A Social-Status Rationale for Repugnant and Protected Market Transactions*

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Abstract

Societies deem repugnant and proscribe market transactions in sex, organs, and surrogacy, despite potential gains from trade. We resolve this tension by observing that repugnance norms help status-conscious individuals. We study an exchange economy in which agents abhor dominance: one loses social status if surpassed by another in the consumption of every good. Repugnance norms forestal dominance by partitioning goods into submarkets and proscribing trade across submarkets. With multiple equilibria, there is scope for coordinating on—or protecting—a good for "overconsumption"; such a good (e.g., owner-occupied housing) is an emergent status good.

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1 Introduction

Philosophers and laymen alike routinely deem some voluntary monetary exchanges repugnant, deriding them as loathsome commodification and advocating their prohibition. While organ sales and prostitution receive perhaps the most universal opprobrium, repugnance may also attach to surrogacy, usury, life insurance, imports, labor on holidays, indentured servitude, dwarf tossing, as well as trade in votes, child-bearing permits, and even art.[1] These sentiments are widespread and so deep-seated that they are aroused even by transactions among third parties. Rather than stemming from ignorance of gains from voluntary trade, these sentiments are robust to the evidence of the benefits of exchange. Why do these seemingly counter-productive attitudes persist? Rather than charge objectors with irrationality, we argue that repugnance can be motivated by familiar efficiency considerations.

We propose a formal framework for thinking about repugnance. Take a pure exchange economy. Partition goods into submarkets and proscribe trade across submarkets. Examples of submarkets are conventional commercial goods, favors exchanged among friends and family, and different types of kidneys. We identify **repugnance** with the social norm that proscribes exchange across submarkets.

When preferences are identical Cobb-Douglas, repugnance generally leads to a Pareto worsening (as we show) and, so, cannot be justified on welfare grounds. However, the simple model described above misses a crucial and empirically salient feature: each individual cares about the social status conferred on him by his consumption decision. We model this status concern in a stark but supremely tractable way: to each individual, more important than his private enjoyment of consumption is whether another agent's consumption bundle dominates his in every dimension. That is, each agent lexicographically prefers any allocation at which no agent consumes more that him of *every* good to any allocation at which some agent does. In other words, an agent preserves his social status whenever he can make a face-saving comparison with every other agent; for him, the relevant comparison good is one in which he is not dominated. Perceptions of com-

[1] Of course, repugnance norms and exchange restrictions differ across cultures and across time.

parison goods are thus subjective and, in principle, can vary not only across individuals but also with each comparison that a given individual makes.[2]

The described operationalization of status is inspired by the flexible social comparisons observed in everyday life. For example, neither a scholar nor an athlete need be threatened by the other, the first secure in his superior intellect and the latter in his physical prowess. The scholar obtains greater education, while the athlete frequents the gym. More intimidating to the scholar would be another scholar with better education, a better publication record, and keener intellect. Nevertheless, the first scholar may yet save face by choosing instead to compare along a different dimension, finding that he devotes more time to his family or church than does his rival.

Having sifted through the philosopher's case studies of repugnance toward markets (e.g., Satz, 2010), we have uncovered two (non-exhaustive) underlying motives. Both are traceable to dominance and are captured by our model. The first motive is unequal gains from trade. One may condemn such inequality when it leads one party to dominate the other. For example, before selling her kidney, a woman may be poor but nevertheless in decent health and, so, undominated by a wealthy businessman on dialysis. While her selling a kidney to the businessman creates apparent gains to both, it also creates dominance; the businessman remains wealthier than the woman but now also enjoys greater longevity (say, because the woman eats poorly and has limited access to healthcare). The described objection to trade is paternalistic. Had the woman correctly anticipated dominance, she would have refrained from selling her kidney. Paternalistic objections underpin various other prohibitions, as exemplified by smoking, drinking, and statutory rape laws, as well as age restrictions at cinemas and strip clubs.

The second motive for repugnance toward markets is subtler. It implicates a third party. To understand the externality, consider a poet, who subsists in a hovel but regales in a bohemian lifestyle. By consuming copious sex, the poet is unthreatened by the sprawling estate of a Wall Street financier, a workaholic with no time for girlfriends. With legalized prostitution, however, the financier's purchase of sex leaves the poet without a face-saving comparison; the financier now boasts greater wealth and a more adventurous sex life. This concern applies independently

[2] Penn (2016) reasons similarly: "The idea that individuals and groups 'selectively value' certain skill domains as an ego-defense mechanism has been well-supported in psychological studies, and the phenomenon can be derived from a number of theories of self-protection. At the individual level, numerous scholars have argued that perceived shortcomings on a particular domain cause people to describe that domain as less relevant to their concept of self."

of the welfare of the prostitute and, so, is not paternalistic; instead, it aims to protect the welfare of a third party, the poet.[3]

To capture both motives, we consider two types of individuals: naïfs and sophisticates. **Naïfs** choose bundles to maximize their consumption utility, unaware of the painful consequences of dominance. **Sophisticates** seek bundles that, first, avoid dominance and only then maximize consumption utility. One might have thought that sophistication would take care of the paternalistic objection to comprehensive markets. It turns out that it does not, as we show.

We compare equilibria induced by various partitions into submarkets according to the lexicographic Pareto criterion, which lexicographically prioritizes dominance avoidance over consumption utilities. This criterion, first, minimizes (in the inclusion sense) the set of dominated agents and then maximizes (in the Pareto sense) the agents' consumption utilities. To illustrate, with naïfs, the set of dominated agents is minimized at autarky. As a result, lexicographic Pareto optimal partitions are as coarse as they can be as long as no additional instances of dominance are introduced.

Sometimes, sophisticates avoid dominance where naïfs would be unable to. A sophisticate can do so by matching the consumption of some good. This good is interpreted as an endogenously emerging status good. Are status goods different for different agents? If not, then which good do the sophisticates coordinate on as the status good? We show that each status good has the lowest consumption weight (i.e., is "least liked") in its submarket. Thus, with comprehensive markets, the status good is generally unique.

Sophistication and partitions can be either complements or substitutes. That is, an optimal partition for sophisticates can be either finer or coarser than for naïfs. In particular, sophistication need not obviate repugnance. Moreover, multiple equilibria with different welfare properties may exist. As a result, there is room for **protection**, defined as equilibrium selection through coordination of the agents on targeting a particular good or goods.[4]

We identify optimal market structures in two stylized economies defined by proportional or specialized endowments. Although a qualified argument for comprehensive markets can be made when agents are sophisticated, no market structure stands out as uniformly best in general, across

[3]The purchase of performance-enhancing drugs also reflects this externality. Their use may lead a wealthy athlete to dominate a poor athlete, who is a third party to the transaction between the wealthy athlete and his drug supplier.

[4]Fair-trade coffee, owner-occupied housing, and locally-sourced produce are commonly protected.

all environments. The plurality of the model's predictions accords with the observed diversity of norms and laws among societies, both contemporaneous and through history.

To clarify the role of the model's assumptions, we investigate two extensions. In one, agents' preferences differ. Diverse preferences make it more likely that different sophisticated agents would target different goods even within the same submarket—behavior that is nongeneric with identical preferences. Moreover, with diverse preferences, the arrival of new goods eventually obviates both repugnance and protection, regardless of whether agents are sophisticated or naïve. Each agent finds a good about which he, and only he, is especially passionate and consumes more of it than anyone else does.

The model's second extension shows that partitioning goods, which is our focus, neither replaces nor can be replaced by partitioning agents. The latter kind of partitions appears in the study of international trade and, in our context, corresponds to the modern-day repugnance toward cultural appropriation, as well as to the miscegenation laws of the past and to non-fraternization policies during the times of military occupation.

Section 2 introduces the model. The economies in which all agents are naïve or all are sophisticated are explored in Sections 3 and 4, respectively. Section 5 presents various interpretations of the model in an example. Section 6 investigates two extensions. Section 7 speculates that, consistent with the model's predictions, the social-status induced repugnance has been on decline. Section 8 discusses our results in the context of related literatures in economics and philosophy. Section 9 contains concluding remarks. Appendix A has all the proofs. Supplementary examples, which illustrate some of the assertions made in the main text, are in Appendix B.

2 A Model of Repugnance and Protection

We introduce a textbook pure-exchange economy and modify it to accommodate submarkets and social comparisons.

2.1 A Modified Textbook Exchange Economy

A Textbook Exchange Economy

Agents $\mathcal{I} \equiv (1, \ldots, I)$ exchange goods $\mathcal{L} \equiv \{1, \ldots, L\}$. Agent i's endowment is $\omega_i \equiv (\omega_{il})_{l \in \mathcal{L}} \in \mathbb{R}^L_+$, where ω_{il} is his endowment of good l.[5] The aggregate endowment vector is $\Omega \equiv \sum_{i \in \mathcal{I}} \omega_i \in \mathbb{R}^L_{++}$. Each agent's **consumption utility** $u \colon \mathbb{R}^L_+ \to \mathbb{R}$ is Cobb-Douglas and parameterized by **consumption weights** $\alpha \in \mathbb{R}^L_{++}$; that is, for any bundle $x_i \in \mathbb{R}^L_+$, $u(x_i) \equiv \sum_{l \in \mathcal{L}} \alpha_l \ln x_{il}$. An **economy** is a tuple (ω, α), where $\omega = (\omega_i)_{i \in \mathcal{I}}$.

Modification 1: Submarkets

Repugnance proscribes certain transactions by delineating a **market structure**, defined as a partition $\mathcal{P} \equiv (\mathcal{L}_k)_{k \in \mathcal{K}}$ of the set $\mathcal{L}$ of goods into submarkets $\mathcal{K} \equiv \{1, 2, \ldots, K\}$.[6] At the extremes are **comprehensive markets** ($K = 1$) and **autarky** ($K = L$). A good l that is isolated in its own submarket is **nontradable**. A **partitioned economy** is a triple $(\omega, \alpha, \mathcal{P})$.

Because agents' preferences are separable across submarkets, Walrasian equilibrium for a partitioned economy can be defined as Walrasian equilibrium in each submarket. Formally, a **Walrasian equilibrium** for a partitioned economy $(\omega, \alpha, \mathcal{P})$ is a price-allocation pair $(p, x) \in \mathbb{R}^L_{++} \times \mathbb{R}^{IL}_+$ such that, in each submarket $k \in \mathcal{K}$, the price-allocation pair $(p_l, x_l)_{l \in \mathcal{L}_k}$ is a Walrasian equilibrium for the economy $\left((\omega_{il})_{i \in \mathcal{I}}, \alpha_l\right)_{l \in \mathcal{L}_k}$. That is, at a Walrasian equilibrium, markets for all goods clear, and each agent maximizes his preference subject to spending in each submarket at most the wealth that he derives from his endowment in that submarket.[7]

Proposition 1. *Each market structure induces a unique Walrasian equilibrium. The equilibrium allocation x is such that, in each submarket $\mathcal{L}_k$, each agent i consumes the amount that is proportional to the aggregate*

[5] We let sets $\mathbb{R}$, $\mathbb{R}_+$, and $\mathbb{R}_{++}$ denote the real, non-negative real, and positive real numbers, respectively. For any two vectors x and y in $\mathbb{R}^L$, we write $x \leq y$, $x < y$, and $x \ll y$ to indicate that, for each good $l \in \mathcal{L}$, $x_l \leq y_l$, $x_l \leq y_l$ and $x \neq y$, or $x_l < y_l$, respectively.

[6] A partition of $\mathcal{L}$ is a collection of nonempty disjoint subsets of $\mathcal{L}$ whose union is $\mathcal{L}$. Also, P is **finer** than P' (and P' is **coarser** than P) if $P \neq P'$ and if every element of P is a subset of some element of P'.

[7] Because we interpret Walrasian outcomes as approximations of unfettered exchange, we must explain why unfettered exchange does not occur across submarkets. We credit the social norms of repugnance, as well as laws, for proscribing such exchange. Efficiency-promoting social norms may emerge from group selection or intelligent design by shamans, priests, and politicians. As Émile Durkheim and Sigmund Freud observe, individuals can sacralize or fetishize nearly any good, as an identity building exercise; once internalized in preferences, the social norms of repugnance do not require much external enforcement.

endowment:

$$x_{il} = \left(\frac{\sum_{m \in \mathcal{L}_k} \alpha_m \omega_{im} / \Omega_m}{\sum_{m \in \mathcal{L}_k} \alpha_m} \right) \Omega_l, \qquad l \in \mathcal{L}_k,$$

where the coefficient of proportionality (in the parentheses) is agent i's share of wealth in the submarket. The supporting price vector is $p = (\alpha_l / \Omega_l)_{l \in \mathcal{L}}$.

It turns out that, in the textbook economy, partitioning markets is never beneficial. Merging submarkets does not change the prices but removes some restrictions on how agents can spend their wealths. Facing fewer restrictions, each agent is weakly better off:

Proposition 2. *Merging submarkets weakly increases each agent's equilibrium consumption utility. As a result, each agent weakly prefers comprehensive markets to any other market structure.*

Proposition 2 notwithstanding, few commentators abjure their repugnance sentiments on the grounds of superior consumption utilities when markets are comprehensive.[8] Neither do we. Instead, we view the model of Propositions 1 and 2 as incomplete and supplement it with a missing element: agents' concern for social status.

Modification 2: Social Status Concerns

We now assume that, in addition to his consumption utility, each agent also cares about his social status, which is affected by the comparisons of his consumption bundle to others' consumption bundles. In particular, each agent abhors being dominated. We say that agent i is **dominated** at an allocation x if there exists an agent j whose bundle is greater, and strictly so in every dimension in which agent i consumes a positive amount.[9] Each agent's preferences lexicographically prioritize dominance avoidance: he prefers any allocation in which he is undominated to any allocation in which he is dominated. While agents loathe being dominated, none enjoys dominating.

[8] The proposition's conclusion relies on the assumption that consumption utilities are identical (cf. Chambers and Hayashi, 2017, Theorem 1).

[9] Formally, agent i is dominated by agent j if $x_j > x_i$ and, for any good l, $x_{il} > 0$ implies $x_{jl} > x_{il}$. The definition of dominance falls short of requiring $x_j \gg x_i$ to avoid the pathological cases in which agent i avoids dominance by matching agent j's zero consumption of some good. Such cases are pathological because we all necessarily consume zero amount of goods that have not yet been invented. To assume that matching on zero enables one to avoid dominance amounts to saying that there is no and cannot in principle be dominance.

We compare allocations according to the lexicographic Pareto criterion, which modifies the standard Pareto criterion to prioritize dominance avoidance. Let $\mathcal{D}(x)$ denote the set of dominated agents at allocation x. An allocation x is **lexicographically Pareto preferred** (or, simply, **LP-preferred**) to allocation x' if

1. $\mathcal{D}(x) \subsetneq \mathcal{D}(x')$ or

2. $\mathcal{D}(x) = \mathcal{D}(x')$ and $(u(x_i))_{i\in\mathcal{I}} > (u(x'_i))_{i\in\mathcal{I}}$.

A market structure with a corresponding equilibrium is **LP-optimal** (or **LP-best**) if no other market structure with its corresponding equilibrium (if it exists) induces an LP-preferred allocation.[10]

Normatively, the LP-criterion reflects agents' abhorrence of dominance: reducing the set of dominated agents overrides all gains in consumption utilities. Positively, both those who are vulnerable to dominance and those who are liable to dominate may agree that dominance is undesirable; the former to avoid being dominated and the latter to avoid revolts and social unrests by the former.

The stark choice to model social status considerations as lexicographic delivers a model that is rich in predictions while being simple and tractable. The dominance criterion is powerful enough to perform status comparisons when markets are partitioned, in which case the incommensurability of prices in different submarkets rules out the total wealth as a marker for status. The dominance criterion is minimal in the sense that an agent acknowledges the loss of status only if he cannot plausibly deny that he envies another agent. Here, plausible deniability amounts to exhibiting a monotone utility function according to which the agent would not envy.

2.2 Two Types of Maximizing Behavior and Equilibria

All agents ultimately care about status but may or may not account for it when choosing consumption bundles. A **naïf** is unaware of the consequences of dominance; at a Walrasian equilibrium, each naïf chooses a bundle that maximizes his consumption utility. We refer to a Walrasian equilibrium with naïfs as **nEquilibrium**. The nEquilibrium always exists and is unique (Proposition 1).[11]

[10] That is, a market structure that has no equilibrium cannot threaten the LP-optimality of another market structure.

[11] Because agents are naive, the discontinuity in their preferences has no bearing on their choices and, so, Proposition 1 applies.

A **sophisticate** is foresighted and seeks to avoid dominance; at a Walrasian equilibrium, each sophisticate chooses a bundle that maximizes his full preferences while taking other agents' consumption bundles (and prices) as given. We refer to a Walrasian equilibrium with sophisticates as **sEquilibrium**. In contrast to nEquilibrium, sEquilibrium need not exist, because the sophisticates' preferences are discontinuous. Furthermore, sEquilibria may be multiple, thereby creating scope for coordination, a policy tool that is distinct from the choice of market structure.

3 Naïfs

Assume that all agents are naïfs. Once one recognizes the agents eventual status concerns, the textbook model no longer advocates comprehensive markets. Instead:

Proposition 3. *Comprehensive markets maximize the instances of dominance at nEquilibrium. Indeed, generically in endowments, agents' nEquilibrium consumption bundles are strictly ordered by dominance.*

Proposition 3 invites a search for market structures that improve on comprehensive markets by averting dominance. Because of the lexicographic nature of our welfare criterion, first we ask: How much dominance can be averted? The answer is that a naïf avoids dominance at an nEquilibrium for some partition if and only if he avoids dominance in autarky. Indeed, if, in autarky, one agent's endowment dominates another's, then it will continue to do so in any possible submarket and at all prices, for the former agent will be wealthier in each submarket and will consume a proportionally greater share of all goods. If, however, an agent is not dominated in autarky, then, trivially, autarky is one market structure that enables him to avoid dominance.

Having identified autarky as the limit on dominance mitigation, we next seek to raise consumption utilities. To do so, we appeal to the logic of Proposition 2 and focus on the coarsest market structures at which the same agents are dominated as in autarky. At least one of these market structures is LP-optimal; an optimum must exist because the number of possible market structures is finite.

Myopic evolutionary dynamics is not guaranteed to lead to an LP-optimal market structure. Suppose that a society starts out in autarky, and then markets are expanded by sequentially merging any two submarkets whose merger does not increase the incidence of dominance. Such a

merger is always a weak Pareto improvement. Nevertheless, one can construct examples (e.g., Example B.1) in which the terminal (and the coarsest) market structure would not be LP-optimal, thereby leaving room for market (re)design.[12]

4 Sophisticates

Now assume that all agents are sophisticates.

The Promise of Sophistication

At an sEquilibrium, the wealthiest agents avoid dominance simply by maximizing their consumption utilities. Those who are too poor to **target** (ie., match another agent's consumption of some good to avoid being dominated by that agent) cannot avoid dominance; these agents, too, simply maximize their consumption utilities. The remaining, moderately wealthy, agents avoid dominance by targeting some good or goods. Does the sophisticates capacity to resist dominance obviate repugnance? In particular (with spoilers in brackets),

1. May sophistication avert dominance when repugnance cannot? [səʎ]
2. Can sophistication and repugnance be substitutes? [səʎ]
3. Can sophistication and repugnance be complements? [səʎ]
4. With sophisticated agents, does the room for protection (i.e., equilibrium selection) remain even if repugnance can be deployed? [səʎ]

We answer these questions in a series of examples, before moving to some of the general features of sEquilibria.

In Example 1, Bob is endowed with less of each good than Alice is. As a result, no market structure would rescue a naive Bob from dominance; repugnance has no value. If sophisticated, however, he can target Alice's consumption of one of the goods and avoid dominance. Thus, sophistication averts dominance when repugnance cannot, which answers question 1 in the affirmative.

[12] In such examples, evolutionary dynamics arrives at what Ely (2011) calls a kludge.

Example 1 (Sophistication averts dominance)**.** Let

$$\alpha = (1,2) \qquad \text{and} \qquad \omega = \begin{pmatrix} 2 & 2 \\ 1 & 1 \end{pmatrix}.$$

For every market structure, the unique nEquilibrium has each agent consume his endowment and agent 2 (Bob) dominated by agent 1 (Alice). With comprehensive markets, there exists an nEquilibrium, denoted by (p, x), in which $p = (4, 5)$, and agent 2 avoids dominance by matching agent 1's consumption of good 1:[13]

$$x = \begin{pmatrix} \frac{3}{2} & \frac{12}{5} \\ \boxed{\frac{3}{2}} & \frac{3}{5} \end{pmatrix}.$$

△

Example 2 illustrates substitutes. Sophistication and repugnance are **substitutes** if the partition that is LP-best for sophisticates is coarser than the partition that is LP-best for naïfs. In the example, a naive Bob sells the good that, had he kept it, would have enabled him to avoid being dominated by Alice. Either sophistication or a trade restriction in that good can preclude Bob from the self-destructive sale. Thus, Example 2 answers question 2 in the affirmative.

Example 2 (Sophistication substitutes for repugnance)**.** Let

$$\alpha = (1,2) \qquad \text{and} \qquad \omega = \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}.$$

With comprehensive markets, agent 2 (Bob) is dominated by agent 1 (Alice) at the nEquilibrium but not at the unique sEquilibrium $(p, x) = ((1,2), \omega)$. At allocation x, no agent is dominated; comprehensive markets are LP-best when the agents are sophisticated. Alternatively, the same allocation x can be sustained at the nEquilibrium when good 1 cannot be traded. △

Example 3 illustrates complements and protection. Sophistication and repugnance are **complements** if any partition that is LP-best for sophisticates is finer than any partition that is LP-best

[13] A boxed entry of a matrix identifies an agent and a good that he targets.

for naïfs. Recall that **protection** consists in coordinating agents on an sEquilibrium with superior welfare properties. Protection comprises norms and laws that encourage agents to identify status with, and, so, target, some goods rather than others.

In Example 3, just as in Example 1, Bob is endowed with less of each good than Alice is, so no market structure precludes dominance when Bob is naïve. By contrast to Example 1, however, a sophisticated Bob is too poor to afford to match Alice's consumption of any good when markets are comprehensive; sophistication alone is not enough to avoid dominance. Repugnance can help sophisticated Bob, however, because—we assume—he is not as far behind Alice in his endowment of some goods as others. The role of repugnance, then, is to circumscribe a submarket in which, at least at some sEquilibrium, Bob can afford to match Alice's consumption of some good. The role of protection is to coordinate the agents on the sEquilibrium at which Bob can afford to match by raising the relative price of the good that he matches, thereby motivating Alice to consume less of it. Thus, Example 3 answers questions 3 and 4 in the affirmative by showing that sophistication and repugnance can be complements and that protection can be indispensable even if repugnance can be deployed.

Example 3 (Sophistication and protection complement repugnance)**.** Let

$$\alpha = (6,7,7) \qquad \text{and} \qquad \omega = \begin{pmatrix} 116 & 58 & 58 \\ 2 & 31 & 31 \\ 2 & 31 & 31 \end{pmatrix}.$$

With comprehensive markets, agent 2 (Bob) and agent 3, if naïve, are dominated by agent 1 (Alice) for all market structures, and, so, comprehensive markets are LP-best when the agents are naïve. Sophistication alone is of no avail: with comprehensive markets, the unique sEquilibrium coincides with the nEquilibrium, as can be checked.

When complemented by repugnance, however, sophistication precludes dominance. Indeed, let $\mathcal{P} = \{\{1\},\{2,3\}\}$. There are four sEquilibria. In one, agent 2 targets good 2, agent 3 targets

good 3, the prices are $p = (1, 1, 1)$, and the allocation is[14]

$$x = \left(\begin{array}{c|cc} 116 & 58 & 58 \\ 2 & \boxed{58} & 4 \\ 2 & 4 & \boxed{58} \end{array}\right).$$

In another sEquilibrium, agents 2 and 3 both target good 2, the prices are $\hat{p} = (1, 29, 11)$, and the allocation is

$$\hat{x} = \left(\begin{array}{c|cc} 116 & 40 & 105\frac{5}{11} \\ 2 & \boxed{40} & 7\frac{3}{11} \\ 2 & \boxed{40} & 7\frac{3}{11} \end{array}\right).$$

The remaining two sEquilibria either flip the roles of agents 2 and 3 in equilibrium (p, x) or flip the roles of goods 2 and 3 in equilibrium $(\hat{p}, \hat{x})$. Allocation $\hat{x}$ Pareto dominates allocation x and is LP-best when the agents are sophisticated. Because allocation $\hat{x}$ cannot be supported by any partition as a unique sEquilibrium outcome, protection is indispensable. △

Example 3 confirms that none of the policy instruments that we consider is redundant. If one believes social norms to be powerful enough to proscribe certain trades (repugnance), then surely they should be strong enough to coordinate sophisticated agents on an equilibrium (protection).

The Emergent Status Goods

When he targets, a sophisticate effectively selects a **status good**, his target. Will all agents who target target the same good? If they do, we call such an nEquilibrium **pooling**. If, instead, agents target at least two different goods, we call such an sEquilibrium **separating**. If no good is targeted, the sEquilibrium is **nontargeting** and coincides with the nEquilibrium.

Which goods make likely targets? Proposition 4 suggests that status goods are the "least liked" ones.

Proposition 4. *Suppose that markets are comprehensive. Then, in each sEquilibrium, the wealthiest agents maximize their consumption utilities, as do those who are too poor to target any good. The remaining agents*

[14] Vertical lines partition the matrix to reflect the goods partition into submarkets.

target the wealthiest agents' consumption of the good or goods whose consumption weights are the smallest in their submarket.

Intuitively, an agent who targets prefers to do so at the lowest cost. Because the wealthiest agents spend the least on the goods with the lowest consumption weights, these goods are the likely targets.

Concerned with comprehensive markets, Proposition 4 admits just one way in which separating equilibria may emerge: distinct goods share the lowest consumption weight and are targeted by different agents. This scenario is void when consumption weights are generic. When markets are noncomprehensive, separating equilibria may emerge in two more ways: (i) distinct agents target in distinct submarkets; (ii) the same agent targets in distinct submarkets.[15]

Proposition 4 does not fully characterize sEquilibria when markets are comprehensive. For one, no sEquilibrium may exist, a situation to which we shall return. If an equilibrium does exist, it may be nontargeting. When targeting does occur, the least liked goods are targeted, but Proposition 4 does not say by whom and in which submarkets; different sets of agents may target in different sEquilibria.

The Welfare Implications of Sophistication

Does sophistication make agents better off? Taking the prices and others' choices and sophistication (or its lack) as given, becoming sophisticated benefits a particular agent as long as an sEquilibrium exists. If all agents turn from naifs into sophisticates, however, a Pareto improvement is not guaranteed. Targeting by some agents affects equilibrium prices and may leave other agents less wealthy and worse off. Even an LP-improvement is not guaranteed; Example 4 illustrates how universal sophistication may render a formerly undominated agent dominated.

[15] Case (ii) prevails even for generic consumption weights if an agent finds it cheaper to target other agents' consumption of distinct goods than to consume a maximal amount of some other good (Example B.2).

Example 4 (Universal sophistication creates new instances of dominance)**.** Let

$$\alpha = (4, 5) \qquad \text{and} \qquad \omega = \begin{pmatrix} 1350 & 18 \\ 0 & 1098 \\ 0 & 1098 \\ 0 & 1098 \\ 0 & 1098 \\ 612 & 0 \\ 612 & 0 \\ 612 & 0 \\ 612 & 0 \\ 612 & 0 \end{pmatrix}.$$

With naive agents, comprehensive markets are LP-best and induce the nEquilibrium with

$$p = (4, 5) \qquad \text{and} \qquad x = \begin{pmatrix} 610 & 610 \\ 610 & 610 \\ 610 & 610 \\ 610 & 610 \\ 610 & 610 \\ 272 & 272 \\ 272 & 272 \\ 272 & 272 \\ 272 & 272 \\ 272 & 272 \end{pmatrix},$$

at which agents 6, 7, 8, 9, and 10 are dominated. Once all agents turn into sophisticates, the unique sEquilibrium prevails:

$$\hat{p} \approx (2.5, 1) \qquad \text{and} \qquad \hat{x} \approx \begin{pmatrix} 603 & 1862 \\ 198 & 610 \\ 198 & 610 \\ 198 & 610 \\ 198 & 610 \\ \boxed{603} & 22 \\ \boxed{603} & 22 \\ \boxed{603} & 22 \\ \boxed{603} & 22 \\ \boxed{603} & 22 \end{pmatrix},$$

at which the dominated agents are 2, 3, 4, and 5, none of whom was dominated at the nEquilibrium. △

We conclude the discussion of the welfare implications of sophistication by examining an agent's unilateral transformation from a naif into a sophisticate in the light of sEquilibrium nonexistence. Because sophisticates maximize a preference relation that is discontinuous, sEquilibrium need not exist. This nonexistence reflects the **treadmill effect**: by attempting to target a good, agents may drive up its price so much that they can no longer afford to target it.[16] For all preferences and for all market structures except for autarky, one can find an endowment profile such that no sEquilibrium would exist. Nonexistence is not nongeneric, as Figure 4.1 illustrates.

Suppose we were to declare nonexistence pessimal: any market structure in which no equilibrium exists is worse than any market structure in which an equilibrium exists. Under this interpretation, one may observe **immiserizing sophistication**: a single agent who gains sophistication is worse off if his sophistication leads to equilibrium nonexistence.[17] Example 5 illustrates.

[16] Formally, the aggregate excess demand has a discontinuity at the price at which an agent spends his entire wealth on the targeted good.

[17] Immiserizing sophistication echoes the immiserizing growth paradox of the textbook pure-exchange economy.

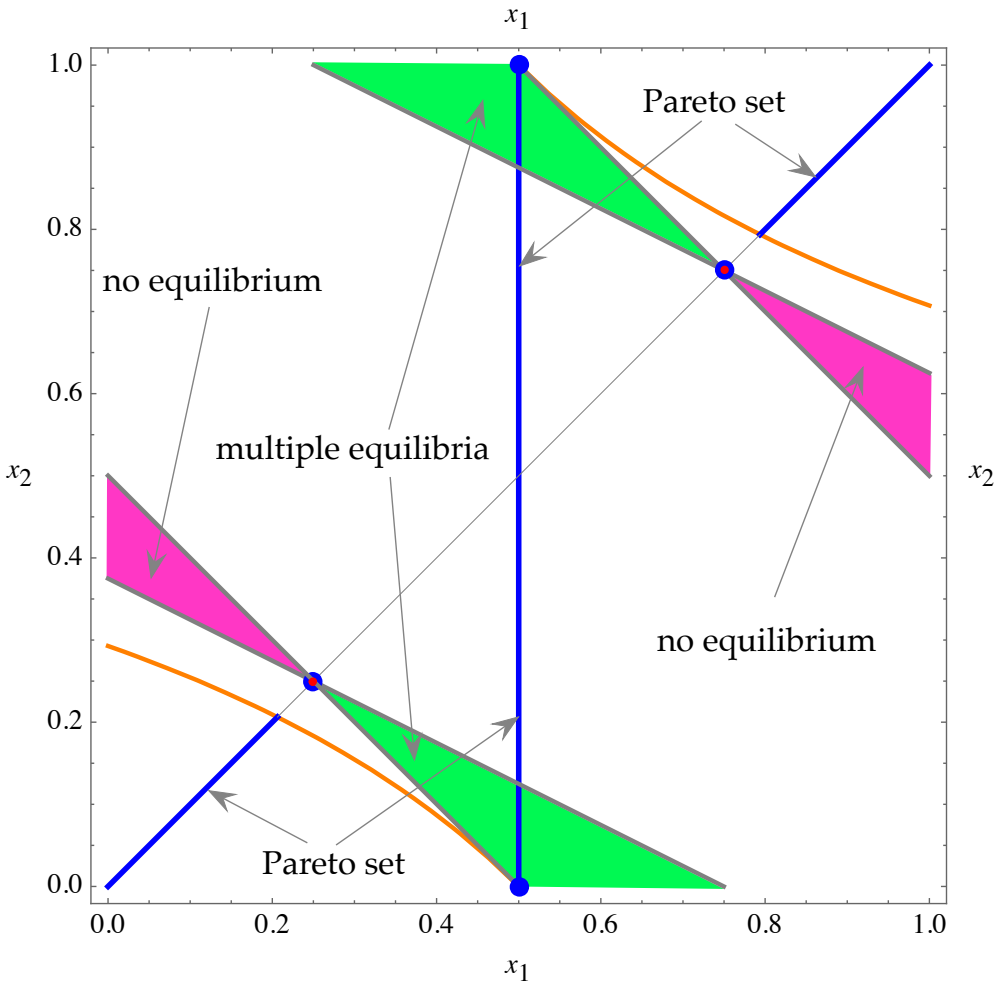

Figure 4.1: An Edgeworth box economy with sophisticates, $\alpha = (1, 2)$, and the aggregate endowment $(1, 1)$. A unique sEquilibrium exists from all endowments profiles except those labeled "no equilibrium" or "multiple equilibria."

Endowments	Naïfs	Sophisticates
proportional	comprehensive	
specialized	autarky	comprehensive

Table 4.1: Dominance-minimizing market structures.

Example 5 (Immiserizing sophistication)**.** Let

$$\alpha = (1, 2) \qquad \text{and} \qquad \omega = \begin{pmatrix} 30 & 18 \\ 0 & 12 \end{pmatrix}.$$

Markets are comprehensive. The unique nEquilibrium is

$$p = (1, 2) \qquad \text{and} \qquad x = \begin{pmatrix} 22 & 22 \\ 8 & 8 \end{pmatrix}.$$

This nEquilibrium is not sEquilibrium, however, because agent 2 is sufficiently wealthy to match agent 1's consumption of good 1 at prices p. Therefore, at any sEquilibrium, agent 2 must target some good. Because $\alpha_1 < \alpha_2$, Proposition 4 implies that good 1 must be targeted, split equally between the two agents. For agent 1 (who is so wealthy as to optimally act naively) to be willing to split, the supporting prices must be $\hat{p} = (6, 5)$, as can be verified. At these prices, however, agent 2 can no longer afford to target. As a result, no sEquilibrium exists when markets are comprehensive. △

Because the nonexistence of sEquilibrium in Example 5 is independent of agent 1's sophistication, the example also illustrates agent 2's immiseration as he alone gains sophistication.

A Case for Sophistication and Comprehensive Markets

LP-optimal market structures depend delicately on endowments. More can be said about the two stylized economies, characterized by their endowment types:

Proportional For each agent i, there exists a positive coefficient γ_i such that $\omega_i = \gamma_i \Omega$.

Specialized $I = L$, and, for each agent i, $\omega_{ii} = \Omega_i$.

Endowments	Naïfs	Sophisticates
proportional	maximal	possibly some
specialized	none	none

Table 4.2: Corresponding amount of dominance.

Proposition 5 shows that, in the stylized economies, comprehensive markets are LP-optimal.

Proposition 5. *Generically in consumption weights and in endowments (drawn from the relevant classes),*[18]

1. *For proportional endowments,*

   (a) *When agents are naïve, any market structure, including comprehensive markets, is LP-optimal and has each agent consume his endowment; all but the wealthiest agent are dominated.*

   (b) *When agents are sophisticated, comprehensive markets minimize the instances of dominance. Each agent i with $\gamma_i \geq \min_{l \in \mathcal{L}} \{\alpha_l\} \max_{j \in \mathcal{I}} \{\gamma_j\}$ avoids dominance by consuming the same amount of the lowest consumption-weight good as the wealthiest agent does; the remaining agents are dominated.*

2. *For specialized endowments,*

   (a) *When agents are naïve, autarky is uniquely LP-optimal; no agent is dominated.*

   (b) *When agents are sophisticated, comprehensive markets are uniquely LP-optimal. Each agent avoids dominance by consuming the same amount of the lowest consumption-weight good.*

Beyond the economies of Proposition 5, one can find examples in which no sEquilibrium would exist. We prefer not to ascribe economic significance to nonexistence. The responsible discontinuity of preferences is a stylized assumption, made for tractability, not realism.[19] For this reason, we prefer to be agnostic about the welfare comparisons of market structures when no sEquilibrium exists for at least one of them.

[18] There exist nongeneric economies in which LP-best market structures are nonunique. For the clarity of exposition, the proposition suppresses such economies.

[19] We conjecture that, with continuous preferences, equilibrium can be restored by appealing to the standard techniques: introducing a continuum of agents to mitigate the nonconvexity of preferences (Noguchi and Zame, 2006).

5 Interpreting the Model

5.1 Four Interpretations of the Leading Example

We illustrate the model's descriptive power with various interpretations of our **leading example**:

$$\alpha = (2,2,1,1) \qquad \text{and} \qquad \omega = \begin{pmatrix} 84 & 0 & 0 & 0 \\ 0 & 84 & 0 & 0 \\ 0 & 0 & 84 & 0 \\ 0 & 0 & 0 & 84 \end{pmatrix}.$$

With comprehensive markets, the unique nEquilibrium has

$$p = (2,2,1,1) \qquad \text{and} \qquad x = \begin{pmatrix} 28 & 28 & 28 & 28 \\ 28 & 28 & 28 & 28 \\ 14 & 14 & 14 & 14 \\ 14 & 14 & 14 & 14 \end{pmatrix}.$$

Agents 3 and 4 are dominated at x. These are the poor agents because they are endowed with less valued goods.

With naïve agents, the unique LP-best market structure is $\{\{1,2\},\{3,4\}\}$; the associated unique nEquilibrium is

$$p' = (1,1,1,1) \qquad \text{and} \qquad x' = \left(\begin{array}{cc|cc} 28 & 28 & 0 & 0 \\ 28 & 28 & 0 & 0 \\ \hline 0 & 0 & 28 & 28 \\ 0 & 0 & 28 & 28 \end{array}\right),$$

at which no agent is dominated at x'.

With sophisticated agents, comprehensive markets are LP-best and induce four sEquilibria: two separating ones and two pooling ones. In one of the separating sEquilibria, agents 3 and 4

Interpretation	Agents	Goods 1 and 2	Goods 2 and 4
health	couples	food and shelter	healths of a husband and a wife
intertemporal	individuals	food and shelter today	food and shelter tomorrow
uncertainty	farmers	crops and livestock when dry	crops and livestock when wet
international	countries	textiles and agriculture	arts and athletics

Table 5.1: Four interpretations of the leading example.

avoid dominance by targeting goods 3 and 4, respectively:

$$\hat{p} = (12, 12, 7, 7) \qquad \text{and} \qquad \hat{x} \approx \begin{pmatrix} 28 & 28 & 24 & 24 \\ 28 & 28 & 24 & 24 \\ 14 & 14 & \boxed{24} & 12 \\ 14 & 14 & 12 & \boxed{24} \end{pmatrix}.$$

At the other separating sEquilibrium, agents 3 and 4 swap the goods they target. In one of the pooling sEquilibria, agents 3 and 4 avoid dominance by targeting good 3:

$$\tilde{p} = (6, 6, 4, 3) \qquad \text{and} \qquad \tilde{x} \approx \begin{pmatrix} 28 & 28 & 21 & 28 \\ 28 & 28 & 21 & 28 \\ 16 & 16 & \boxed{21} & 16 \\ 12 & 12 & \boxed{21} & 12 \end{pmatrix}.$$

At the other pooling sEquilibrium, agents 3 and 4 target good 4 instead. Direct calculations show that, while the pooling equilibria deliver higher utilitarian welfare, the separating ones deliver higher utility to the worst off agent. Either type of equilibrium Pareto improves on the LP-best, partitioned, market structure when the agents are naïve. So, there is room for protection, depending on the planner's preference; goods 3, 4, or both will emerge as protected.

For this leading example, Table 5.1 summarizes four interpretations, described below.

Trade in Organs

Agents are couples, each comprising a husband and a wife. Goods 1, 2, 3, and 4 are food, shelter, husband's health, and wife's heath, respectively. The first couple own a farm. The second couple own an estate. The third couple are in exceptionally robust health but for the fact that the husband

needs a type-A kidney transplant while his wife is of type B. The fourth couple are in exceptionally robust health but for the fact that the husband needs a type-B kidney transplant while his wife is of type A. The consumption utilities are such that food and shelter are more important to the agents than health.

When agents are naïve, the LP-best market structure permits the exchange of kidneys for kidneys, but not for food or shelter. In the U.S., such an exchange is implemented by means of a variation on the top trading cycles algorithm, which selects the unique Walrasian-equilibrium allocation of the submarket comprised of kidneys (Shapley and Scarf, 1974). The market structure with kidney exchange, $\{\{1,2\},\{3,4\}\}$, LP-dominates the market structure in which kidneys are nonexchangeable, $\{\{1,2\},\{3\},\{4\}\}$.

Comprehensive markets permit couples to exchange health for food or shelter, which corresponds to selling kidneys and other organs (e.g., livers) for money. When agents are sophisticated, comprehensive markets are LP-optimal and kidneys are protected, so as to select an sEquilibrium in which no agent is dominated. Protection raises the prices of kidneys relative to their nEquilibrium prices. Each agent is better off in the sophisticated society that has replaced repugnance towards trade in kidneys by the protection of kidneys.

Intertemporal Trade

Agents are individuals. Goods are food and shelter today, and food and shelter tomorrow. The first individual is endowed with food today. The second individual is endowed with shelter today. The third individual expects food tomorrow. The fourth individual expects shelter tomorrow. The agents are impatient; they discount future at the rate of 50%.

Comprehensive markets permit agents to lend and borrow. When agents are naïve, the equilibrium interest rate is $\frac{2}{1} - 1 = 100\%$, and agents 3 and 4 are dominated. Dominance is avoided at the LP-best market structure, which permits the exchange of goods within, but not across, periods; borrowing and lending are deemed repugnant. Historically, such repugnance corresponded to anti-usury laws, common to the Judaism and Christianity of the past and to the present-day Islam.

Comprehensive markets are LP-optimal when agents are sophisticated. No agent is dominated. The consumption of either or both tomorrow's goods is protected, depending on which sEquilibrium is selected. At either separating sEquilibrium, the interest rate is $\frac{12}{7} - 1 = 71\%$, lower than under naiveté. At either pooling sEquilibrium, the interest rate is $\frac{6}{4} - 1 = 50\%$ for the targeted commodity and $\frac{6}{3} - 1 = 100\%$ for the other one.[20] With sophistication, the interest rates drop because the poor start targeting future consumption, thereby raising its relative price.

Uncertainty

Agents are farmers. Goods are crops and livestock, whose quantities depend on whether the season is dry or wet. As a result, there are four state-contingent goods (goods 1 through 4): crops when it is dry, livestock when it is dry, crops when it is wet, and livestock when it is wet. The first farmer is endowed in crops when it is dry. The second farmer is endowed in livestock when it is dry. The third farmer is endowed in crops when it is wet. The fourth farmer is endowed in livestock when it is wet. A dry season is twice as likely as a wet one.

Comprehensive markets permit farmers to trade in insurance contracts. When all are naïve, farmers 3 and 4 are dominated. Dominance is avoided at the LP-best market structure, which permits the exchange of goods within, but not across, states; crop insurance and livestock insurance are deemed repugnant.[21]

When farmers are sophisticated, the insurance markets open. Consumption of crops or livestock (or both) when wet is protected.[22] Note that what is protected is consumption in the less likely state of the world, the state of an "accident" or "natural disaster."

International

Agents are countries. Goods are textiles, electronics, arts, and athletics. Country 1 excels at textiles. Country 2 excels at electronics. Country 3 excels at art. Country 4 excels at athletics. Art and athletics receive a lower consumption weight than textiles and electronics.

[20] Generally, with two or more goods each period, "the" interest rate is undefined. Instead, interest rates are good-specific. Usury prohibitions cap them all: "Thou shalt not lend upon interest to thy brother: interest of money, interest of victuals, interest of any thing that is lent upon interest" (Torah, Deuteronomy 23:19).

[21] Historically, some kinds of insurance, such as life insurance, have been regarded as repugnant.

[22] Alvin Roth ("Opposite of repugnance: Protected transactions," *Market Design* (blog), May 29, 2009, http://marketdesigner.blogspot.mx/2009/05/opposite-of-repugnance-protected.html) lists crop insurance programs among examples of protected transactions.

Comprehensive markets permit international trade in all goods; countries 3 and 4 are dominated. This dominance can be avoided by prohibiting immigration (i.e., art and athletics are nontradable), either by law or xenophobia. A better way to avoid dominance, however, is to let art be exchanged for athletics (through cultural exchanges) and let textiles be exchanged for electronics, while prohibiting exchange across the two classes of goods. With sophisticated agents, comprehensive markets avoid dominance by protecting art, athletics, or both; the relative prices of art and athletics weakly rise.

5.2 Additional Interpretations

The status externality that we emphasize speaks to situations beyond the four interpretations of our leading example:

Prostitution The prohibition of prostitution designates sexual favors as, if not nontradable, then at least exchangeable for only a small set of goods or services, such as other sexual favors. Prostitution jeopardizes the status of men (through material wealth spillovers) and of women (through looks- and character-derived wealth spillovers).

Vote selling Voters may not exchange votes for money. The democratic ideal enshrines the "one person, one vote" maxim, thereby helping prevent dominance.[23] However, nondominance does not proscribe logrolling (trading votes for votes); it would suffice for vote-derived wealths to be equalized across agents.[24]

Indentured servitude The modern liberal ethos deems some rights inalienable, as reflected by the prohibitions of slavery and indentured servitude. Equality and nontradability of human rights ensure non-dominance.

Dwarf tossing European courts restrict the employment opportunities of dwarfs. Even when all participants are better off, allowing able-bodied dwarfs to be tossed for remuneration would jeopardize the status of other dwarfs.

[23] Some U.S. states' restriction of the franchise of felons may be seen as removing their social-status protection.

[24] For instance, Weyl and Posner (2018) propose a voting mechanism that recognizes the fungibility of votes across elections while insisting on the equalization of vote-derived wealths, for reasons that echo our dominance argument: "A natural notion of fairness is to divide influence over public goods equally: give every individual an equal endowment of influence or voice measured in units of that voice."

Simony Religions gather moral goods in a single partition element so that moral transgressions may be forgiven by service, prayer, and good works but not cash payments (known as simony), thereby preventing dominance.

College courses Platform iBid at the University of Chicago Booth School of Business creates a submarket populated by numerous courses and lets MBA students bid. This submarket is distinct from the submarket populated by the goods traded for cash. By equalizing the students' endowments of tokens that can be used to bid for courses, the school prevents dominance by the materially wealthy.

Public school seats School districts tend to favor priority-based mechanisms (e.g., deferred acceptance, or DA) over comprehensive exchanges (top trading cycles, or TTC). TTC enables a student's priority ("endowment") at a popular school to "spill over" to other schools, including those at which his priority is low. With TTC, a student may have a higher chance of admission into a middling school if he has a priority at a excellent school. DA limits such spillovers.

Domestic help A taboo on extensive domestic help (e.g., live-in maids) ensures roughly egalitarian consumption of domestic chores and leisure.

Military service Universal military service ensures roughly egalitarian consumption of the combat experience and civilian life.

Hazardous occupations Hazardous occupations such as loggers, fishers, roofers, and truckers are socially acceptable. By contrast, the low-risk sale of an organ, such as a kidney or a part of a liver, is regarded by many as repugnant. The uncertainty interpretation of our model explains why. A hazardous occupation furnishes ample states of the world in which no injury occurs; its practitioner is unlikely to see his consumption dominated state by state. By contrast, selling a kidney promises a sure injury from the surgery (in addition to a small risk of serious complications), at all states, and, therefore, is more likely to be dominated.

Eugenics Commercial genetic enhancements can make the rich strong, healthy, handsome, smart, and happy and, so, dominant. This dominance is threatening and explains why genetic en-

hancements are deemed repugnant by some. Cosmetic surgery and performance-enhancing drugs are disdained for similar reasons.

6 Extensions: Two More Dominance Mitigators

The model's assumption of identical preferences is empirically false.[25] Our first extension shows that the thereat of dominance is less severe when agents' preferences differ and diminishes further as goods become plentiful (or more narrowly defined). This extension suggests a diminishing role for repugnance as societies move toward acceptance and promotion of the diversity of tastes, consistent with the recent experiences of Western cultures. Our second extension licenses repugnance to proscribe exchange not only across classes of goods but also across groups of agents. The latter proscription, which captures the observation that some goods are not exchanged across religious, class, ethnic, or cultural divides, helps mitigate dominance when no other tool is effective.

6.1 Diverse Preferences

Each agent i's Cobb-Douglas consumption utility is now parameterized by a vector $\alpha_i \in \mathbb{R}^L_{++}$ of individual consumption weights. For every market structure, nEquilibrium exists and is unique (for the usual reasons, presented in the proof of Proposition 1).

Diverse Preferences Favor Comprehensive Markets

By contrast to the case with identical preferences, with diverse preferences, merging markets may help avoid dominance, even when agents are naive. A larger submarket enables an agent to direct greater wealth towards consuming the good to which he is particularly partial in that submarket. When different agents are partial to different goods, such specialization in consumption counters dominance. Example 6 illustrates.

[25] This assumption is Occam's razor and an echo of Stigler and Becker's (1977) challenge to seek understanding, first, by appealing to the easily measurable variation in endowments, technology, and market structure, and only then entertaining the ineffable differences in tastes.

Example 6 (Merging markets decreases dominance)**.** Let

$$\alpha = \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix} \qquad \text{and} \qquad \omega = \begin{pmatrix} 20 & 20 \\ 10 & 10 \end{pmatrix}.$$

In autarky, agent 2 is dominated. With comprehensive markets, nEquilibrium

$$p = (4, 5) \qquad \text{and} \qquad x = \begin{pmatrix} 15 & 24 \\ 15 & 6 \end{pmatrix}$$

avoids dominance. △

When preferences are diverse and goods many, dominance may be avoided even if agents are naïve and markets comprehensive. Each agent is likely to have a good that he likes so much that, at the nEquilibrium, he consumes more of it than anyone else does; no one is dominated. Proposition 6 makes this point in a setting with independently and identically drawn consumption weights. In the proposition, an endowment sequence $\left(\omega^L\right)_{L=1}^{\infty}$ is uniformly bounded if there are scalars $\underline{\omega}$ and $\bar{\omega}$ with $0 < \underline{\omega} < \bar{\omega} < \infty$ such that for all $L \in \mathbb{N}$, all $l \in \{1, 2, \ldots, L\}$, and all $i \in \mathcal{I}$, $\omega_{il} \in [\underline{\omega}, \bar{\omega}]$.

Proposition 6. *Fix a uniformly bounded sequence $\left(\omega^L\right)_{L=1}^{\infty}$ of endowment matrices. Suppose that, for every L, each agent i's vector $\alpha_i^L \in \mathbb{R}_+^L$ of consumption weights is drawn uniformly at random from the probability simplex Δ^{L-1}. Then, no matter how small an $\varepsilon > 0$, there exists a sufficiently large L such that the probability that no agent is dominated at the nEquilibrium with comprehensive markets exceeds $1 - \varepsilon$.*

Remark 1. One can interpret the endowment sequence in the proposition as referring to an economy that grows as new goods are introduced, while the endowments of, and tastes for, old goods remain unchanged.[26]

Proposition 6 suggests that a society in which goods are numerous and not lumped into broad categories for the purpose of social comparisons need not resort to taboos on exchange. That is, a

[26]Formally, $L' > L$ implies $\alpha_{il}^{L'} = \alpha_{il}^{L}$ and $\omega_{il}^{L'} = \omega_{il}^{L}$ for all i and all $l \leq L$. Each α_{il}^{L} can be assumed to be drawn from the exponential distribution. Then, for any L, each agent's vector of consumption weights, once normalized, can be treated as drawn uniformly from the probability simplex.

society that is culturally liberal will also tend to be economically liberal in the sense of castigating few market transactions as repugnant.

The formal proof of Proposition 6 is in the appendix. Here is a sketch, which (for the clarity of exposition) deviates from the proposition's statement by assuming that agents' endowments and tastes are perfectly correlated: $\omega_i = \alpha_i$ for all i. At the nEquilibrium, all goods have the same price, and each agent i consumes $x_i = \alpha_i$. Then, the proposition amounts to saying that if goods are numerous, then, with probability close to one, no two agents' taste vectors can be ranked. Indeed, it is quite likely that each agent will have a good that he likes more than anyone else does. The probability that every agent has such a good would be straightforward to compute if the components of each α_i were independent, which they are not because $\sum_{l \in \mathcal{L}} \alpha_{il} = 1$. Nevertheless, with sufficiently many goods, approximate independence of a subset of the components of each α_i suffices to arrive at the proposition's conclusion.

Dominance Reversals

Diverse preferences enable a new phenomenon: dominance reversals in response to changes in market structures. With identical preferences, if Alice dominates Bob for some market structure, then there exists no market structure for which Bob would dominate Alice. This is no longer true when agents' preferences differ. Example 7 illustrates.

Example 7 (Dominance reversal)**.** Let $\alpha_{32} = 7$ and, for each remaining agent i and good l, $\alpha_{il} = 1$. Let

$$\omega = \begin{pmatrix} 400 & 40 & 40 \\ 0 & 360 & 0 \\ 0 & 0 & 360 \end{pmatrix}.$$

No agent is dominated in autarky. With partition $\{\{1,2\},\{3\}\}$, agent 1 dominates agent 2 in the nEquilibrium with

$$p = (1,1,1) \qquad \text{and} \qquad x = \left(\begin{array}{cc|c} 220 & 220 & 40 \\ 180 & 180 & 0 \\ 0 & 0 & 360 \end{array}\right).$$

With comprehensive markets, the dominance relationship reverses: agent 2 dominates agent 1 in the nEquilibrium

$$\hat{p} = (5, 8, 5) \qquad \text{and} \qquad \hat{x} = \begin{pmatrix} 168 & 105 & 168 \\ 192 & 120 & 192 \\ 40 & 175 & 40 \end{pmatrix}.$$

△

Drastic changes in market structure, such as those observed during the economic transition toward market economies (either away from the planned economies of Eastern Europe and China or away from the military law in times of war), generate much animosity. Not only do some lose while others gain, but the prevailing social hierarchy crumbles as the sets of dominant and dominated agents flip. Example 7 illustrate the challenges that a society faces as it transitions from military to civilian life if agents 1, 2, and 3 are interpreted as a pilot, a programmer, and an artist, and goods 1, 2, and 3 are aviation, information technology (IT), and art. In the military, art is not traded, and the pilot dominates the programmer. As civilians, the agents face comprehensive markets. The artist's skills are now valuable, and he indulges his strong taste in IT, which raises the price of IT relative to aviation. As a result, the programmer dominates the pilot.

Rank reversals may also explain hostility toward immigration. By indulging xenophobia, societies limit immigrants' economic and social opportunities and prevent favorable social comparisons by immigrants.[27]

Separating Equilibria Are No Longer Nongeneric

With identical preferences and generic endowments, at most one good is targeted in each submarket, so separating sEquilibria may appear anomalous, nongeneric even, when markets are comprehensive. However, separating equilibria are not nongeneric in the class of diverse preferences. Agents with diverse preferences separate naturally within a given submarket as each agent seeks to consume more of his favored good, as in Example 6. Consequently, even with identical preferences, separating sEquilibria regain significance as approximations of sEquilibria in nearby economies with slightly perturbed (diverse) preferences.

[27] Xie, Ho, Meier and Zhou (2017) document aversion to social-rank reversals when experimental subjects have opportunities to redistribute income .

6.2 Partitioning Agents

In addition to exchange across submarkets of goods, repugnance may attach to exchange across certain groups, or **cliques**, of individuals. Some instances of this latter kind of repugnant exchange go by the name of **cultural appropriation**. In American culture, the epithet stigmatizes caucasians who "act black" by sporting afros or performing rap and blacks who "act white" by zealously seeking academic accomplishments.[28] Other instances of repugnance are racism, as when "white" radio stations of the 1950s would deny airtime to Chuck Berry but welcome Elvis Presley, or nationalism, as when imports are condemned.

Short of attempting a comprehensive analysis of cliques, we show that no logical relationship between goods partitions and agent partitions exists (Examples 8 and 9). Furthermore, joint application of both kinds of partitions may be necessary to induce allocations unattainable by either type of partition alone (Example 10). Finally, Example 10 shows that it may be optimal to make only some transactions between cliques taboo. In all three examples, agents are naive.

Submarkets vs. Cliques

Example 8 shows that submarkets do not obviate cliques and Example 9 shows the converse.

Example 8 (Cliques improve on submarkets)**.** Let

$$\alpha = (1,1) \qquad \text{and} \qquad \omega = \begin{pmatrix} 24 & 12 \\ 24 & 0 \\ 0 & 24 \end{pmatrix}.$$

[28] So strong is the opposition to cultural appropriation that three Canadian editors lost their jobs in May 2017 while defending it (Malik, Kenan, "In Defense of Cultural Appropriation," *The New York Times*, June 14, 2017). A typical charge—here, against Miley Cyrus—goes like this: "Her famously cavalier borrowing of black culture, on songs like "We Can't Stop," from her 2013 album, "Bangerz," or Mike WiLL's "23," on which she raps ("I'm naughty by nature, I'm like hip-hop hooray"), is especially troubling to consider now. As Zeba Blay pointed out on the Huffington Post, Cyrus's casual trying-on and discarding of black culture is a function of extraordinary privilege. That she has essentially scrubbed her music and image of any hints of the hip-hop and R.&B. she once lauded and imitated makes her previous embrace of those genres feel disingenuous, if not sinister." (*The New Yorker*, May 26, 2017, https://www.newyorker.com/culture/cultural-comment/miley-cyruss-creepy-return-to-wholesomeness.) The social stigma that attaches to blacks and Hispanics "acting white" is documented by Roland G. Fryer (see, e.g., Fryer, Roland G., *EducationNext*, Winter 2006, Vol. 6, No. 1, http://educationnext.org/actingwhite/).

At the nEquilibrium with comprehensive markets and no cliques,

$$p = (3,4) \qquad \text{and} \qquad x = \begin{pmatrix} 20 & 15 \\ 12 & 9 \\ 16 & 12 \end{pmatrix},$$

agents 2 and 3 are dominated. The only alternative goods partition, autarky, LP-improves on comprehensive markets and ensures that no agent is dominated. One can improve on autarky, however, by partitioning agents instead of goods. In particular, the restriction that no goods be exchanged across cliques $\{1\}$ and $\{2,3\}$ induces the nEquilibrium,[29]

$$\begin{matrix} p_{\{1\}} = (1,2) \\ p_{\{2,3\}} = (1,1) \end{matrix} \qquad \text{and} \qquad \hat{x} = \left(\begin{array}{cc} 24 & 12 \\ \hline 12 & 12 \\ 12 & 12 \end{array}\right),$$

where $p_{\{1\}}$ and $p_{\{2,3\}}$ are the price vectors faced by cliques $\{1\}$ and $\{2,3\}$, respectively.[30] At this equilibrium, no agent is dominated, while some gains from trade are reaped. △

Example 9 (Submarkets improve on cliques)**.** Let

$$\alpha = (1,1,1) \qquad \text{and} \qquad \omega = \begin{pmatrix} 12 & 0 & 24 \\ 12 & 12 & 24 \end{pmatrix}.$$

At the nEquilibrium with comprehensive markets and no cliques,

$$p = (2,4,1) \qquad \text{and} \qquad x = \begin{pmatrix} 8 & 4 & 16 \\ 16 & 8 & 32 \end{pmatrix},$$

agent 1 is dominated. Proscribing all trade between cliques $\{1\}$ and $\{2\}$ induces autarky, which LP-improves on the no-clique market by averting dominance. The outcome of the agent partition can be further LP-improved upon by instead partitioning goods, into submarkets $\{1\}$ and $\{2,3\}$,

[29] Horizontal lines demarcate exchanges that cannot occur across cliques.

[30] The definition of nEquilibrium is extended to situations in which some agents cannot trade some or all goods with some other agents in an obvious way. Cliques may face different prices to make sure that markets for relevant goods clear within cliques.

which induces the nEquilibrium

$$\hat{p} = (1, 4, 1) \qquad \text{and} \qquad \hat{x} = \left(\begin{array}{c|cc} 12 & 3 & 12 \\ 12 & 9 & 36 \end{array}\right),$$

at which no agent is dominated, and some gains from trade are reaped. △

Cultural Appropriation

We now allow goods to relate to cliques in one of two ways. **Cultural goods** can be exchanged within cliques, never across. **Universal goods** can be exchanged freely both within and across cliques. Cultural appropriation is operationalized as proscribed (and, so, repugnant) exchange of cultural goods across cliques. Example 10 explains how the coexistence of cultural and universal goods can be LP-optimal, consistent with the casual observation of modern societies.

Example 10 (Coexistence of cultural and universal goods)**.** Let

$$\alpha = (1, 1, 1, 1) \qquad \text{and} \qquad \omega = \begin{pmatrix} 0 & 44 & 8 & 16 \\ 48 & 0 & 8 & 16 \\ 32 & 0 & 32 & 24 \\ 0 & 36 & 32 & 24 \end{pmatrix}.$$

At the nEquilibrium with comprehensive markets and no cliques,

$$p = (1, 1, 1, 1) \qquad \text{and} \qquad x = \begin{pmatrix} 17 & 17 & 17 & 17 \\ 18 & 18 & 18 & 18 \\ 22 & 22 & 22 & 22 \\ 23 & 23 & 23 & 23 \end{pmatrix},$$

all but agent 4 are dominated. Dominance can be avoided by partitioning the agents into two cliques, $\{1, 2\}$ and $\{3, 4\}$, and proscribing all exchange across the cliques (i.e., all goods are cul-

tural), leading to the nEquilibrium,

$$\hat{p}_{\{1,2\}} = (22, 24, 66, 33) \qquad \text{and} \qquad \hat{x} = \left(\begin{array}{cccc} 24 & 22 & 8 & 16 \\ \hline 24 & 22 & 8 & 16 \\ 16 & 18 & 32 & 24 \\ 16 & 18 & 32 & 24 \end{array}\right),$$
$$\hat{p}_{\{3,4\}} = (22, 24, 66, 33)$$

at which no agent is dominated. Further LP-improvement can be attained by designating only goods 1 and 2 as cultural; goods 3 and 4 are universal and can be exchanged both within and across cliques. The implied nEquilibrium,

$$\tilde{p}_{\{1,2\}} = (198, 216, 396, 396) \qquad \text{and} \qquad \tilde{x} = \left(\begin{array}{cccc} 24 & 22 & 12 & 12 \\ \hline 24 & 22 & 12 & 12 \\ 16 & 18 & 28 & 28 \\ 16 & 18 & 28 & 28 \end{array}\right),$$
$$\tilde{p}_{\{3,4\}} = (693, 616, 396, 396)$$

avoids dominance and realizes greater gains from trade than does the blanket prohibition on exchange between cliques. The nEquilibrium allocation $\tilde{x}$ is not equivalent to any goods-partition nEquilibrium and is not LP-dominated by any goods-partition nEquilibrium. The utilitarian welfare at $\tilde{x}$ is the same as with no cliques and with the goods partition $\{\{1,2\},\{3,4\}\}$, which induces the highest utilitarian welfare among all goods partitions and is not LP-comparable to $\tilde{x}$. △

To interpret Example 10, let goods 1 and 2 be hairstyles and music, and goods 3 and 4 be housing and education. Agents 1 and 2 are **hipsters**, well-endowed with artistic goods: hairstyle and music. Agents 3 and 4 are **traditionalists**, well-endowed with conventional goods: housing and education.[31] Designating all goods as cultural, avoids dominance but is suboptimal. Instead, designating only artistic goods as cultural, and the rest as universal, delivers higher welfare.

The conclusion of Proposition 6 also applies to cliques. When goods are many and preferences are diverse, there is no role for repugnance, neither toward exchange across submarkets or nor toward exchange across cliques.

[31] One could advance analogous interpretations along religious, racial, ethnic, and gender lines. For example, the Amish exchange spiritual counseling and judicial goods only within their own culture while trading food and furniture universally, both among themselves and with the English.

7 Synthesis

Much of progress, both economic and social, is externality management, which consists in identifying, condemning, and mitigating externalities. We focus on a social-status externality, mitigated by repugnance and protection. Anecdotally, the repugnance norms that derive from this externality appear to be in historic (albeit nonmonotone) decline, a point to which we return. Conventional, non-status, externalities account for the cases of repugnance that remain and multiply: child labor (externalities on future selves), contract killings and sex for promotion (externalities on the final consumer), dog fights and fur coats (externalities on animals), and violation of occupational licensing (externalities on the poorly informed). These conventional externalities and their mitigation are well understood and are not our focus.

While universal among humans and animals, status concerns may be suspended when survival is at stake. Starving Chinese peasants during Mao's Cultural Revolution countenanced the sale of children, with hairpin feathers deployed in lieu of "for sale" signs. The sale of children was not repugnant even though conducive to dominance. Formally, contrary to our model, consumption utility trumped status concerns. As a result, comprehensive markets were optimal (Proposition 2); no transaction was repugnant.

With subsistence secure, individuals are willing to sacrifice consumption to preserve favorable comparisons. A simple way to do so is to adopt taboos that designate some goods as nontradable. Over time, such goods have become access to emergency healthcare and basic education, one's children and organs, and the right to cast a vote in elections. Related are monogamy, prohibitions on selling one's reproductive services, and the requirements to "consume" the mandatory military and the jury services. In addition to making a good nontradable, its endowments can be also destroyed in search of endowment equalization; celibacy, asceticism, penitence, and dietary vows are examples. In a similar vein, sumptuary laws in Western Europe and Russia's clothing reforms under Peter the Great prescribed different fashions to different social classes so that rich merchants would not outdress nobility.[32]

Over time, policy makers and market designers have been moving beyond nontradables and sumptuary laws by discovering ways to expand the scope of markets without jeopardizing social

[32]Numerous examples of sumptuary laws can be found in the eponymous Wikipedia entry: https://en.wikipedia.org/wiki/Sumptuary_law.

status. A prime example is the exchange of kidneys of different types in the U.S. and Europe. Furthermore, school vouchers are ubiquitous in Chile, the United State last drafted soldiers nearly a half-century ago, and the United Kingdom and Ireland recognize surrogacy contracts, as do several U.S. states, while class-based dress codes have become passé. This expansion of markets is consistent with the insight that, to avoid dominance, it may suffice to equalize expenditure on classes of goods, not necessarily on individual goods (Sections 3 and 5).

While some disappearances of repugnance are enabled by clever market design, others are due to dominance avoidance thanks to the increasing incidence of sophistication, which may come from experience or from the public education that emphasizes the welfare consequences of social status. With sophisticates, markets tend to become more comprehensive; repugnance ebbs away (Proposition 5). Multiple equilibria emerge, to which policy makers respond by attempting to coordinate the society on equilibria that protect consumption of certain goods, such as locally-sourced produce and fair-trade coffee, which acquire protected status in part because they have low consumption weights and, so, are relatively inexpensive (Proposition 4).

Another secular tendency in Western societies has been the rise of the socially liberal ethos, which encourages the diversity of preferences. Concurrently, new goods have been emerging through innovation, international trade, and refined distinctions among status-relevant categories. For example, the number of Olympic sports has more than tripled, from nine at the inaugural games in 1896 to thirty-three planned for the 2020 games. Moreover, each sports encompasses multiple subcategories distinguished by gender, weight, style, or distance. Similarly with dress, niche styles like hipster, goth, eccentric professor, and starving artist have been replacing broad occupational uniforms, such as a suit of clothes and a tie. These liberal tendencies obviate repugnance (Proposition 6).

To summarize, we discern an arc toward more comprehensive markets and attribute it to better management of social-status externalities.[33] Two theoretical considerations conspire against a monotone fall in repugnance. Burgeoning sophistication may render formerly impotent mar-

[33]While a comprehensive empirical argument for the decline in status-motivated repugnance would require a monograph akin to Pinker's (2011) and (2018) discourses on the secular decline in violence and on social progress, Elías, Lacetera, Macis and Salardi (2017) provide suggestive evidence. They look at over a hundred countries between years 1960 and 2015 and document a secular tendency toward more permissive legislation on prostitution and gestational surrogacy.

ket partitions effective at preventing dominance (Example 3). Furthermore, mitigation of hitherto unrecognized preexisting dominance concerns may temporarily increase repugnance.

8 Prior Art

We now place our study in the context of objections to unfettered trade made by (in no particular order) philosophers, social psychologists, and economists.

8.1 Philosophy

Our model has direct counterparts to four objections that anti-commodification philosophers raise against voluntary exchange:[34]

Paternalism Markets may encourage individuals to make self-destructive choices. In our model, at nEquilibrium, a naïf whose endowment is undominated may voluntarily purchase a bundle that would lead him to be dominated by the wealthy and, hence, to be worse off. In this case, a market partition would be paternalistically motivated, to protect the naïf from himself.

Exploitation Markets may encourage the strong to exploit the vulnerable. In our model, at nEquilibrium, the poor are exploited by the rich who come to dominate them in the following sense. A good that the poor would have targeted at sEquilibrium is cheaper, or "mispriced," at the nEquilibrium. This mispricing enables the rich to consume much of this good and dominate the poor, thereby "exploiting" the poor's ignorance of their own preferences.

Misallocation Misallocation arises when markets lead to wealth spillovers and, thus, to unequal consumption of all goods, not just those distributed especially unequally. Market partitions contain such spillovers.

Harm to Others A voluntary exchange between two parties may harm a third party. (A market in slaves, who have no say in whether they are bought or sold, is an example.) This externality argument is familiar to the economist and takes a special form in our model: by trading with

[34] We adopt the taxonomy of objections due to Brennan and Jaworski (2015), who also provide a careful review of the anti-commodification literature.

Bob, Alice may come to dominate a third party, Carol. There is nothing about Walrasian markets per se that makes the exchange harmful to Carol; the same exchange executed by a social planner would be as bad. One can condemn market only if one takes "market" to mean a submarket that are so comprehensive as to permit dominance.[35]

Two remaining common philosophical objections are outside our model's scope:

Corruption Markets corrupt preferences by making one selfish and reinforcing negative stereotypes. We do not model changes in preferences. To the extent that the market changes individual preferences, as an empirical matter, it appears simply to make them more diverse, which is socially beneficial, according to our model.

Semiotic Some market exchanges may inherently affront. Participation reveals private information and amounts to offensive speech.[36]

From a benevolent planner's standpoint, combatting dominance resembles combatting inequality. If one agent dominates another, then the two are clearly unequal. Specific egalitarianism, which equates agents' consumption of some good, also averts dominance.[37] While aversion to inequality is often not explicit in philosophers' objection to commodification, we view it as operating implicitly. Debra Satz corroborates:[38]

> It often seems that inequality, not the corruption of value, drives our response to particular markets. [...] What is the difference between an ordinary market and this trading system in which people barter organs on behalf of loved ones? The morally salient difference is that, in the kidney exchange system, people could not use money to get access to an organ: the standing of rich and poor were thereby equalized. That people respond very differently to kidney chains and kidney markets suggests that there is an egalitarian intuition behind the prohibition on organ trading, not a view about the meaning of body parts.

[35] Brennan and Jaworski (2015) single out another objection to markets: rights violations, such as a market in slavery or child pornography. We view this objection as a special case of "harm to others."

[36] For instance, a market for surrogate mothers offends by saying: "A woman is but an incubation machine."

[37] The term "specific egalitarianism" is Tobin's (1970).

[38] Satz, Debra. "Response: The Egalitarian Intuition." *Boston Review*, May/June 2012: http://bostonreview.net/archives/BR37.3/ndf_debra_satz_markets_morals.php.

> Indeed, the central debates in our society today about the place of the market - debates about health care, education, and political influence - do not so much raise questions about the meaning of these specific goods as about inequality.

Scanlon (2017) observes that inequality of consumption breeds inequality of status and, like us, ascribes first-order importance to the latter. Our view of status further resonates with Adam Smith's denouncement of a society in which some are so poor as to be unable to appear in public without shame (Smith, 1776). One way to operationalize shame ("a condition of humiliating disgrace or disrepute," according to the Merriam-Webster dictionary) is to say that Bob is ashamed if it is common knowledge that he envies Alice. Bob's envy is common knowledge if, no matter what increasing utility function he were to have, he would prefer Alice's bundle to his; he cannot save face by lying about his preferences (as long as they are increasing). This notion of shame coincides with our notion of dominance.

Our emergent partition of goods into submarkets echoes Walzer's (1983) spheres of justice: "[...] no citizen's standing in one sphere or with regard to one social good can be undercut by his standing in some other sphere or with regard to some other good." These spillovers across spheres are prevented by "blocked exchanges," our repugnant transactions. Walzer's goal—as ours—is to avoid dominance, thereby attaining what he calls "complex equality."

Our approach to modeling submarkets differs from Walzer's approach to spheres, which are fixed and exogenous to the problem of justice, as are the mechanisms that allocate goods within each sphere. By contrast, our theory prescribes the composition of submarkets and conceives of situations in which justice calls for no submarkets at all. Similarly, instead of appealing to tradition and culture to legitimize exchange mechanisms within submarkets, we let these mechanisms to be Walrasian, for their simplicity and efficiency properties. Were we to entertain alternative exchange mechanisms, our LP-criterion would correctly compare outcomes regardless of the mechanism.

Broadly, the anti-commodification literature is special in two respects: it tends not to recognize trade-offs between normative desiderata, such as equality and individual welfare, and it tends to view markets as a binary, on/off, proposition. By pursuing a slightly more nuanced, partition-based, view of markets, we escape the anti-commodification conclusion that markets ought to

be condemned. In that, we reinforce the importance of factoring in the details of the economic environment, as emphasized by Brennan and Jaworski (2015).

8.2 Social Psychology

Haidt (2012) counts five universal moral themes (care, fairness, community, authority, and purity) that are co-opted, differently by different cultures, to shape the norms of repugnance. While the themes themselves are biologically fixed, the weight that each theme receives when determining the repugnance of a transaction varies across cultures and time. Repugnance norms are thus malleable, as our model assumes.

Persuasive evidence that a typical individual loathes being dominated but does not enjoy dominating quite as much is provided by Card, Mas, Moretti and Saez (2012): "We find an asymmetric response to the information about peer salaries: workers with salaries below the median for their pay unit and occupation report lower pay and job satisfaction, while those earning above the median report no higher satisfaction." Speaking of male baboons, Gesquiere, Learn, Simao, Onyango, Alberts and Altmann (2011) suggest a mechanism: "[. . .] being at the very top of a social hierarchy may be more stressful than being immediately below because of physiological costs of life at the top." Dominance comes with increased metabolic rate and added stress, which damages the immune system, thereby offsetting the benefits of dominance.

8.3 Economics

That repugnance is an effective constraint on trade is emphasized by Roth (2007). We also borrow Roth's usage of "protected transaction" as the opposite of "repugnant transaction."[39]

The idea that restrictions on trade may improve welfare is well-understood by economists. It is easy to write down a two-agent two-good pure exchange economy in which a negative externality causes autarky to Pareto dominate Walrasian trade.[40] Our contribution is to propose a particular externality—the status externality—that illustrates in a simple exchange economy some of the

[39]See Roth, Alvin. "Opposite of Repugnance: Protected Transactions." Market Design (blog), May 29, 2009, http://marketdesigner.blogspot.mx/2009/05/opposite-of-repugnance-protected.html.

[40]In a similar vein, exogenously incomplete markets justify further, endogenous, restrictions on markets. Newbery and Stiglitz (1984) provide a classical example, in which trade restrictions facilitate otherwise inaccessible insurance arrangements.

objections raised by anti-commodification philosophers. The ego-defense mechanism provided by the self-serving comparisons of the kind that drive our status externality has been used to model political behavior by Penn (2016).

Our analysis consists in correcting one imperfection, the status externality, with another imperfection, partitioned markets.[41] The alternative, adding the missing market for status, encounters two problems. Unlike, say, pollution, social status in our model, with self-serving binary comparisons of entire consumption bundles, cannot be reduced to a one-dimensional "bad" that would then be taxed. Moreover, even if a status "bad" could somehow be defined for taxation purposes, naïfs are supposed not to understand this definition. By assumption, they do not think about social status until it is too late. Even sophisticates may gloss dominance avoidance motives with other sentiments, just as peahens fail to recognize the sexual selection purpose of their interest in elaborate tail plumage. As long as status motives remain shrouded, a satisfactory market solution will remain elusive, as successful as a campaign for peacocks to all halve their tail lengths.

9 Concluding Remarks

We conclude by highlighting some of the model's assumptions.

1. The restriction of the consumption preferences to Cobb-Douglas requires any two goods to be related in one of two ways: as perfect substitutes or with the unitary elasticity of substitution. It is therefore natural to interpret a good in the model as an aggregate category of goods in practice.[42] When incorporating a new good, one should assess whether the good is distinct enough from the existing alternatives to be viewed as a separate argument in the utility function.

2. For analytical convenience and to accentuate the role of social comparisons, we postulate that agents lexicographically prioritize dominance avoidance. A more realistic specification would recognize a trade-off between dominance and consumption utility. Furthermore, at least to some extent, individuals care about how many others dominate them and in how

[41] In the same spirit, Malamud and Rostek (2017) correct one imperfection, market power, with another imperfection, partitioned markets.

[42] This interpretation suggests, consistent with introspection, that one would not avoid dominance by hoarding light bulbs or safety pins.

many goods, so one would expect dominance to be a matter of degree. Extensions in this vein may begin with continuous preferences as formulated by Fehr and Schmidt (1999) and Penn (2016). Goods may also differ in conspicuousness and, thus, potential status salience. Ostentatious dominance avoidance may provide better ego protection that obscure actions.[43]

3. Trade restrictions in the model are dichotomous: goods may be exchanged either freely or not at all. Instead of proscribing trade outright, subtler restrictions would constrain exchange rates instead of proscribing trade outright. Elaborating the model in this way might explain the condemnation of price gouging, surge pricing, and usury, as well as the support for rent control and minimum-wage laws. Alternatively, certain goods may be traded only as bundles. For instance, watching women's beach volleyball may be socially acceptable, whereas a similar amount of nudity if unbundled from sport, say, in a strip club, may carry social opprobrium.

4. We assume that individuals compare themselves to all others. In practice, comparison are specific rather than universal. Individuals envy slightly wealthier neighbors while cheering Bill Gates and Elon Musk. Restricting comparison groups—say, to those with whom one interacts socially or through trade—would reduce the instances of harmful dominance.[44]

A Appendix: Omitted Proofs

Proof of Proposition 1

An equilibrium exists because a Walrasian equilibrium in each submarket exists for the standard reasons: each agent's consumption utility is strictly monotone, continuous, and concave, and he is endowed with a positive amount of at least one good.[45] The equilibrium is unique because each agent's consumption utility satisfies the gross substitutes condition. Indeed, direct computation verifies that the prices specified in the proposition induce a Walrasian equilibrium in each submarket.

[43] For instance, one may prefer to avoid dominance with a flashy car or a glossy education credential rather than a rare-stamp collection or memory of Shakespearian sonnets.

[44] The idea goes back at least to John Rawls's (1971) concept of non-comparing groups.

[45] In the argument, the assumptions that each agent's consumption utility is strictly monotone and that he is endowed with a positive amount of at least one good replace the common assumptions that each agent's consumption utility is weakly monotone and that his endowment of every good is positive.

Proof of Proposition 2

The unique (subject to normalization) Walrasian equilibrium price vector, $p = (\alpha_l/\Omega_l)_{l\in\mathcal{L}}$, is independent of the partition.[46] As a result, the budget constraints for the finer partition imply the budget constraints for the coarser partition; each of the latter constraints is simply obtained by adding up some of the former constraints. Therefore, each agent's consumption-utility maximization problem is weakly more restrictive—and, so, each agent is weakly worse off—with the finer partition than with the coarser partition.

Proof of Proposition 3

Because agents' consumption utilities are Cobb-Douglas, with comprehensive markets, agents' nEquilibrium consumption bundles are proportional to the aggregate endowment and, so, are strictly ordered by dominance if and only if the agents' wealths are strictly ordered. Agents' endowment profile defies strict ordering of equilibrium wealths if this profile is in the set

$$N \equiv \bigcup_{i\in\mathcal{I},j\in\mathcal{I}\setminus i} \left\{ \omega \in \mathbb{R}_+^{IL} \mid \sum_{l\in\mathcal{L}} \frac{\alpha_l \left(\omega_{il} - \omega_{jl}\right)}{\sum_k \omega_{kl}} = 0 \right\},$$

meaning that at least two agents have identical equilibrium wealths. The set N has Lebesgue measure zero in the set $\mathbb{R}_+^{IL}$ of individual endowments, which is the sense in which this set is nongeneric. Thus, generically, agents' equilibrium wealths and, therefore, consumption bundles are strictly ordered.

Proof of Proposition 4

Step 1: The wealthiest agents consume naïvely.

By contradiction, suppose that a wealthiest agent does not act naïvely. Then, by acting naïvely, he can increase his consumption utility without jeopardizing his status; no agent can afford a bundle that would dominate his.

Step 2: The agents who cannot afford to target any good consumed by the wealthiest—we call such agents "poor"—consume naïvely.

[46] This independence relies on the assumption that agents' consumption utilities are identical and Cobb-Douglas.

Because dominated by the wealthiest agent whatever he does, the poor can do no better than to consume naïvely.

Step 3: The agents who are neither the wealthiest nor poor—we shall call them middling—target the wealthiest agent's consumption of one and only one good.

Normalize $\sum_{l \in \mathcal{L}} \alpha_l = 1$. Fix any sEquilibrium (p, x). Define $W \equiv \max_{i \in \mathcal{I}} \{p \cdot e_i\}$. If middling agent i's sophistication compels him to target the wealthiest agent's consumption of good l (and only of that good), then he consumes bundle

$$x_i^{(l)} \equiv \arg \max_{\tilde{x}_i \in \mathbb{R}_+^L} \left\{ u\left(\tilde{x}_i\right) \mid p_l \tilde{x}_{il} \geq \alpha_l W,\, p \cdot x_i \leq p \cdot e_i \right\},$$

where $x_{il}^{(l)} = \alpha_l W / p_l$ by convexity of the agent's problem.

Let us show that no middling agent would ever seek to consume more of any good than the wealthiest agent does. The argument is by induction. Take the wealthiest middling agent and call him agent i; his only threat of dominance comes from the wealthiest agent. By way of contradiction, suppose that, at the sEquilibrium allocation x, agent i consumes more of some good l than the wealthiest agent does. Then, by construction of $x_i^{(l)}$, $u\left(x_i^{(l)}\right) > u\left(x_i\right)$. By the strict concavity of u, one can find a $\lambda \in (0,1)$ that is sufficiently close to 1 so that agent i is undominated by the wealthiest agent when consuming the bundle $\lambda x_i + (1-\lambda)\, x_i^{(l)}$ while preferring this bundle (by Jensen's inequality) to bundle x_i, which contradicts equilibrium. Hence, agent i cannot consume more of any good than the wealthiest agent does. The inductive argument proceeds by looking at the second-wealthiest middling agent, whose only threat of dominance, again, is the wealthiest agent, and so on. In the end, no middling agent is shown to consume more of any good than the wealthiest agent does.

Because no agent consumes more of any good than the wealthiest agent does, for any middling agent i to avoid dominance, it suffices to consume the same amount of some good, say good l, as the wealthiest agent consumes, which is best accomplished by consuming bundle $x_i^{(l)}$, by construction of $x_i^{(l)}$. Bundle $x_i^{(l)}$ is such that every good but good l is consumed in smaller quantity by agent i than by the wealthiest agent. Thus, each middling agent targets exactly one good.

Step 4: Each middling agent targets a good with the lowest consumption weight.

Take any middling agent i and an arbitrary good l that he can afford to target. His consumption utility from bundle $x_i^{(l)}$ is

$$\begin{aligned} v\left(x_i^{(l)}\right) &= \sum_{k\in\mathcal{L}} \alpha_k \ln x_{ik}^{(l)} \\ &= \alpha_l \ln\left(\frac{\alpha_l W}{p_l}\right) + \sum_{k\in\mathcal{L}\setminus\{l\}} \alpha_k \ln\left(\frac{\alpha_k\left(p\cdot e_i - \alpha_l W\right)}{\left(1-\alpha_l\right)p_k}\right) \\ &= \sum_{k\in\mathcal{L}} \alpha_k \ln\frac{\alpha_k}{p_k} + \alpha_l \ln W + \left(1-\alpha_l\right)\ln\frac{p\cdot e_i - \alpha_l W}{1-\alpha_l} \\ &= \sum_{k\in\mathcal{L}} \alpha_k \ln\frac{\alpha_k}{p_k} + f\left(\alpha_l\right), \end{aligned}$$

where $f\left(\alpha_l\right)$, the only term that depends on l, is defined as

$$f\left(s\right) \equiv s\ln\frac{\left(1-s\right)W}{p\cdot e_i - sW} + \ln\frac{p\cdot e_i - sW}{1-s}.$$

To show that the agent targets only the lowest-α_l good one must show that f is strictly decreasing. Differentiating,

$$\frac{\mathrm{d}f\left(s\right)}{\mathrm{d}s} = 1-\gamma+\ln\gamma, \qquad \text{where} \qquad \gamma \equiv \frac{W-sW}{p\cdot e_i - sW}.$$

From $p\cdot e_i < W$ and $p\cdot e_i \geq sW$, conclude $\gamma > 1$, which implies $1-\gamma+\ln\gamma < 0$. Thus, for any two goods l and k, $\alpha_l < \alpha_k$ implies $u\left(x_i^{(l)}\right) > u\left(x_i^{(k)}\right)$; each middling agent targets the lowest-α_l good.

Proof of Proposition 5

Normalize $\sum_{l\in\mathcal{L}}\alpha_l = 1$ and, invoking genericity, $\alpha_1 < \alpha_2 < \ldots < \alpha_L$. Recall that $\sum_{i\in\mathcal{I}}\gamma_i = 1$ and, invoking genericity, normalize $\gamma_1 > \gamma_2 > \ldots > \gamma_I$.

1. *Proportional endowments*.

   (a) *Naive agents.* For any market structure, the unique (subject to normalization) nEquilibrium prices are $p = \left(\alpha_1/\Omega_1, \ldots, \alpha_L/\Omega_L\right)$, at which each agent optimally consumes his endowment. As a result, all market structures are LP-equivalent and, so, LP-optimal. In particular, comprehensive markets are LP-optimal. Moreover, because the wealthiest

agent's endowment dominates all other agents' endowments, so does his nEquilibrium consumption.

(b) *Sophisticated agents.* Define

$$m \equiv \max \{i \in \mathcal{I} \mid \gamma_i \geq \alpha_1 \gamma_1\}. \tag{A.1}$$

i. *A lower bound on dominance.* Fix an arbitrary market structure $\{\mathcal{L}_1, \ldots, \mathcal{L}_K\}$ and a corresponding sEquilibrium (p, x), if it exists. Agent 1 is the wealthiest one in each submarket and, so, maximizes his consumption utility; on any good $l \in \mathcal{L}_k$, he spends amount

$$p_l x_{1l} = \frac{\alpha_l \sum_{s \in \mathcal{L}_k} p_s \omega_{1s}}{\sum_{s \in \mathcal{L}_k} \alpha_s} = \frac{\alpha_l \gamma_1 \sum_{s \in \mathcal{L}_k} p_s \Omega_s}{\sum_{s \in \mathcal{L}_k} \alpha_s} > \alpha_l \gamma_1 \sum_{s \in \mathcal{L}_k} p_s \Omega_s.$$

For any $i > m$, agent i's submarket-$\mathcal{L}_k$ wealth is

$$\sum_{s \in \mathcal{L}_k} p_s \omega_{is} = \gamma_i \sum_{s \in \mathcal{L}_s} p_s \Omega_s < \alpha_1 \gamma_1 \sum_{s \in \mathcal{L}_s} p_s \Omega_s \leq \alpha_l \gamma_1 \sum_{s \in \mathcal{L}_s} p_s \Omega_s,$$

where $l \in \mathcal{L}_k$ is arbitrary, and the first inequality uses $i > m$ and the definition of m, in (A.1). Thus, at sEquilibrium (p, x), no agent i with $i > m$ can afford to match agent 1's consumption of any good; agents $\{m+1, \ldots, I\}$—maybe more—are dominated.

ii. *Comprehensive markets.* We shall construct a comprehensive-markets sEquilibrium (p, x) by guessing that, at prices[47]

$$p = \left(\frac{\alpha_1 + \frac{\alpha_1}{1-\alpha_1} \sum_{i=1}^{m} \sum_{l \in \mathcal{L} \setminus \{1\}} \frac{\alpha_l}{\Omega_l} (\omega_{1l} - \omega_{il})}{\Omega_1 - \frac{\alpha_1}{1-\alpha_1} \sum_{i=1}^{m} (\omega_{11} - \omega_{i1})}, \frac{\alpha_2}{\Omega_2}, \ldots, \frac{\alpha_L}{\Omega_L} \right), \tag{A.2}$$

agents $\{2, \ldots, m\}$ match agent 1's consumption of good 1, while the remaining agents consume naively. That is, agents $\{1, 2, \ldots, m\}$ consume good 1 in the amount

$$x_{11} = \frac{\alpha_1 p \cdot \omega_1}{p_1},$$

[47] By (A.1), $m \leq (1 - \gamma_1) / (\alpha_1 \gamma_1)$, thereby guaranteeing that the price p_1 in (A.2) is positive.

while each agent $i \in \{m+1, \ldots, I\}$ consumes

$$x_{i1} = \frac{\alpha_1 p \cdot \omega_i}{p_1}.$$

Market-clearing for good 1 requires

$$m x_{11} + \sum_{i=m+1}^{I} x_{i1} = \Omega_1,$$

which can be verified to hold at the guessed prices. The guessed prices can also be verified to clear the market for each good $l \in \mathcal{L} \setminus \{1\}$:

$$\sum_{i \in \mathcal{I}} x_{il} = \sum_{i=1}^{m} \frac{\alpha_l \left(p \cdot \omega_i - p_1 x_{11}\right)}{\left(1 - \alpha_1\right) p_l} + \sum_{i=m+1}^{I} \frac{\alpha_l p \cdot \omega_i}{p_l} = \Omega_l.$$

Finally, note that, consistent with the equilibrium guess, agent m, defined in (A.1), is the least wealthy agent who can afford to target good 1:

$$\max \{i \in \mathcal{I} \mid p \cdot \omega_i \geq p_1 x_{11}\} = \max \{i \in \mathcal{I} \mid \gamma_i \geq \alpha_1 \gamma_1\} = m.$$

The verification of the conjectured sEquilibrium is thus complete.

iii. *Dominance minimization.* By part 1(b)i, for any market structure, at least agents $\{m+1, \ldots, I\}$ are dominated. By part 1(b)ii, with comprehensive markets, only agents $\{m+1, \ldots, I\}$ are dominated. So, comprehensive markets minimize the set of dominated agents.

2. Specialized endowments.

(a) *Naive agents.* Because agents' endowments cannot be ranked, no agent is dominated in autarky. We show that any nonautarkic market structure $\{\mathcal{L}_1, \ldots, \mathcal{L}_K\}$ entails dominance. For any market structure, the unique (subject to normalization) nEquilibrium price vector is $p = (\alpha_1/\Omega_1, \ldots, \alpha_L/\Omega_L)$. Hence, the wealths of any two distinct agents i and j with nonzero endowments in some submarket $\mathcal{L}_k$ are α_i and α_j, respectively, and satisfy $\alpha_j \neq \alpha_i$ by genericity. Assuming $\alpha_j > \alpha_i$, agent j dominates agent i by consuming

more of each good than agent i does in submarket $\mathcal{L}_k$ and the same zero amount in the remaining submarkets.[48] Thus, with generic consumption weights, each nonautarkic market structure involves dominance.

(b) *Sophisticated agents.* Unless markets are comprehensive, each agent's consumption utility is $-\infty$ because each agent has a submarket in which his wealth and, therefore, consumption are both zero. Therefore, to establish the LP-optimality of comprehensive markets it suffices to construct a corresponding sEquilibrium in which no agent is dominated and in which each agent's consumption utility is finite. We shall construct such a comprehensive-markets sEquilibrium by guessing that, at prices

$$p = \left(\frac{\alpha_1 \alpha_L L}{\Omega_1}, \frac{\alpha_2}{\Omega_2}, \ldots, \frac{\alpha_L}{\Omega_L} \right), \tag{A.3}$$

all agents consume the same amount of good 1. Agent L is the wealthiest agent: his wealth, $p_L \Omega_L = \alpha_L$, exceeds wealth α_i of any agent $i \in \{2, \ldots, L-1\}$, as well as the wealth of agent 1, $\alpha_1 \alpha_L L$, because $\alpha_1 < 1/L$. Therefore, agent L maximizes his consumption utility and, so, spends amount $p_1 x_{L1} = \alpha_1 \alpha_L$ on good 1. Because this amount is less than the wealth of each of the remaining agents, each of them optimally targets good 1 by consuming amount $x_{L1} = \alpha_1 \alpha_L / p_1 = \Omega_1 / L$ of it. The market for good 1 clears: $L x_{L1} = \Omega_1$. The market-clearing condition for the remaining goods can also be verified:

$$\sum_{i \in \mathcal{I}} x_{il} = \sum_{i \in \mathcal{I}} \frac{\alpha_l \left(p \cdot \omega_i - p_1 x_{L1} \right)}{\left(1 - \alpha_1 \right) p_l} = \Omega_l, \qquad l \in \mathcal{L} \setminus \{1\}.$$

Because each agent has money left over after targeting good 1, each agent's consumption bundle is in $\mathbb{R}^L_{++}$ and consumption utility positive. Thus, comprehensive markets is the uniquely LP-optimal market structure.

[48] Recall that, by definition, no agent can avoid dominance by matching another agent's zero consumption of some good.

Proof of Proposition 6

We sample each agent i's utility weights α_i^L uniformly from the $(L-1)$-dimensional simplex by following Devroye (1986, Chapter V): Take the unit interval $[0,1]$ and sample from it $L-1$ points independently and uniformly at random, adding 0 and 1 to the sample. The distance between any two adjacent points in the sample is called a **uniform spacing**. The i^{th} uniform spacing defines α_{il}^L.

Uniform spacings are distributed identically, although not independently, because they must add up to one (Pyke, 1965, Section 2.1). Independence does hold asymptotically, however (Nagaraja et al., 2015, Lemma 1). In particular, for any fixed positive integer R,

$$\left(L\alpha_{i1}^L, \ldots, L\alpha_{iR}^L\right) \xrightarrow{d} (Z_1, \ldots, Z_R) \qquad \text{as} \qquad L \to \infty,$$

where $Z_1, \ldots, Z_R$ are mutually independent standard exponential random variables, and "$\xrightarrow{d}$" denotes convergence in distribution. That is, the first R spacings are jointly distributed asymptotically independently, each with the asymptotic c.d.f. $\Pr\left\{\alpha_{il}^L \leq u\right\} \equiv 1 - e^{-uL}$. Letting $M_i^{R,L} \equiv \max_{l \in \{1,\ldots,R\}} \alpha_{il}^L$ denote the largest of the first R uniform spacings in a model with L goods,

$$\Pr\left\{M_i^{R,L} \leq u\right\} \to \Pr\left\{\alpha_{il}^L \leq u\right\}^R \qquad \text{as} \qquad L \to \infty.$$

At the comprehensive-markets nEquilibrium, each agent i's demand x_{il} for good l is bounded:

$$\frac{\alpha_{il}^L \underline{\omega} \sum_{m \in \mathcal{L}} p_m}{p_l} \leq x_{il} \leq \frac{\alpha_{il}^L \bar{\omega} \sum_{m \in \mathcal{L}} p_m}{p_l},$$

where $(p_l)_{l \in \mathcal{L}}$ is the vector of equilibrium prices. Using the bounds in the display above, agent i is guaranteed not to be dominated if there is a good l such that, for each agent $j \in \mathcal{I} \setminus \{i\}$,

$$\alpha_{il}^L \geq \alpha_{jl}^L \lambda, \qquad \text{where} \quad \lambda \equiv \frac{\bar{\omega}}{\underline{\omega}}.$$

The probability of this no-dominance event is bounded below by the probability that agent i's maximal spacing $M_i^{R,L}$ weakly exceeds λ times the spacing for the corresponding good for each other agent, which, in turn, is bounded below by the probability of the event—which we parametrize by a $\kappa \in (0,1)$—that $M_i^{R,L} \geq \kappa$ and that the remaining agents' corresponding spacings do not ex-

ceed κ/λ. The latter lower bound is, asymptotically,

$$\left(1 - \Pr\left\{\alpha_{il}^{L} \leq \kappa\right\}^{R}\right) \Pr\left\{\alpha_{il}^{L} \leq \frac{\kappa}{\lambda}\right\}^{I-1} = \left(1 - \left(1 - e^{-\kappa L}\right)^{R}\right) \left(1 - e^{-\frac{\kappa L}{\lambda}}\right)^{I-1}.$$

In the bound above, setting $R = \sqrt{L}$ and, for any $b \in \mathbb{R}_{++}$, $\kappa = b/L$ yields

$$\left(1 - \left(1 - e^{-b}\right)^{\sqrt{L}}\right) \left(1 - e^{-\frac{b}{\lambda}}\right)^{I-1} \to \left(1 - e^{-\frac{b}{\lambda}}\right)^{I-1} \qquad \text{as} \qquad L \to \infty.$$

If b is arbitrarily large, then the limit in the display above is arbitrarily close to 1. In other words, as the number of goods grows, the probability that a given agent is not dominated at the nEquilibrium with comprehensive markets approaches 1.

We now bound the probability of the event that no agent is dominated at the nEquilibrium with comprehensive markets. This probability is bounded below by the probability that, for every agent, his maximal spacing weakly exceeds λ times the spacing for the corresponding good for each other agent, which, in turn, is bounded below by the probability of the event—parametrized by a $\kappa \equiv b/L \in (0,1)$—that, for every agent i, $M_i^{R,L} \geq \kappa$ and that the remaining agents' corresponding spacings do not exceed κ/λ. Because spacings are asymptotically independent both across and within agents, this event's probability is asymptotically

$$\left(1 - e^{-\frac{b}{\lambda}}\right)^{I(I-1)}.$$

The lower bound in the display above approaches 1 as $b \to \infty$, thereby establishing the desired result.

B Appendix: Supplementary Examples

Example B.1 (Evolution fails naifs)**.** All agents are naive. Let

$$\alpha = (1,1,1,1) \qquad \text{and} \qquad \omega = \begin{pmatrix} 0.01 & 0.55 & 0.1 & 0.2 \\ 0.6 & 0.01 & 0.1 & 0.2 \\ 0.4 & 0.01 & 0.4 & 0.3 \\ 0.01 & 0.45 & 0.4 & 0.3 \end{pmatrix}.$$

Partition $\{\{1\},\{2\},\{3\},\{4\}\}$, autarky, avoids dominance. So does the coarser and Pareto superior partition $\{\{1,3\},\{2\},\{4\}\}$. So does the yet coarser and Pareto superior partition $\{\{1,3,4\},\{2\}\}$. No further coarsening is possible without admitting dominance. Nevertheless, the coarsest no-dominance partition $\{\{1,3,4\},\{2\}\}$ is not LP-optimal; partition $\{\{1,2\},\{3,4\}\}$ also avoids dominance while delivering higher consumption utilities for all agents. Thus, evolution modeled as an LP-improving market coarsening need not lead to an LP-optimal outcome. △

Example B.2 (An agent targets in distinct submarkets)**.** All agents are sophisticated. Let

$$\alpha = (1,2,2,3) \qquad \text{and} \qquad \omega = \begin{pmatrix} 4 & 4 & 4 & 4 \\ 18 & 6 & 6 & 6 \\ 6 & 18 & 6 & 6 \\ 6 & 6 & 18 & 6 \\ 6 & 6 & 6 & 18 \end{pmatrix}.$$

Market structure $\mathcal{P} = \{\{1,2\},\{3,4\}\}$ induces sEquilibrium

$$p \approx (1.1,2,2,2,3) \qquad \text{and} \qquad x \approx \begin{pmatrix} \boxed{5.7} & 3.1 & \boxed{5.7} & 2.75 \\ 9.7 & 10.5 & 5.7 & 6.2 \\ 13.1 & 14.15 & 5.7 & 6.2 \\ 5.7 & 6.15 & 10.5 & 11.4 \\ 5.7 & 6.15 & 12.3 & 13.4 \end{pmatrix},$$

at which agent 1 targets good 1 to match this good's consumption by agents 4 and 5 and targets good 3 to match this good's consumption by agents 2 and 3.

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