69. **Standards Wars.** If standardization costs are different, firms play a coordination game. A 2X2 version of this game is presented below. Entries represent profits.

\[
\begin{array}{ccc}
\text{Player 1} & \text{Standard 1} & \text{Standard 2} \\
\text{Standard 1} & (a, b) & (c, d) \\
\text{Standard 2} & (e, f) & (g, h)
\end{array}
\]

70. Standard 1 is an equilibrium if \(a > e, b > d\). Similarly, standard 2 is an equilibrium if \(g > c, h > f\). In this game, we will assume that firm i has higher profits when “its” standard \(i\) get adopted, \(a > g, b < h\). Profits, in case of disagreement, will depend on the particulars of the industry. One standard assumption that captures many industries is that in case of disagreement profits will be lower than those of either standard, \(e, c < g\; d, f < b\). Under these circumstances, the setting of
either standard will constitute a non-cooperative equilibrium. There is no guarantee that the highest joint profit standard will be adopted. Since consumers surplus does not appear in the matrix, there is no guarantee of maximization of social welfare at equilibrium.

71. Extreme inequality in market shares and profits of firms in a network industry is commonly observed. Such extreme inequality is commonly explained in industry circles by attribution to history. Stories abound on who or which company “was at the right place at the right time” and therefore now leads the pack. Traditional economic theory cannot easily explain such extreme inequality and may also resort to “managerial,” “entrepreneurship,” or “historical” explanations which are brought over in economics only when all else fails. As a last resort, if all else fails to explain a market phenomenon, economists tend to dismiss what they cannot explain as an “aberration” or a temporary phenomenon that will certainly disappear in the long equilibrium! Such explanations
are deficient not only because they may be incorrect, but also because they tend to treat situations as isolated events and therefore lose all potential predictive power that is derived from correct modeling of economic phenomena.

72. We provide a simple explanation of market structure in network industries without resorting to managerial, entrepreneurship, or historical explanations. The explanation is based on two fundamental features that network industries have and other industries lack: the existence of network externalities and the crucial role of technical compatibility in making the network externalities function.

73. Firms can make a strategic choice on if they are going to be compatible with others, and, sometimes, on if they will allow others to be compatible with them. The ability of a firm to exclude other firms from sharing a technical standard depends on the property rights that a firm has. For example, a firm may have a copyright or a patent on the
technical platform or design, and can therefore exclude others from using it.

74. Compatibility with competitors brings higher network externality benefits (“network effect”) and therefore is desirable. At the same time, compatibility makes product X a closer substitute to competing products (“competition effect”), and it is therefore undesirable. In making a choice on compatibility, a firm has to balance these opposing incentives.

75. In a network industry, the traditional decisions of output and price take special importance since higher output can increase the network externalities benefits that a firm can reap. Network effects are stronger (i) for inherent reasons; (ii) because marginal cost is low; and (iii) because the firm-specific elasticity of demand is low, so that a firm does not lose much from expanding output.

76. Inequality in market shares and profitability is a natural
consequence of incompatibility. Under incompatibility, network
externalities act as a quality feature that differentiates the products.
Firms want to differentiate their products because they want to avoid
intense competition.

77. In making the choice between compatibility and incompatibility,
firms take into account the intensity of the network externality. The
more intense the network externality, the stronger is the incentive for a
firm to break away and be incompatible from substitutes. It follows that
in industries with very intense network externalities, firms will choose
incompatibility.

78. Incompatibility implies inequality. Inequality is accentuated by
output expansion to increase the network externality effect. At
equilibrium, the ratio of outputs of consecutive firms is over 2.6.
Moreover, a firm of higher output has a higher perceived quality, and is
therefore able to quote a higher price. Thus, the inequality in profits is
even more acute than the inequality of outputs.

79. Suppose that there are $S = \{1, \ldots, S\}$ firms, and potentially $I = \{1, \ldots I\}$ technical platforms. They have the option to coordinate to the same platform (compatibility), have incompatible designs (total incompatibility), or coordinate in groups to compatible platforms that are incompatible with others (partial incompatibility). For a benchmark, assume that all firms produce identical products, except for whatever quality is added to them by network externalities. As a benchmark, also assume that no firm has any technical advantage in production over any other with respect to any particular platform and that there are no production costs. I consider here only the extreme case of “pure network goods” where there is no value to the good except from network externalities. The summary of the equilibria is in the following table.
Table: Quantities, Market Coverage, and Prices Under Incompatibility

<table>
<thead>
<tr>
<th>Number of firms S = I</th>
<th>q₁</th>
<th>q₂</th>
<th>q₃</th>
<th>Market coverage $\Sigma_{j=i}^{I} q_j$</th>
<th>p₁</th>
<th>p₂</th>
<th>p₃</th>
<th>pₛ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.6666</td>
<td></td>
<td></td>
<td>0.6666</td>
<td>0.222222</td>
<td></td>
<td></td>
<td>2.222e-1</td>
</tr>
<tr>
<td>2</td>
<td>0.6357</td>
<td>0.2428</td>
<td></td>
<td>0.8785</td>
<td>0.172604</td>
<td>0.0294</td>
<td>0.0035</td>
<td>2.948e-2</td>
</tr>
<tr>
<td>3</td>
<td>0.6340</td>
<td>0.2326</td>
<td>0.0888</td>
<td>0.9555</td>
<td>0.170007</td>
<td>0.0231</td>
<td>0.0030</td>
<td>3.508e-3</td>
</tr>
<tr>
<td>4</td>
<td>0.6339</td>
<td>0.2320</td>
<td>0.0851</td>
<td>0.9837</td>
<td>0.169881</td>
<td>0.0227</td>
<td>0.0030</td>
<td>4.533e-4</td>
</tr>
<tr>
<td>5</td>
<td>0.6339</td>
<td>0.2320</td>
<td>0.0849</td>
<td>0.9940</td>
<td>0.169873</td>
<td>0.0227</td>
<td>0.0030</td>
<td>7.086e-5</td>
</tr>
<tr>
<td>6</td>
<td>0.6339</td>
<td>0.2320</td>
<td>0.0849</td>
<td>0.9999</td>
<td>0.169873</td>
<td>0.0227</td>
<td>0.0030</td>
<td>9.88e-11</td>
</tr>
<tr>
<td>7</td>
<td>0.6339</td>
<td>0.2320</td>
<td>0.0849</td>
<td>0.9999</td>
<td>0.169873</td>
<td>0.0227</td>
<td>0.0030</td>
<td>0</td>
</tr>
</tbody>
</table>

80. The market equilibria exhibit extreme inequality. Entry after the third firm has practically no influence on the output, prices, and profits of the top three firms as well as the consumers’ and producers’ surplus. From the fourth one on, firms are so small that their entry hardly influence the market.

81. Although consumers’ surplus is increasing in the number of active firms, total surplus is decreasing in the number of firms. That is, the more firms in the market, the lower is total welfare. This remarkable result comes from the fact that when there are fewer firms in the market there is more coordination and the network effects are larger. As the
number of firms decreases, the positive network effects increase more than the dead weight loss, so that total surplus is maximized at monopoly.

82. Compared to the market equilibrium under compatibility, the incompatibility equilibrium is deficient in many dimensions. Consumers’ and total surplus are higher under compatibility; the profits of all except the highest production firm are lower under incompatibility; and prices are lower under compatibility except for duopoly.

83. The remarkable property of the incompatibility equilibrium is the extreme inequality in market shares and profits that is sustained under conditions of free entry. Antitrust and competition law have placed a tremendous amount of hope on the ability of free entry to spur competition, reduce prices, and ultimately eliminate profits. In network industries, as shown in this paper, free entry brings into the industry an infinity of firms but it fails miserably to reduce or to flatten the
distribution of market shares. Entry does not eliminate the profits of the high production firms. And, it is worth noting that, at the equilibrium of this market, there is no anti-competitive behavior. Firms do not reach their high output and market domination by exclusion, coercion, tying, erecting barriers to entry, or any other anti-competitive behavior. The extreme inequality is a natural feature of the market equilibrium.

84. Another feature of the equilibrium discussed earlier is the fact that total surplus is highest at monopoly while consumers’ surplus is lowest at monopoly. This poses an interesting dilemma for antitrust authorities. Should they intervene or not? In non-network industries, both consumers’ and total surplus are lowest at monopoly. In this network model, maximizing consumer’s surplus would imply minimizing total surplus.

85. Whatever the answer to the previous dilemma, there is an even more difficult problem for antitrust authorities. At the long run
equilibrium of this model, free entry is present and an infinity of firms have entered, but the equilibrium is far from competitive. No anti-competitive activity has lead firms to this equilibrium. Traditional antitrust intervention cannot accomplish anything because the conditions such intervention seeks to establish already exist in this market. Unfortunately the desired competitive outcome is not.

86. Can there be an improvement over the market incompatibility equilibrium? Yes, a switch to the compatibility equilibrium which has higher consumers’ and total surpluses for any number of firms. Is it within the scope of competition law to impose such a change? It depends. Firms may have a legally protected intellectual property right that arises from their creation of the design of the platform. Only if anti-competitive behavior was involved, can the antitrust authorities clearly intervene.

87. **Interconnection or Foreclosure by a Local Monopolist.** Many
telecommunications, airline networks and railroad networks have the structure of Figure 27b. In a railroad network, there may be direct consumer demand for links AB, BC, as well as AC. This figure can also represent a telephone network with demand for local telephone services (AB) and for long distance services (ABC); in that case, there is no direct demand for BC, but only the indirect demand arising from long distance calls ABC. In many cases, one firm has a monopoly of a link that is necessary for a number of services (here AB), and this link is a natural monopoly. This bottleneck link is often called an essential facility. The monopolist can foreclose any firm by denying access to the bottleneck facility. What are his incentives to do so?