

Externality and taboo: Resolving the Judaic pig puzzle

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Abstract

Judaic law famously bans pigs. For millennia, scholars have wondered why. This paper uses the economics of property rights to resolve the puzzle. We argue that the Judaic pig ban was an instrument for internalizing swine externalities. Free ranging pigs in search of sustenance trespass on agricultural landowners' property, wreaking destruction. Activities that foster such pigs thus create negative externalities that can cripple agricultural economies. When the expected cost of swine externalities becomes large, internalization becomes worthwhile: lawmakers with a vested interest in the agricultural economy ban activities that foster free ranging pigs. That is what transpired in ancient Judah, where lawmakers were priests whose livelihoods depended on agriculture, where all swine ranged freely, and where the expected cost of swine externalities surged during the late Iron Age. Lawmakers invoked God to enjoin involvement with pigs because a supernatural injunction was cheaper to enforce than a natural one: in a land of faithful Hebrews, Yahweh's swine prohibition enforced itself. The Judaic pig ban's features are consistent with pig bans recently adopted by US states such as Montana, which everyone agrees are instruments for internalizing swine externalities.

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The boar out of the wood doth waste it...

Psalms 80:13

Cursed is the person who raises pigs...

Sotah 49b

Introduction

Perhaps the most famous taboo in all religion is the Judaic ban on pork. “And the LORD spake unto Moses and to Aaron, saying unto them, Speak unto the children of Israel, saying...the swine...he is unclean to you” (Leviticus 11: 1-2, 7).¹ Deuteronomy (14:8) repeats the injunction, whose codification biblical scholars date to the late eighth or seventh century BC and whose authorship they ascribe to Judean priests (see, for instance, [Price, 2020](#); [Schniedewind, 2003, 2004](#); [Weinfeld, 1985](#)).² The reason for “the Hebrew pork ban has been a matter of speculation for the past two thousand years” ([Simoons, 1994](#): 64). Pigs are an excellent source of protein and calories—one that many people consider most palatable. And “Pigs were part of the locally consumed fauna in the prehistory of the southern Levant” ([Sapir-Hen, 2019](#): 53; see also, [Meiri et al., 2013](#)). Why, then, in the late Iron Age did Judean priests take pork off Yhwh’s approved menu?

“Because God said so” is one answer. And that, in effect, is how the biblical injunction answers for itself: “the swine, because it divideth the hoof, yet cheweth not the cud, it is unclean unto you” (Deuteronomy 14:8). Why the hog’s foot-and-digestion combination is problematic is left as one of God’s mysteries. Scholars must therefore look elsewhere to find a scrutable rationale for the Judaic pig ban.

One of the first places scholars looked historically was to the pig’s hygiene. Among their other charms, swine will dine on trash and feces. Twelfth-century rabbinic authority [Maimonides \(1904\)](#) thus rationalized the ban on the grounds that swine are filthy creatures. From that observation it was a small step to the idea that Jewish law banned hogs because they’re hazardous to human health. After *Trichinella* was discovered in the nineteenth century, trichinosis thus became the favored theory since eating undercooked pork can cause trichinosis infection (see, for instance, [Heisen, 1891](#)). Modern scholars, however, reject the hygienic hypothesis for the Judaic pig ban, and with good reason: filthy habits and disease-carrying capacity are hardly unique to pigs. Chickens, for instance, also eat garbage

and excrement (Redding, 2015). Yet Jewish law did not ban them. And cows, sheep, and goats carry anthrax, making those animals a more serious health threat to consumers than swine (Harris, 1985). But Jewish law did not ban them either.

Second to the hygiene hypothesis, the most famous theory of the Judaic pig ban belongs to anthropologist Mary Douglas. According to Douglas (1966), swine were prohibited because they are a taxonomic anomaly. If one divides ungulates into ruminants with cloven hooves and nonruminants without, and one defines ritual uncleanness as that which is out of place, then the pig is ritually unclean. For the pig is a nonruminant ungulate with cloven hooves and therefore out of place in the proposed taxonomy. The attraction of this hypothesis for the Judaic pig ban is its close relationship to the biblical explanation, considered above. Like the biblical explanation, however, the taxonomic one is not an actual explanation. Why ritual uncleanness should be defined as that which is out of place or ungulates should be classed per the proposed taxonomy is as mysterious as why the wrong foot-and-digestion combination defiles animals in the eyes of God.

Other hypotheses for the Judaic pig ban are contradicted by the fact that it is not necessary to ban what no one wants anyway. The climate theory, for example, postulates that in the mostly hot and semiarid southern Levant, husbanding pigs was more trouble than it was worth (Harris, 1974). Another theory proposes that Hebrews rejected swine in favor of ruminants since, unlike ruminants, pigs grow best on human fare and thus compete with people for food (Harris, 1985). Yet another theory suggests that Hebrews eschewed pork for fowl because chickens convert feed calories into edible calories for humans more efficiently than do pigs (Redding, 2015). If any of these theories were correct, Hebrews would have willingly avoided swine, in which case the Judaic pig ban would not have been required.³

This paper uses the economics of property rights to resolve the Judaic pig puzzle. We argue that ancient Judah's pig ban was an instrument for internalizing swine externalities.⁴ Our theory is simple. Free ranging pigs in search of sustenance trespass on agricultural landowners' property, wreaking destruction. Activities that foster such pigs thus create negative externalities that can cripple agricultural economies. When the expected cost of swine externalities becomes large, internalization becomes worthwhile: lawmakers with a vested interest in the agricultural economy ban activities that foster free ranging pigs. That is what transpired in ancient Judah, where lawmakers were priests whose livelihoods depended on agriculture, where all swine ranged freely, and where the expected cost of swine externalities surged during the late Iron Age. Lawmakers invoked God to enjoin involvement with pigs because a supernatural injunction was cheaper to enforce than a natural one: in a land of faithful Hebrews, Yahweh's swine prohibition enforced itself.

To illustrate our theory, we compare the Judaic pig ban to swine bans recently adopted by US states such as Montana, which everyone agrees are instruments for internalizing pig externalities. Despite being separated by the better part of 3000 years and accordingly significant contextual differences, the underlying features of both pig bans are the same. Short of an implausible coincidence, this suggests that the Judaic pig ban was an instrument for internalizing pig externalities.⁵

Pigs

Sus scrofa

Pigs are animals of the genus *Sus*. They first appeared in the Near East a million years ago. Pig domestication began in the Pre-Pottery Neolithic, and by the late Iron Age, European haplotypes had replaced Near Eastern haplotypes in the southern Levant.⁶ The swine that inhabited the southern Levant in the late eighth and seventh centuries BC are thus the same species found in that region and most other regions today: *Sus scrofa*. Its members include the Eurasian wild boar, that animal's domesticated descendants, and their hybrid offspring. Members of *Sus scrofa* that live in the wild are called "wild" or "feral" pigs.

Sus scrofa is a remarkable creature—and a formidable one. Pigs are large: the average adult wild swine is between 50 and 75 inches long and weighs between 75 and 200 pounds (West et al., 2009: 8). Pigs are built like tanks: wild swine have massive, heavy skulls; razor-sharp tusks; and tough, hairy hides that on mature males cover a cartilage-protected ribcage which "can deflect or stop arrows and even bullets" (Price, 2020: 29). Pigs are fast and agile: wild swine can run 30 mph, jump fences that are less than 3 feet tall, and climb out of enclosures whose walls are nearly 6 feet tall (Higginbotham, 2013: 6).

Pigs are environmentally adaptable: "A variety of habitats, from tidal marshes to mountain ranges, are suitable for wild pigs" (Barrett and Birmingham, 1994: D66). Pigs grow astonishingly fast: "a pig can go from a three-pound piglet to a 220-pound grunter in less than 6 months" (Zeder, 1996: 302). And pigs are incredibly prolific: indeed, "Wild pigs are perhaps the most prolific large mammal on Earth" (West et al., 2009: 8).

Unlike goats, sheep, and cows, sows can birth more than once a year, and their issue is far more numerous—on average, 6 to 10 piglets *per litter*,⁷ compared to less than 1 calf or just 1.2 lambs *per year* (Redding and Rosenberg, 1998: 68). In fact, pigs "out-compete all other domesticated animals in breeding frequency, [and] number of young per litter" (Zeder, 1998: 110). Since pigs also reach sexual maturity at a young age and have low natural mortality rates, swine populations can easily explode. Ecologists

thus regard wild pigs as an invasive species. A “large herd can be produced from a few ‘starter’ animals,” and very quickly (Price, 2020: 24). “Given adequate nutrition, a wild pig population can double in just 4 months” (Barrett and Birmingham, 1994: D66). Even after accounting for wild competitors and less than ideal breeding conditions (such as quality of wild habitat), which would increase the length of time needed to double population (see footnote 7), the rate of wild population growth is sufficiently fast to generate the problems we describe in the next sub-section.

For pigs, “nutrition” is just about anything organic. To subsist, however, they require high-calorie foods like cereals, fruits, nuts, tubers, and seeds. Swine are therefore pleased to dine on, for example, wheat, barley, olives, and grapes. “Pigs will travel long distances to consume attractive foods” (West et al., 2009: 16). The average range of wild swine in the US is 19 square miles, and they can increase their traveling range to more than 100 miles if necessary (Peters and Undark, 2020). Pigs find attractive foods by relying on exceptional olfactory organs that can detect some odors up to 7 miles away and 25 feet underground (Higginbotham, 2013: 4).

What pigs can do for themselves is matched only by what they can do for people. Unlike caprids or cattle, swine offer little in the way of secondary products, such as wool, milk, or traction power. In terms of primary product, however, swine can’t be beat. “The pig is the ultimate meat machine” (Zeder, 1996: 302). Its size, “high reproductive turnover, and a fast growth rate” ensure “a large quantity of high-quality protein” (Horwitz et al., 2017: 105). In terms of “the quantity and caloric value of their meat yield,” pigs dominate “all other domesticated animals” (Zeder, 1998: 110).

Pigs have another advantage over other domesticates: they can be reared very cheaply. Whereas rearing caprids or cattle normally requires intensive husbandry—close animal management, control, and supervision—swine can be reared effectively via extensive husbandry. In its free-range form, such husbandry “set[s] pigs loose so that they must forage their own food and reproduce at will” (Price, 2016: 86). Free-range pig husbandry does not depend on keeping large herds, so it is well suited to household-level production. And it “requires minimal labor to maintain the husbanded pigs, as they are allowed to roam (and feed) freely” (Redding and Rosenberg, 1998: 67). In Sardinia, for example, where free-range swine husbandry survives, “breeders report that they might not see their pigs for an entire month when there is enough food in the woods. The animals usually remain within a 10 km radius of the farm and eventually come back” for protection from predators or when they tire of foraging for their meals (Guillaume, 2018: 157). Return provides an opportunity for culling, and the process then repeats.

Piggish problems

There is a reason why in Greco-Roman mythology the goddess Artemis sends a swine to devastate the crops and vineyards of Calydon; why a hog stoppable only by Hercules ravages the farmlands of Psophis; and why Zeus looses a boar to destroy the Lydians. It is the same reason why, in the seventeenth century, swine triggered King Philip's War between New England colonists and Native Americans; why, in the nineteenth century, there was a Pig War between Americans and Brits in the San Juan Islands; why, at one point, Egypt's government resorted to sending out its army against wild hogs (Simoons, 1994); and why Palestine's president recently accused Israel of releasing feral swine in the West Bank (Toameh and Keinon, 2014). That reason: free ranging pigs are an agricultural menace, "shockingly destructive" in their search for food (Morthland, 2011). So destructive, in fact, that *Sus scrofa* holds the title of "America's 'Most Destructive' Species" (Miller, 2021).⁸

Wild pigs can do damages to agricultural activities in two ways: direct and indirect. Directly, as "pigs are...fond of cultivated crops" (Price, 2020: 15), they can simply trespass on farms and consume existing crops. And their talent for finding crops using an exceptional sense of smell; willingness to travel to crops using their extensive range; ability to access even well-protected crops using their powerful bodies, sharp tusks, running, jumping, and climbing skills—not to mention their intelligence, for pigs are also among the smartest members of the animal kingdom—means that free ranging swine pose a serious trespass risk to agricultural landowners. "The pig is a major predator of domestic crops, with 30 to 90% of its diet consisting of field crops" (Redding, 1991: 22).

The problem is not merely that free ranging swine consume landowners' produce. It is the damage they do in the process. Pigs trample crops, ruin fields, and "damage infrastructure such as fences, irrigation ditches, roads, dikes, and other structures" (West et al., 2009: 17). Since swine are opportunistic omnivores, "Wild pigs sometimes prey on livestock, including lambs, goats, [and] newborn cattle." Further, "Because of their size and strength, wild pigs can damage even robust fences, thus compromising the fence's ability to contain livestock and exclude predators" (West et al., 2009: 17).

To inflict damage on agricultural landowners, free ranging pigs needn't directly target crops or livestock at all. They can inflict damage indirectly if "they use their strong snouts and neck muscles to dig and overturn soil in search of grubs, insects, mast, root bulbs, plant material, and fungus. This rooting (also called grubbing) activity can result in the destruction of crops and pasture" and "damages irrigation systems" (Frederick, 1998: 82–83). A single rooting swine can create a crater 5 feet wide and 3 feet deep

(Morthland, 2011).⁹ This indirect effect compounds the direct effects of crop trampling and consumption and attacks on other livestock.

The economic toll that free ranging pigs can exact is therefore large. In the US, for example, wild swine are responsible for an estimated \$800 million of destruction every year, from ruined wheatfields, vineyards, and irrigation systems to maimed calves, dead lambs, and decimated fences (Pimental et al., 2005).¹⁰ To cope with the problem, in 2014 the US Congress appropriated \$20 million for a national feral-pig task force. In 2018, it set aside another \$75 million to combat wild hog populations (Miller, 2021). That is in addition to the efforts of state governments where “Free ranging pigs frequently cause damage to...crops, livestock, and property” (Frederick, 1998: 82).

A theory of the Judaic pig ban, with special reference to montana

Among those efforts are bans on activities that foster free ranging pigs. More than a dozen states prohibit, for example, possessing wild swine (Centner and Shuman, 2015). These pig bans puzzle no one: they are explicitly instruments to internalize pig externalities. Free ranging swine are wont to trespass on agricultural landowners’ property, wreaking destruction. Activities that foster such swine thus create negative externalities that can cripple agricultural economies. To internalize those externalities, lawmakers ban activities that foster free ranging swine.

Bans are favored for internalization because alternative “options within the standard suite of management techniques are either unsuitable or ineffective for pigs” (West et al., 2009: 22). Frighten devices and guard animals don’t deter them. “Habitat manipulation is impractical given the adaptability of the species” (West et al., 2009: 22). “Fencing is generally not practical except in small areas” (Barrett and Birmingham, 1994: D67) since, recall, “Pigs are notorious escape artists” (Miller, 2021).¹¹ And given their reproduction rate, “it can be exceedingly difficult to remove enough animals from an established pig population to induce a population decline” (West et al., 2009: 24).

Liability rules, which can internalize trespass externalities in the context of intensively husbanded livestock such as cattle, are generally ineffective in the context of free ranging swine since, unlike cattle, free ranging pigs spend most of their time in the wild and display no telltales of who, if anyone, may have fostered their existence.¹² A landowner whose crops are destroyed by such a pig thus cannot normally identify the responsible animal, let alone the responsible person. Similarly, a landowner will not strike a Coasean bargain with potential fosterers of free ranging pigs to forbear fostering activity because he could not enforce the bargain. Even if the landowner could somehow identify all potential fosterers, and even if his cost of bargaining

with them were not prohibitive, should a free ranging swine damage his property, the landowner would have no way of knowing which pig did the damage, who fostered it, or whether that pig was a product of anyone's fostering activity at all.¹³

Because of these factors, "it is unlikely that individual landowners will be able to reduce pig populations, regardless of the intensity of control efforts on their individual properties. If a population reduction is desired, it almost certainly will require efforts across a geographic area larger than that of the average private landholding" (West et al., 2009: 41–42). In other words, it will require a statewide ban on activities that foster free ranging swine.

Consider, for instance, the swine ban recently adopted by Montana. More than 60% of land in Montana is devoted to raising crops—principally wheat and barley—or to raising livestock—principally cows and sheep (Montana Department of Agriculture, 2020). Activities that foster free ranging pigs, such as possessing, feeding, or transporting wild swine, thus create negative externalities for agricultural landowners that could spell significant economic loss for the state.

Although wild pigs have established populations in many other US states, they have not established a population in Montana. And just ten years ago, it did not seem they could anytime soon. More recently, however, feral swine in Canada began assembling outside Montana's northern border. Then, in 2013, a Montanan hunter brought three wild pigs into the state. A population of wild swine, recall, can grow rapidly, and once established, "the cost to" eradicate it "is usually prohibitive" (Barrett and Birmingham, 1994: D70). Montana state officials thus killed the imported pigs. The hunter's action, however, evidenced that other citizens might try to do the same or, if wild pigs from Canada made it across the border of their own accord, that some citizens might foster such pigs by feeding or even breeding them.

Faced with this prospect, Montanan lawmakers calculated that it was worthwhile to adopt a policy for internalizing pig externalities: "we realized we lack some authority over a species of animal that's been shown to be highly destructive" (Baumann, 2015). Contributing to lawmakers' calculation was the growing value of Montana's cropland, which in 2014 was at an all-time high having doubled since 2001 (USDA, 2021). In 2014, Montana's Senate Committee on Agriculture, Livestock and Irrigation thus proposed a feral-pig ban. In 2015, Montana's governor signed it into law. The ban prohibits possessing, feeding, or transporting wild pigs, as well as intentionally, knowingly, or negligently allowing swine to live in a feral state—in short, any involvement with free ranging pigs at all—under penalty of a large fine.

Three features characterize Montana's pig ban and its adoption. (1) *The ban prohibits free ranging pigs*: Montana prohibits activities that foster wild swine. Because such swine range freely, they pose a significant trespass risk

to agricultural landowners. Montana, however, does not prohibit activities that foster other pigs. Pig husbandry in modern America is intensive and typically occurs indoors. In Montana, therefore, husbanded swine do not range freely and so do not pose a significant trespass risk to agricultural landowners. The ban thus prohibits free ranging pigs, as those are the swine that threaten agricultural landowners' property.

(2) *The ban emerged when the expected cost of pig externalities increased sharply*: Montana introduced its ban in 2015—after cropland values had risen to new heights and it became evident that citizens could and might engage in activities that foster wild swine. Montana, however, did not pursue a ban in, say, 2000, when the value of cropland was less than half its value in 2015 (USDA, 2021) and when there was no evidence that citizens might engage in activities that foster wild pigs. Like prohibiting other activities, prohibiting activities that foster free ranging pigs is costly. The ban thus emerged only when anticipated pig externalities increased sharply, making internalization worthwhile.

(3) *The ban was promulgated by lawmakers with a vested interest in the agricultural economy*: Montana's pig ban benefits agricultural landowners but injures citizens who would foster wild swine. Self-interested lawmakers thus promulgate such a ban only if they share the interests of agricultural landowners. Because of agriculture's economic importance to Montana, the state's congressmen depend on support from agricultural landowners for their political positions. Further, many of the state's congressmen are agricultural landowners themselves. More than a fifth of Montana's 63rd Legislature (2013–2014) whose members declared a private occupation declared "Farming, Ranching & Forestry" (Montana State Legislature, 2021). The ban was thus promulgated by lawmakers with a vested interest in the agricultural economy, who personally benefit from internalization.

Our theory of the Judaic pig ban simply extends to ancient Judah the logic behind swine bans recently adopted by Montana and other US states. As in Montana, agriculture was important to ancient Judah's economy—only more so, for agriculture *was* ancient Judah's economy. That economy was based on "The cultivation of cereals, grapes, and olives, combined with the raising and breeding of herds of sheep and goats" (Röthlin, 2009: 95). In other words, it was a veritable smorgasbord for free ranging swine. Like in Montana, but again magnified, activities that fostered free ranging pigs thus threatened economy-crippling externalities. To internalize them, lawmakers in ancient Judah banned activities that foster such pigs, just as congressmen in Montana would do some 2700 years later.

Ancient Judah's lawmakers, of course, were not congressmen who served under a governor. Rather, they were religious authorities: priests who served under a king. "[H]ow intimately interwoven religion and state were. The king, as head of state, was also the head of the national religion as his god's

viceroys" (Ahlström, 1982: 80). And "Serving as state functionaries at various levels of the political-economic structure, the official Yahwistic priesthood functioned to create, propagate, and manage the state ideology" (Green, 1997: 356). Likewise, whereas Montana's swine ban is enforced by the Department of Livestock under penalty of fine, Judah's ban was enforced by Yahweh under penalty of defilement.¹⁴ The reason is straightforward: in modern America, worldly ban-enforcement is cheap relative to divine ban-enforcement, and vice versa in the ancient southern Levant.

Twenty-first century technology, income, and human capital enable impressive conventional-governance capacity in Montana, where, on the other hand, belief in defilement for disobeying God is practically nonexistent. In contrast, Iron Age technology, income, and human capital seriously hamstrung conventional-governance capacity in ancient Judah. But as ancient Judeans were devoted Hebrews, strong belief in an omniscient God who supernaturally sanctioned violators of his commands was widespread. Amid such belief, commands from God are largely self-enforcing, which takes the burden off lawmakers who cannot effectively enforce law themselves. Historically, when religious belief was strong but conventional governance was not, lawmakers thus often substituted divine law and its enforcement for the worldly kind (see, for instance, Leeson, 2012; 2013a, 2014).¹⁵

"[M]ost biblical laws," for example, were "enacted by classes which had the right to do so, but had not power to carry them out" (Oden, 1984: 164). Hence, "biblical law codes...are authoritative and binding because the laws are presented as divine revelations" (Ro, 2018: 57). Since God is omniscient and omnipotent, he can detect and punish all violations. "[T]he Bible contains numerous passages...which detail in no uncertain terms the severe punishments that await the disobedient" (Hayes, 2015: 21). Divine punishment is therefore self-executing when violators have self-knowledge of their violations, in which case enforcement is guaranteed.

The Judaic pig ban, inscribed in the Hebrew Bible, is a canonical specimen of such law and its enforcement. "And the LORD spake unto Moses and to Aaron, saying unto them, Speak unto the children of Israel, saying....the swine...he is unclean to you" (Leviticus 11:1-2, 7).¹⁶ On the one hand, for ancient Hebrews a more authoritative source of law was not imaginable. From God's lips to Moses' ears, then "given into the charge of the priests," the "teachers of the law in general" (Grabbe, 1995: 43). On the other hand, the certainty of becoming unclean in the eyes of Yahweh was a powerful, self-executing deterrent to self-aware disobedience. If for some reason that should not be powerful enough, there was also the divine punishment for disobeying God more generally offered in Deuteronomy, which "threatens the disobedient with destruction" (Hayes, 2015: 21). And not just *his* destruction: "the concept of divine punishment during this period

was basically collective and transgenerational” (Ro, 2018: 123). Deuteronomy thus also contains “lengthy descriptions of the diseases, military defeats, poverty, and humiliation that will befall the nation if it defies Yahweh’s will” (Hayes, 2015: 21). The ancient Hebrew willing to risk involvement with pigs must have been hardened indeed, knowing it would mean defilement, personal destruction, and potentially kingdom-wide calamity at the hands of an all-knowing, all-powerful God.

In ancient Judah the credibility of priests in divine affairs thus gave them credibility in legal ones. And that “gave the priesthood great power. Not only were priests able to teach the will of the gods...They could control the national tradition and the myths of the...Israelites” (Grabbe, 1995: 197). That power was extremely useful for protecting Judah’s agricultural economy from the ravages of free ranging swine, since by invoking a divine injunction, priests promulgated a pig ban that enforced itself. While Judah’s enforcement method thus differed from Montana’s, the reason for its ban did not: to internalize pig externalities.

Illustrating the internalization theory of the Judaic pig ban

Testing a theory that offers to resolve a puzzle with origins nearly three millennia old poses a special challenge. Quantitative data are lacking, and if the historical record contained direct evidence for the Judaic pig ban’s motivation, the puzzle would have been resolved long ago. There is, however, a workaround. Montana’s swine prohibition is only seven years old. Its history is thus completely known, and its internalizing motivation is certain. Insofar as the features of Montana’s prohibition typify laws whose *raison d’être* is internalizing pig externalities, they furnish an illustration of our theory. Those features, recall, suggest that a swine ban motivated by internalization will (1) prohibit free ranging pigs, (2) emerge when the expected cost of pig externalities increases sharply, and (3) be promulgated by lawmakers with a vested interest in the agricultural economy. If, as we hypothesize, the Judaic pig ban was an instrument for internalizing swine externalities, that ban should therefore exhibit features (1)–(3).

This illustration, though indirect, is informative. Montana’s and Judah’s pig bans are separated by the better part of 3000 years and accordingly significant contextual differences. Yet, the similarities are great enough to consider them reasonable parallels (see notably footnotes 5 and 17 for more details). We later examines whether ancient Judah’s swine prohibition proscribed free ranging pigs. We also considers whether that prohibition emerged when the expected cost of pig externalities increased sharply. Finally, we investigates whether it was promulgated by lawmakers with a vested interest in the agricultural economy. Our findings support the

internalization theory of the Judaic pig ban. The underlying features of that ban are consistent with Montana's recent pig ban, which everyone agrees is an instrument for internalizing swine externalities.

The Judaic pig ban prohibited free ranging pigs

A pig ban motivated by internalizing swine externalities proscribes activities that foster free ranging pigs—swine that pose a trespass risk to agricultural landowners. Montana's law thus proscribes wild swine exclusively since, in Montana, husbanded pigs are husbanded intensively and do not range freely. The Judaic pig ban, in contrast, proscribes all swine: "*the swine...is unclean to you*" (Leviticus 11:7 [italics added]). It is a "prohibition against raising pigs and eating their meat" (Lev-Tov, 2000: 14). Our theory therefore predicts that in the ancient southern Levant even husbanded pigs ranged freely.

And they did. "[F]ree range pig husbandry was common knowledge in ancient Israel and Judah" (Guillaume, 2018: 159). Such husbandry, recall, sets pigs loose to feed themselves and reproduce as they will. Swine so husbanded therefore range freely. Free-range husbandry reduces the labor and feed cost of rearing swine to practically nil. It is thus an excellent subsistence tactic to serve the meat needs of poor households for whom intensive husbandry is prohibitively expensive. Such were most households in ancient Israel and "Judah, a tiny, landlocked country lacking natural resources and having an economy that could, at best, be categorised as a subsistence agrarian economy" (Röthlin and Le Roux, 2013: 3). Hence, in the ancient southern Levant, "farmers relied on the ability of pigs to feed themselves in the wild" (Guillaume, 2018: 158).

Whereas in Montana the distinction between husbanded and wild swine is clear and large, in the ancient southern Levant it was therefore hazy and slim. "Ancient pigs constantly navigated between the domestic and wild spheres" (Guillaume, 2018: 157). And since all of them ranged freely, activities that fostered any swine created externalities—swine husbandry and its ultimate purpose, pork consumption, first and foremost. Consistent with the internalization theory, the Judaic pig ban thus proscribed involvement with all pigs.

That in the southern Levant even husbanded swine ranged freely explains why a ban was required for internalization instead of a more limited declaration along the lines of "Thy pigs shalt not damage thy neighbor's property," although the latter, too, could have been presented as a divine command. In blurring the line between husbanded and wild swine, free-range husbandry blurred the line between "owned" and "unowned" swine. Further, since husbanded pigs spent much of their time in the wild, what they did or didn't do to someone else's property was unknown to their husbander.

Divine enforcement of “Thy pigs shall not damage thy neighbor’s property” would therefore have been problematic. Divine punishment self-executes only when a rule violator has self-knowledge of his violation. But in the case of the above rule, that requires self-knowledge of what the violator under free-range pig husbandry often does not know: which swine are his and whether they damaged someone else’s property. In contrast, self-knowledge of violating a ban on mere involvement with swine is nearly certain. Hence, so too is divine enforcement of such a ban.

The Judaic pig ban emerged when the expected cost of pig externalities increased sharply

A pig ban motivated by internalizing swine externalities emerges when the expected cost of those externalities exceeds the cost of internalization. Montana thus introduced its ban only in 2015—after cropland values jumped to new heights and it became evident that citizens could and might engage in activities that foster free ranging swine. The Judaic pig ban, in contrast, dates to the late eighth or seventh century BC. Our theory therefore predicts that the expected cost of pig externalities in ancient Judah increased sharply at the time of “the emergence of the biblical law in the late Iron II” ([Sapir-Hen et al., 2015](#): 308).

It did. Furthermore, the reasons it did are similar to the reasons that the expected cost of pig externalities in Montana increased sharply circa 2015. On the one hand, the number of Judeans inclined to foster pigs—all of which, recall, ranged freely—surged in the late Iron Age. And on the other hand, during the same period, the value of Judah’s cropland surged too.

After the death of King Solomon c.930 BC, the United Kingdom of Israel split, creating two Hebrew kingdoms in the southern Levant: Israel, also called the Northern Kingdom, whose capital was Samaria, and Judah, also called the Southern Kingdom because it bordered Israel to the south, whose capital was Jerusalem. While the kingdoms’ inhabitants shared the same religion, as of the eighth century BC, they did not share the same taste for pork. “[A] dichotomy is evident between sites located in the lowland territories of Israel and Judah. Pigs appear in significant frequencies in the former. Moreover, the pigs found in north Israelite assemblages reflect an important component of the local economy; they were raised and consumed on-site” ([Sapir-Hen et al., 2015](#): 312). In contrast, “In Judah, the...near-absence of pigs is noted in all sites during the Iron II” ([Sapir-Hen, 2019](#): 56).

That dichotomy is significant because of what transpired as the eighth century gave way to the seventh: Judah experienced “a surge in population due to an influx of northerners” ([Fox, 2000](#): 234). In 722 BC the Assyrians conquered Israel, driving a “huge influx of refugees from the north” into Judah where, over the next couple decades, they relocated among their

southern brethren (Röthlin, 2009: 112). The migration's effect on Judah was momentous. "Jerusalem," for example, "mushroomed, historically speaking, overnight (...) During the quarter millennium after King Solomon's reign, the city changed very little, but around 700 B.C. it increased to three or four times its former size" (Broshi, 1974: 23). And not just Jerusalem: overall, "the settlement of Judah grew immensely at this period and the population doubled" (Weinfeld, 1985: 90). Historians have debated the magnitude and pace of this migration process, but there was nonetheless a migration pattern from the North to the Southern Kingdom (Finkelstein and Silberman, 2006; Na'aman, 2014; Sapir Hen et al., 2015; Sapir-Hen, 2019; see also Itkin, 2022).

Northerners, recall—especially from lowland territories bordering Judah—were inclined to husband pigs: "in the Kingdom of Israel, a lot of people ate pork during the 8th century B.C." (Zeldovich, 2021). The Southern Kingdom's entry of new citizens therefore consisted of "Israelites who moved to Judah in the late 8th and early 7th centuries BCE, bringing with them pig-culture traits" (Sapir-Hen et al., 2015: 313). Consistent with the internalization theory, the Judaic pig ban, which dates to the same period, thus emerged when the number of citizens inclined to foster free ranging swine—and therefore the expected cost of pig externalities—increased in the Southern Kingdom. Although there are debates on the magnitude and pace of the migration (Na'aman, 2014), the migration fits with the pattern of "pig migration" (either by trade or by feral pigs moving) in the Eastern Mediterranean pre-950 BC (Meiri et al., 2017; Sapir-Hen et al., 2015).¹⁷

That was not all. For the late eighth century also witnessed "the incorporation of the kingdom into the Assyrian global economy" (Finkelstein and Silberman, 2006: 264–265). Consequent to incorporation, the value of Judah's cropland rose to an all-time high, just as pig-inclined northerners were pouring across the border. Not only, then, did the prospect of pig externalities surge in the late eighth and seventh centuries BC; the danger to Judah's economy surged too.

"During the first half of the eighth century BCE, 'increased opportunities and pressures generated by peace, interregional cooperation and coordination, and access to wider markets via long-distance seaborne trade and short-distance overland trade' encouraged Israel and Judah to contribute their primary product to the web of international relations" (Green, 1997: 373). That product was olive oil, wine, and wheat, whose new access to export markets accordingly increased the value of Judah's olive orchards, vineyards, and wheatfields. Further, new trade opportunities propelled the coeval "phenomenon of agricultural specialization and intensification" (Green, 1997: 372).¹⁸ That intensification consisted of three closely related changes, each of which pushed the value of Judah's cropland higher still.

The first was Judah's "method of large-scale farming that was introduced in the 8th century" (Welch, 2015: 56). Such farming consolidated small landholdings into large, centrally managed estates, enabling crop production at scales previously inaccessible and bringing hitherto uncultivated zones under cultivation.¹⁹ Second, "the rapid agricultural intensification of Judah and Israel in the eighth century BCE" embodied agricultural specialization geared to commerce (Chaney, 2017: 160). Thus, for example, "Upland fields previously intercropped to provide a mixed subsistence for peasant families were combined into large vineyards and olive orchards producing a single crop for market" (Chaney, 2017: 77).

Third, "As far as the technology is concerned, we witness great advances in the eighth century" in Judah. "This can be seen in the olive oil industry," for instance, where "it appears that far more surpluses were produced in this period than in the preceding centuries, and toward the end of this century, relatively large centers for the production of oil surpluses" were established (Faust, 2018: 186). On the one hand, Judah leveraged technology that increased the productivity of processing agricultural product, for example the beam press. "[T]he device appears to have come into widespread use in the eighth century," when Judah's "export trade was thirsty for every drop of olive oil it could get" (Chaney, 2017: 152). Likewise, Judah's eighth century "innovations in irrigation allowed extensive cereal cultivation" in peripheral zones (Welch, 2015: 77). On the other hand, Judah adopted commercial innovations that supported the market for its agricultural products internationally. "A royal standardization of measures," for example, "was instituted to expedite this seaborne trade in agricultural commodities" (Chaney, 2017: 124). Similarly, "a state-controlled system of weights... must have begun no later than the reign of king Hezekiah (726-697 B.C.) who introduced control of Judean internal and foreign trade" (Avishur and Heltzer, 2000: 140).

Consistent with the internalization theory, the Judaic pig ban, which dates to the same period, thus emerged when the value of cropland—and therefore the expected cost of pig externalities—increased sharply in Judah. Considered together with the contemporaneous flood of northern migrants inclined to swine husbandry, which also increased the expected cost of swine externalities in Judah, it is little wonder why the Judaic pig ban emerged in the late Iron Age.²⁰

The Judaic pig ban was promulgated by lawmakers with a vested interest in the agricultural economy

A pig ban motivated by internalizing swine externalities is promulgated by lawmakers with a vested interest in the agricultural economy, who personally benefit from internalization. Montana's swine prohibition was thus promulgated

by congressmen who depend on support from the state's agricultural landowners for their political positions, many of which congressmen are agricultural landowners themselves. The Judaic pig ban, in contrast, was promulgated by priests who served under Judah's king. Our theory therefore predicts that Judah's priests had a vested interest in the kingdom's agricultural economy.

They did. Judah's priests depended on agriculture for their livelihoods in two ways. First, for their priestly positions they relied on the king—Judah's largest agricultural landowner and the residual claimant of the kingdom's agricultural economy. Second, priests' primary source of income was the tithe, a tax levied on agricultural product. A prospering agricultural economy thus benefited priests indirectly by keeping them in their employer's good graces and benefited them directly by increasing their personal incomes.

Ancient Judah, recall, was a theocracy. “[R]eligion was an arm of the royal administration” (Ahlström, 1982: 8). Hence, so were the priests: “the state cultic apparatus was an integrated component of the larger structural apparatus of the state” (Green, 1997: 356). Indeed, “priests in ancient Israel were clearly royal employees, subject to the orders of the king” (Oden, 1984: 164–165). What the king ordered were policies that benefited the agricultural economy since a prospering agricultural economy benefited the king.

“[T]he kings of Israel and Judah were owners of vast estates” (Davies, 1989: 358). During the late Iron Age, olive orchards, vineyards, and “expansive area of pasturage for goats, sheep, and horses,” for example, were “under the control of Judah's government” (Wright, 2018: 7; Premnath, 1984: 59). Moreover, agricultural land the king did not himself own was often owned by his clients—other members of Judah's ruling class who relied on the king for land and were, like their royal patron, absentee landlords. “[A]n administrative system was in vogue among the ancient Israelites through which servants of the crown were supported by the income from estates. The ‘ownership’ of many of these estates was granted (or at least sanctioned) by the king” (Rainey, 1967: 41).

Estate owners—royal and royal-adjacent—spearheaded Judah's agricultural intensification. “As a policy, agricultural intensification was initiated and engineered by the urban-based ruling elite,” who “sought the maximally efficient production of wheat, oil, and wine for export” (Chaney, 2017: 179, 154). More agricultural exports meant more luxury imports, which were made available by new trade opportunities, discussed above, and were in high demand by the king and his cronies. “[T]he ruling elite” thus “had a powerful economic incentive to increase production of the three preferred export crops” (Chaney, 2017: 124–125). And the king's incentive was most powerful of all because his vested interest in the agricultural economy was greatest.

In addition to being Judah's largest agricultural landowner, the king was the residual claimant of Judah's agricultural export trade, over which he

exercised royal privilege. “[F]oreign trade was initiated and monopolized by the crown” (Premnath, 1984: 105–106). Among the valuable benefits this monopoly conferred was the ability to tax merchants carrying agricultural product. “The states controlling the via Maris and, even better, the King’s Highway”—routes connecting traders to Phoenicia, Philistia, Egypt, Arabia, and the kingdoms of Transjordan—“were in a position to guarantee access to their own citizens and to collect tolls...from passing merchants...This was precisely the position that Israel and Judah held during the eighth century B.C.E. and that Judah alone seemed to approach in the later seventh century” (Silver, 1983: 49). That profited the king personally because “there was no distinction between the king’s revenues and those of the kingdom” (De Vaux, 1997: 139). The king’s interest, then, was tied to the agricultural economy. And as considered above, priests’ interest was tied to the king’s: “building temples and appointing priests were royal prerogatives” (Ahlström, 1982: 24). Priests, too, thus had a vested interest in the agricultural economy.

But not only via their relationship to the king.²¹ “[M]uch of the final editing of the Hebrew Bible was done by groups which received the revenues raised by taxes—for example by priests” (Oden, 1984: 172). Chief among those taxes was “the obligation of the people to present tithes of their crops and their increase in flocks and herds” (Stevens, 2006: 93). Tithes were priests’ primary source of income, which was therefore inextricably linked to the fate of the agricultural economy. Prospering agriculture meant more tithes, hence higher priestly income. In contrast, suffering agriculture—for example at the snouts of free ranging pigs—meant less tithes and accordingly diminished priestly income.

Priests, moreover, were beneficiaries of agricultural tax revenues collected by the king, which were comingled with the tithes owed to priests. Because government was theocratic, “the boundaries between the government administration (secular) and the temple (religious) were poorly defined.... These two institutions were intimately connected...perhaps employing the same personnel” (Röthlin, 2009: 107). Consequently, “there was only a theoretical distinction between the national and religious treasuries” (De Vaux, 1997: 139). Indeed, “It is impossible to distinguish religious and governmental taxation since religion and government were one and the same in ancient Israel” (Jose and Moore, 1998: 64). On the one hand, “the king felt free to withdraw funds from the treasuries of both the palace and the temple and to have his own servants oversee collection of Temple offerings.” And on the other hand, “The priests in ancient Israel...were themselves supported by taxes paid to the state sanctuary” (Oden, 1984: 164–165).

Consistent with the internalization theory, the Judaic pig ban was thus promulgated by lawmakers with a vested interest in the agricultural economy. Similar to how Montana’s swine prohibition was promulgated by congressmen dependent on support from Montana’s agricultural landowners

for their political positions, many of whom are agricultural landowners themselves, the Judaic pig ban was promulgated by priests whose livelihoods depended on Judah's agriculture. For their positions, priests relied on the king, who was Judah's largest agricultural landowner and the residual claimant of the kingdom's agricultural economy. And for their income, priests relied chiefly on the tithe, which was a tax on agricultural product.

Persistence of the Judaic pig ban

Everyone agrees that Montana's pig ban is an instrument to internalize swine externalities. Free ranging pigs in search of sustenance trespass on agricultural landowners' property, wreaking destruction. Activities that foster such swine thus create negative externalities that could cripple Montana's agricultural economy. When the expected cost of those externalities increased sharply, Montana's congressmen, who have a vested interest in the state's agricultural economy, therefore banned activities that foster free ranging pigs.

Despite origins some 2700 years older, the Judaic pig ban exhibits the same core features as Montana's. In the ancient southern Levant, wild and husbanded swine alike ranged freely, so activities that fostered any swine created negative externalities that could cripple Judah's agricultural economy. The expected cost of those externalities increased sharply in the late Iron Age, as a torrent of pig-inclined refugees from the Northern Kingdom flooded into Judah and as new trade opportunities and agricultural intensification drove the value of Judah's cropland to new heights. Judah's priests, whose livelihoods depended on agriculture and who served under an agriculture-dependent king, thus invoked a command from God to forbid any involvement with pigs. Yahweh was the right man for the job because, in the first millennium BC, worldly law-enforcement capacity was severely limited, and in a land of faithful Hebrews, God's swine prohibition enforced itself.

The Judaic pig ban thus made good economic sense in late Iron Age Judah, when and where it emerged. But it makes little economic sense today. Israel is no longer an agricultural economy. The Judaic pig ban's target place and people are no longer coextensive: today, large numbers of Jews inhabit areas remote from Israel. And husbanded pigs no longer range freely, as intensive swine husbandry has completely supplanted free-range husbandry nearly everywhere—Israel included. Why, then, does the Judaic pig ban persist?

There are two, interrelated, answers: the first considers the ban *de facto*—in terms of actual adherence; the second, *de jure*—in terms of the ban on the books. *De facto*, the Judaic pig ban is less persistent than one might think. "Jews are increasingly accepting pork as food" (Simoons, 1994: 70). Nearly

60% of American Jews and 16% of Israeli Jews, for example, acknowledge eating pork (Pew Research Center, 2016: 51). Those figures suggest there is *some* persistence but that the taboo has weakened. Moreover, these measures only consider Jews willing to admit their involvement with pigs. In Israel especially, additional Jews may also eat pork but are not prepared to declare the fact on a survey. Still other Israeli Jews, even if they don't consume pork themselves, are willing to countenance pork consumption by coreligionists. Already in the early 1970s, "Jews who were strictly observant," meaning they would not patronize restaurants that served pork, "were estimated to constitute a mere 15% of Israel's population" (Simoons, 1994: 34).

Indeed, the idea that of a strong persistence of the taboo is overstated. The taboo does persist but it has weakened to some degree. For example, "Israel...is experiencing a rapid expansion in swine husbandry" reliant on "large-scale pig factory farms" (Price, 2020: 178, 179). The expansion is despite Israeli federal law, which severely restricts swine rearing and pork sales. That such law is necessary itself bespeaks appreciable *de facto* non-persistence. Yet that some Israelis do not consider current law restrictive enough—desiring blanket criminalization of swine husbandry and pork sales—underscores the fact that appreciable non-adherence is far from no adherence. Likewise, while *de facto* non-persistence is predominant among Jews in America, even there, many continue to adhere to the Judaic pig ban.

Which brings us to the ban *de jure*, whose total persistence is the reason that many Jews still eschew pigs *de facto*.²² Nearly three millennia after the fact, the Judaic swine prohibition remains on the books—or rather, *in* the books of the Torah, namely, Leviticus and Deuteronomy. And how difficult repealing the prohibition would therefore be: Yahweh would need to countermand himself, which is not something omniscience is inclined to do. Therein lies the central drawback of promulgating law by divine command.

Conditional on strong belief, such law is self-enforcing. That enforcement advantage, recall, is why, historically, lawmakers often used divine commands to promulgate law and why Judean priests invoked God to enjoin involvement with swine, inscribing the injunction in Judaism's sacred texts. The advantage, however, comes at a price. Divine commands are not easily walked back if, later, the circumstances that motivated them, under which the commands made good economic sense, should change. Rather, the nature of such commands tends to "once and for all."

Legislating by divine command in ancient Judah thus "cemented the moral prescriptions of the Judahite priesthood as law"; it "bestowed upon these practices a permanency that was integrated into the core of Judahite and later Jewish life, and prevented any 'cultural drift' that could mute or alter them over time" (Price, 2020: 122). Though much time has passed, the prescriptions thus remain unaltered: *de jure*, the Judaic pig ban persists completely despite having outlived its economic usefulness. As intimated

above, *de jure* persistence encourages partial *de facto* persistence—continuing adherence to the pig proscription by some believers—for God’s law has not changed, and perhaps it never could.

Indeed, shy of abandoning faith, the Judaic pig ban’s *de jure* persistence would result in total *de facto* persistence were it not possible for some believers to find a middle way. Many, however, have found that way by reinterpreting the swine proscription and other divine commands in the Hebrew Bible so as to embrace their “spirit” while eschewing their actual, concrete orders. “The most striking example of this is the abolition of food laws in Reform Judaism,” whose “rabbis explicitly reject the food laws in favor of more modern interpretations of the Hebrew Bible” (Price, 2020: 192). Such middle ways have permitted substantial *de facto* abandonment of the Judaic pig ban in a context of changed conditions, notwithstanding the ban’s permanence in, and thus on, the books.

Concluding remarks and lingering puzzles

“The reasons that the pig is prohibited for...Jews have been the source of debate for centuries” (Hesse, 1990: 197). Pigs are an excellent source of protein and calories—one that many people consider most palatable. And pigs have a long prehistory of being raised and consumed in the southern Levant. It thus seems most puzzling that, in the late Iron Age, Judean priests took pork off the menu.

When viewed through the lens of the economics of property rights, however, the Judaic pig ban is not puzzling at all. Free ranging pigs in search of sustenance trespass on agricultural landowners’ property, wreaking destruction. Activities that foster such pigs thus create negative externalities that can cripple agricultural economies. When the expected cost of swine externalities becomes large, internalization becomes worthwhile: lawmakers with a vested interest in the agricultural economy ban activities that foster free ranging pigs. That is what transpired in ancient Judah, where lawmakers were priests whose livelihoods depended on agriculture, where all swine ranged freely, and where the expected cost of swine externalities surged during the late Iron Age. Lawmakers invoked God to enjoin involvement with pigs because a supernatural injunction was cheaper to enforce than a natural one: in a land of faithful Hebrews, Yahweh’s swine prohibition enforced itself. The Judaic pig ban, in other words, was an instrument for internalizing swine externalities.

That it was such an instrument is clear by considering the Judaic pig ban alongside swine bans recently adopted by US states such as Montana, which everyone agrees are instruments for internalizing pig externalities. Despite being separated by the better part of 3000 years and accordingly significant contextual differences, the underlying features of modern Montana’s and

ancient Judah's pig bans are the same. It would be quite a coincidence if swine prohibitions implemented so far apart, temporally and spatially, yet nevertheless sharing the same underlying features did not also share the same underlying function.

Our finding that the Judaic pig ban emerged to internalize pig externalities suggests the possibility that the emergence of other religious swine prohibitions, most notably in Islam, might also reflect internalizing logic. Further, although internalization logic seems unlikely to have played a role in the emergence of, for instance, the Judaic shellfish or camel bans, our analysis raises the question of whether different aspects of property rights logic might help explain other religious animal taboos. We have not analyzed the emergence of other religious animal prohibitions, and each would require its own study. But given the intimate relationship between religion and law in the ancient world, the connection between animals and the development of property rights (see, for instance, Demsetz, 1967; Ellickson, 1991), and the enormous importance and influence of animals on ancient agricultural economies (positive and negative), the economics of property rights presents itself as a powerful engine for analyzing, and perhaps demystifying, other religious animal proscriptions.

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Notes

1. All biblical quotations use the King James Version.
2. Legend says that Deuteronomy was composed by Moses. While we found the above-mentioned sources most convincing, for a counter argument that places the origin in the Northern Kingdom see Edenburg and Müller (2015).
3. Additional problems plague these theories. The climate hypothesis, for example, is problematic also because “there were no major climatic changes during the Iron Age in the southern Levant” to account for changing pig practices (Sapir-Hen et al., 2013: 12).
4. In economics the term externality refers to a spill over cost or benefit. When economists talk about internalizing externalities this refers to solutions that get individuals to behave as if they actually incur the spilled over cost and benefit. See Marciano and Medema (2015) for a good overview of the history of externalities and market failures in the field of economics.

5. It is worth mentioning that the USDA places Montana's agricultural (for ranching and farm) acreage at 58.1M acres. This means that there are 52.6 acres per person in Montana (USDA, 2023:1). In contrast, the population figures of [Broshi and Finkelstein \(1992: 54\)](#) of between 150,000 and 403,000 persons in Palestine during the Bronze Age and that the land area of Israel and Palestine net of the Negev desert is today is 4.2M acres, we are talking of between 10.46 and 28.10 acres per person. While no estimates of farmland to total are available, these proportions are not too dissimilar. In fact, because there is so much more land per person in Montana, the pig would be less likely nuisance there than in Iron Age Palestine. Indeed, more land per person means that pigs are less of a nuisance (see footnote 18).
6. And in Europe.
7. The Food and Agriculture Organization (FAO) suggests that "a well-fed sow will produce at least 10 piglets from each pregnancy and may have 2 litters each year" (FAO, 1994: Ch. 4, Unit 31). However, even if those numbers (even the number of litters per year) are halved (to reflect less than ideal breeding conditions, pig nutrition and wild competitors) the standard mathematical expression for doubling time with a single litter per year allows pig population every 6.6 to 17.7 months. Even with these highly conservative assumptions, this is still fast enough to pose serious enough to pose the problems that we highlight in this paper. Indeed, [Mellish et al. \(2014\)](#), in stimulating potential population growth in modern-day Texas, estimate a mean annual growth rate of 0.32 – which means that wild board populations double every 2.5 years. Montana's Department of Livestock (2021) points to even higher rates of reproduction than Texas.
8. There is, of course, differences in modern vs. ancient concerns in regards to the dangers posed by pigs (for example, in the different human demography, natural predators, wild habitats, etc). However, regardless of these issues, the literature on reproduction in feral conditions seems to point to pigs holding a dangerous status.
9. Despite these very real problems, grubbing, however, can have some positive benefits such as increasing nutrient cycles and decomposition rates (see for example [Pitta-Osses et al., 2022](#)). Moreover, it should be noted that soil properties appear to be only moderately damaged by wild boars in modern studies ([Pitta-Osses et al., 2022](#)). However, damages to soil properties – which then affect crops – is an indirect mechanism through which feral pigs would have caused agricultural damages. Indeed, as we pointed out above, pigs would damage crops and animals directly by eating or attacking them.
10. For state-level estimates, see [McKee et al. \(2020\)](#).
11. A "pig-proof fence" must be high and encircled top and bottom with barbed or electrified wire (see [West et al., 2009](#); [White et al., 2018](#)). That is possible with modern technology, but it was not possible with ancient technology.
12. Hence, while the Hebrew Bible deals with cattle trespass via liability rules (Exodus 22:5), it simply bans pigs.

13. One could ask why subsidies to hunting wild pigs were not adopted. After all, the state could have subsidized the slaying of feral hogs. However, subsidies for hunting imply subsidies for farming. An example reminiscent to the one for pigs is that of the Great Hanoi Rat Massacre of 1902. French colonial authorities – mindful of the public health nuisance that rats posed – offered a bounty per rat killed in order to cull the population. This led to numerous incidences of rat farming operations near and around Hanoi (Vann, 2003). Overall, this did not cull the rat population and a similar logic likely applied to swine. In fact, the US army at Fort Benning did something similar with pigs and ended up with a similar result (Lucas and Fuller, 2018: 516–517). Finally, pigs are not that easy to hunt. As the Montana Department of Livestock (2023) stated: “A group of feral swine is called a sounder. If a sounder is detected and not all of the sounder is killed, animals that escape can disperse further on the landscape and learn behaviors to help them evade further attempts at hunting”.
14. Montana’s Department of Livestock works in cooperation with Montana Fish, Wildlife & Parks, the US Department of Agriculture Wildlife Services, and the Montana Invasive Species Council.
15. And not only historically. In modern contexts, too, when belief is sufficiently strong and/or conventional governance is sufficiently expensive, divine law and its enforcement is often substituted for the worldly kind. See, for instance, Leeson and Coyne (2012) and Leeson (2013b).
16. Likewise, the other Torahic book that inscribes the Judaic pig ban, “the Book of Deuteronomy derives much of its sacred power from the presumption that Moses penned it” (Schniedewind (2004: 9).
17. The question here is how plausible it is that pigs were a significant risk. This is where the parallel with Montana is strongest here. Indeed, Montana had more acres of farmland per person than Palestine would have had during the Iron Age (see footnote 5). As such, a single pig trespassing on a plot would have damaged a smaller share of the crops in Montana than in Iron Age Palestine. Yet, Montana applies a ban on feral pigs even when the numbers of feral pigs are near-zero. Moreover, the total number of “hogs and pigs” in Montana on December 1st 2022 is 225,000. As feral pig populations develop by domesticated pigs escaping farms (or being intentionally released) (Montana Department of Livestock, undated, 1), this number speaks to the potential feral pig problem. That number implies that there are less than 3.9 pigs per 1,000 acres of farmland in Montana. Given the area of modern-day Israel and Palestine (net of the Negev desert), this means only 16,315 pigs would have been needed for the region to have as much of a potential pig problem as Montana today. The evidence discussed by Sapir-Hen et al. (2015) and Sapir-Hen (2019) suggest that pigs in the Iron Age Levant and Israel could have easily matched and exceeded this relatively small number. Combined, these elements suggest that pigs would have posed a large potential problem following the migration to the southern kingdom

18. Judah's need to satisfy tribute obligations to Assyria also encouraged agricultural intensification.
19. On the land consolidation process, see Chaney (2017) and Kessler (2008). On land law in ancient Mesopotamia, Egypt, and Israel, see Ellickson and Thornton (1995).
20. It is also worth noting that the ban may have been made cheaper by the arrival of the chicken as a substitute for the pig as a household waste manager that creates far fewer externalities (Redding, 2015). This could explain why the ban was successful. However, the arrival of the chicken produces a complementary factor to our explanation of the ban rather than a substitute.
21. "Inasmuch as the crown held property and the crown and temple were the two major societal institutions in Israel/Judah, it may be reasonable to infer that the temple held land" (Stevens, 2006: 85; see also, Neufeld, 1960: 50). In that case, priests' vested interest in the agricultural economy extended also to their status as agricultural landowners.
22. Although it is worth mentioning a possibility raised by the work of Safrai (2003). During the Greco-Roman era, property rights were clearly better defined and cheaper to enforce than better (see notably Terpstra, 2019). The taboo, during that era, would have been less problematic. A large number of Greeks and Romans who were fond of pork increased the demand for it in the region. Safrai notes that "some Jewish farmers raised them [pigs]" during the era. Moreover, Safrai noted that the Mishnah in Tractate Uktzin 3:3 "states as a matter of fact that the carcass of a pig (...) could be sold to a non-Jew any place in which there were non-Jews" (2003: 185). This suggests that *de jure* loopholes allowed for the taboo's intensity to be modulated to changing conditions.

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