent with the model presented in this paper that most freedmen of whom we have notice where involved in managerial or entrepreneurial activities as slaves.

4.2.III. Laws protecting slaves and laws protecting masters

The status of a slave originally allowed the master a near-unlimited freedom in exercising his powers. In Apuleius a *vilicus* is punished for being disloyal to his master: after being covered in honey he is left to the bees to be eaten.[58] Nevertheless, from the first century AD to the third century AD, together with a slow-down in the growth of the Roman economy and the end of the period of expansion, the number of slaves stagnated and the slave economy began to decline. We witness imperial legislation to two effects (Thébert, 1989, p. 173): protect slaves from owners and protect owners from slaves. On the one hand, the *Senatusconsultum Silanianum* of AD 10 establishes the *quaestio* (questioning under torture) of all slaves living in the same house of a murdered owner: those who could not show it was impossible for them to help the owner where

[57] Pliny, *Naturalis Historia*, 14.49-51; Suetonius, *De Grammaticis,* 23; Cicero, *Pro Balbo*, 25.56; Seneca, *A Lucilio*, 47.9.
[58] Apuleius, *Metamorphosis*, 8.22.

sentenced to death. Under Nero, in one occasion 400 slaves were put to death (Thébert 1989, p. 182). On the other hand the *ius vitae ac necis* of the *paterfamilias* is limited as to prevent unjustified killings of slaves.

Ulpian states that according to the *ius naturale* all men are equal.[59] This is probably a way to justify the fact that some legal protection was extended to slaves, slaves could in fact buy, sell and own property within their *peculium* and they could within some limits stand in court if their *qualitas* (tasks they were assigned to) would justify it. However, the reason why these changes took place is only rationalized but not at all explained by reference to the *ius naturale*.

Modern authors (Talamanca, 1990, p. 81) resort to moral explanations: more sensitivity for the conditions of the slave. However, the living conditions of slaves did not improve at all and writers such as Seneca who argue for a more human treatment of slaves do so in account of the master's interest and not for the benefit of the slaves: "the benevolence of the owner is a literary topic" (Thébert, 1989, p. 171). Another explanation refers to externalities: bad treatment of slaves increased the likelihood of revolts. However, this explanation does not account for the tragic and persistent living conditions of slaves in the countryside—who were the most likely to revolt—and fails to ccount for the fact that revolts had not occurred for quite some time already. Another explanation (Thébert, 1989, p. 167) looks at the fact that increased autonomy given to slaves weakened the need to control them by the master. However, the implication is quite the opposite: it is the use of rewards that allows more autonomy and not the lack of punishments that followed from autonomy.

On the level of incentives both norms make perfect sense. Limits to abuse were to enforce binding commitments by the owners not to expropriate their slaves.[60] In combination with these rules there were rules that protected creditors from abuses of the owner on the slave's *peculium* on which they had an interest. The *quaestio* is justified as a way to give incentives to the slaves to risk their lives to help the owner in danger. An even more interesting development is the evolution of remedies that enforced the master's informal promise to free a slave. Although the *ius civile* only recognized three formal ways to free a slave, the praetor developed other less formalized forms of manumission that did not give rise to citizenship. The removal of formalities could be seen as a response to claims brought by slaves—although not directly but through a freeman—against broken promises by their owners.

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[59] *Digest* 12.6.64 and 50.17.32

[60] Watson (1987, p. 65): "It was in the interest of masters and slaves alike that the master acquire the reputation for allowing his slaves to buy their freedom with the *peculium*".

4.2.IV. Limitations to manumissions

At the time of Augustus, some limitations to manumissions were introduced. The question to ask is not only why manumissions were limited—traditional explanations (Talamanca, 1990, p. 96-97) point to the need to keep patrimonies from disaggregating and avoid too many freed slaves—but also why the frequency of manumissions was so high that it had to be limited. The answer to this question lies in the fact that it was in the interest of the master to offer freedom as the ultimate reward in order to provide powerful incentives to his slaves in the form of carrots rather than sticks. The fact that at a certain point some limitations to manumissions were introduced suggests that private incentives to manumit were misaligned with public incentives. Manumissions generated potential externalities to other members of the elite, probably by injecting into the Roman society an uncontrolled number of freedmen. Why limit only testaments? The owner had an interest in keeping a slave as long as possible but cannot credibly commit to manumit him by *manumissio vindicta* has he might die abruptly. A credible way in which the owner can commit to free his slave is a testament. This could explain why only *manumissio testamenti* were limited.

4.2.V. Voluntary slavery

Slavery differed from free labor because masters could employ harsher sticks (differential treatment under criminal law, widest power of the *pater familias*) and more effective carrots (freedom itself is used as a carrot). Harris (2007, p. 527) notes that manumission was only for the skilled slaves with some particular merit, not for farm workers, porters, and quarry workers. He also emphasizes that slaves dominated the managerial levels of employment. Some freemen were ready to sell themselves into slavery *ad actum gerendum*, that is to obtain a managerial position, with the attached prospects of enrichment and eventually freedom.

With respect to tasks in which moral hazard was a very important concern, slavery had a major advantage over free labor: slaves could be subjected to harsher punishments: fugitive slaves or thieves could be branded, slaves could be more readily punished or even executed (Thébert, 1989, p. 166). The word "slave" was often used as a synonym of an infamous condition or of low moral esteem (Andreau, 1989, p. 199). Moreover, in risky businesses, slaves allowed the owner a limited liability regime both in torts and in contract by means of the *peculium*. The organization of businesses through slaves was flexible and might reach high levels of complexity: the *servus communis* was a slave in common between more masters—in fact a limited liability company without having to set it up by contract—the *servus vicarious* was a slave who was

owned by another slave, who could also have a *peculium* (Andreau, 2001, p. 131). Therefore, as long as educated slaves were available on the market, masters preferred to entrust tasks plagued by asymmetric information to slaves. Such tasks, however, required the use of carrots rather than sticks. This characteristic, in turn, made slavery comparatively more desirable a condition as compared to freedom for some individuals.

4.3. The decline of classical slavery

The economy slowed down in the second and third centuries AD and wealth became more concentrated in the hands of a smaller group of individuals. Commerce declined (as did mining activities, meat consumption, and seatrade). The elite and the emperor based their wealth on land (Giardina, 2007, p. 752) hence the demand for skilled slaves decreased, as is also indicated by declining slave prices (Jongman, 2007, pp. 601-602). At the same time the supply of skilled slaves declined: wars of expansion had ceased long ago and at the borders there were no longer Greece and Egypt but barbarians of inferior culture. Wars yielded fewer prisoners and those captured had little or no skill. The distinction between slavery and freedom faded away. On the one hand, some punishments reserved to slaves were extended to freeman in account of the fact that the power was more concentrated and was exercised over freemen as well in a more visible way. Some positions in the Imperial administration formerly reserved to freedmen were now open to members of the equestrian class. On the other hand, the poor were equated to the slaves (Thébert, 1989, pp. 184-185). Power could be exercised through coercion rather than through rewards.

The transition period to late antiquity lasted about 120 years from Marcus Aurelius to Diocletian and was characterized by plague (AD 165 and AD 250: decline in population) and war (pressure in the East and at the Rhine-Danube borders: rise in the cost of the military). These causes combined reduced the extent of cultivated land and some peasants fled to avoid taxation. The consequent imperial intervention brought even further concentration of property and hence wealth, monetary policies made wealth concentrated in the hands of the elite who possessed gold and worsened the condition of the poor who lost purchasing power dramatically; social and economic institutions were dramatically re-shaped. The slave mode of production disappeared slowly in the II AD, fading away towards the *colonatus* (Giardina, 2007, pp. 753 ff.).

In the late Empire, the real discriminating element was no longer the *status libertatis* in that many slaves were richer than freemen and weddings between freewomen and slaves were frequent. The real difference was the tasks assigned. Those having to do with bare tasks in

agriculture were linked to the *fundus*. Slavery disappeared as a privileged incentive framework as the economy stagnated and commerce declined. Delegation was no longer so necessary. It was more practical to resort to "classical" punishment schemes. A new distinction arosew between *honestiores* and *humiliores* that iass reflected in the punishments to which these categories of individuals were subjected.

5. Conclusion and testable implications

The use of carrots—monetary or in-kind, including the prospect of freedom—is a latent but not infrequent characteristic of slavery. In a recent case, for example, Amsterdam police discovered that sex slaves in the red-light district where allowed to buy back their freedom for thirty thousand euro.[61] The UNESCO defines slavery as "the human tragedy that affected the greatest number of people for the longest period of time in History".[62] Although traditional slavery has been oficially abolished,[63] slavery is still today a major concern for international organizations and action groups. The OHCHR reports that child labor, children in armed conflicts, sexual exploitation, sale of children, and debt bondage affect millions of people; some figures even suggest 100 millions for child labor alone.[64]

A deeper understanding of slavery might help enhance freedom. In the Roman world, the use of carrots at times broke the chain of coercion that tied the slave to his master, since the use of carrots was the engine behind the concession of freedom to a non trivial portion of the slave population. If a link can be established between certain tasks and the superiority of carrots to sticks as an incentive device, this in turn implies that certain tasks are likely to escape the trap of slavery. According to the analysis presented here, societies where entrepreneurial, complex tasks dominate manual, easily specifiable tasks are less likely to experience slavery and vice versa.

This analysis yields two types of implications that could be further tested. On the one hand, the mechanism that links the economy, the tasks assigned to slaves, and the incentives used by masters is quite general. We have focused on slavery in ancient Rome because the use of carrots

[61] Het Parool, September 7, 2007, front page. Given reported profits of about four million euro a year with ninety sex slaves, the price of freedom corresponds to about two thirds of the yearly return to each slave. The sale of freedom seems difficult to rationalize in terms of the relatively small monetary gains that it yields and more likely to be a way of rewarding effort.

[62] See http://portal.unesco.org/culture/en/ev.php-URL_ID=21671&URL_DO=DO_TOPIC&URL_SECTION=201.html.

[63] See art. 4 of the Universal Declaration of Human Rights and art. 8 of the International Covenant on Civil and Political Rights.

[64] *Contemporary Forms of Slavery*, Fact Sheet No. 14, Office of the United Nations High Commissioner for Human Rights, available at http://www.unhchr.ch/html/menu6/2/fs14.htm.

was particularly widespread and well documented. The same exercise could be done for other forms of slavery and serfdom in order to test the results and verify whether they yield the same implications. On the other hand, if one stretches this argumentation far enough, it is easy to see how it could be applied to such distant topics as the study of authoritarian regimes and international relations. In authoritarian regimes, just like in slavery, a self-interested government exploits the populations. Like with slavery, the government-master is interested in keeping the gains for itself, thus would in principle only use sticks. However, there is evidence that some individuals were treated better than others (scientists or top athletes) and the reason could be that their tasks involve moral hazard. A similar claim could be made with respect to the choice between war and trade as a way to obtain resources from a foreign country. Intuitively natural resources can be extracted using the threat of war while services and highly technical products might have to be bought. Ultimately, this analysis ties quite well with the general notion that economic rents are most likely earned by asymmetrically informed agents.

6. References

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