

Network Neutrality, Product Differentiation, and Social Welfare

A Response to Phoenix Center Policy Paper No. 24

A Policy White Paper Prepared by

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Summary and Overview

This paper will address the issue of network neutrality in light of a recent Phoenix Center Policy Paper by George S. Ford, Thomas M. Koutsky, and Lawrence J. Spiwak, titled “Network Neutrality and Industry Structure,” (hereinafter, Ford *et al.*). The focus of the analysis presented here is an examination of Ford *et al.*’s economic model. The critique of Ford *et al.* is directed at four fatal flaws in their analysis, each of which completely undermines their conclusion that policy makers may harm social welfare by pursuing a policy of network neutrality.

- First, Ford *et al.*’s economic modeling does not address economies of scale in last-mile broadband access networks. This assumption is highly unrealistic and ignores the fact that new entrants in broadband last-mile markets are likely to face higher costs, and will likely need to charge higher prices, than incumbents.
- Second, Ford *et al.*’s economic modeling assumes policy makers, by pursuing a policy of network neutrality, can completely eliminate product differentiation among broadband access providers. This assumption is entirely unreasonable—policy makers will not be able to enforce “commoditization” of broadband access as suggested by Ford *et al.* Network neutrality principles and some differentiation of last-mile broadband networks are not mutually exclusive.
- Third, the approach taken by Ford *et al.* is fatally flawed as they fail to acknowledge the impact of the abandonment of network neutrality on the consumption and production of Internet content, services, and applications. By excluding this important consideration, Ford *et al.*’s approach is overly narrow. Any evaluation of a shift in policy must appropriately identify costs and benefits of alternative actions, and Ford *et al.*’s approach fails to acknowledge the tremendous decline in social welfare which is likely to arise should last-mile broadband access providers be allowed to engage in discrimination against providers of Internet content, applications, and services, an action which would reduce competition, product variety, and customer choice.
- Fourth, the conclusions which Ford *et al.* draw from their model depend on the existence of low levels of sunk costs associated with constructing new last-mile access networks. This assumption is highly unrealistic. If sunk costs of entry are high (which they are), the proposition that network neutrality will harm social welfare is not supported by Ford *et al.*’s model.

It is notable that with regard to the issues of scale economies, product differentiation, and sunk costs, Ford *et al.* ignore positions which they have previously taken on the importance of these market characteristics on the potential for competition to emerge in last-mile networks.

This white paper then offers a brief conclusion regarding the issue of network neutrality in light of Ford *et al.*’s evaluation.

A Note on Terminology

The terms “network neutrality” or “open-access Internet,” as I use them in this white paper, should be understood to reflect outcomes resulting from many of the pro-competitive policies which have been enforced in telecommunications markets in the U.S. The ability of end-users to attach equipment of their choice, the provision of access on nondiscriminatory terms to bottleneck facilities, and the requirement that network providers interconnect are examples of these pro-competitive policies. Network neutrality is also consistent with the end-to-end network principles which have been associated with the operations of the Internet. The Internet has operated in a “neutral” environment of open standardization, interconnection, and deference to the network edge, an environment which has generated substantial benefits for consumers, firms, and society.

While the influences discussed above led to an Internet that was “neutral,” changes in policy have opened the possibility that the previous “neutral” Internet may be threatened. Whether a permanent and enforceable policy of network neutrality should be adopted is the main point of conflict as the potential for new telecommunications legislation unfolds.

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I. The growing threat to the open-access Internet

The future of the Internet is the center of an intense debate. At the foundation of the debate is a dispute as to whether or not the firms that control network infrastructure, especially last-mile broadband access facilities, should be allowed to “differentiate their product.” Network differentiation, while possibly associated with relatively benign technology differences across broadband platforms, may also be associated with last-mile broadband access providers engaging in the strategic manipulation of technology, which will enable discriminatory practices that adversely affect the utilization and production of Internet content, services, and applications.¹ Those advocating for strategic “network differentiation” have gone as far as to suggest that abandonment of protocol standardization, the foundation of the Internet, could be beneficial.²

Consumers today face very few choices of broadband Internet access services.³ The reason for the lack of choice of broadband access provider is the pervasive and substantial fixed and sunk costs associated with building alternative networks. However, today consumers enjoy a tremendous variety of, and competitive supply of, Internet services, content, and applications, which are accessed through a broadband (or dial-up) connection. Furthermore, producers of

¹ A more detailed discussion of issues related to the network neutrality debate is provided in another Roycroft Consulting white paper: “Network Diversity—A Misguided Policy,” by Trevor R. Roycroft. Available at: www.roycroftconsulting.org/response_to_Yoo.pdf

² See, for example: Christopher Yoo, “Promoting Broadband Through Network Diversity.” <http://law.vanderbilt.edu/faculty/Yoo%20-%20Network%20Diversity%202-6-06.pdf>

For a response to Professor Yoo’s arguments and additional discussion of network neutrality issues, see: Roycroft, *op. cit.*

³ The most recent statistics available from the FCC indicate that about 96% of consumers who use broadband do so with either a cable modem or telephone company DSL connection.

Internet content, services, and applications have an equal opportunity to serve the market and earn profits. This competition and product variety is the result of a legacy of Internet governance which encouraged nondiscriminatory access, standardized network protocols, and network interconnection. The competition and product diversity also reflects the heritage of regulatory policies which required the provision of access to the Internet on a nondiscriminatory basis. Thus, in economic terms, the overall welfare of society has been positively influenced by the regime of openness which has dominated the Internet to date.

The potential now arises, due to a series of decisions regarding the regulatory treatment of broadband Internet access facilities, such as cable modem and telephone company DSL connections, that the neutrality of network facilities may be eliminated.⁴ This may result in the introduction of proprietary and non-standardized network protocols, or packet prioritization and discrimination. Abandonment of network neutrality principles will enable the owners of last-mile broadband access facilities to create “differentiated,” and possibly incompatible and exclusive, networks. Alternatively, if network neutrality principles are abandoned, the owners of last-mile broadband access networks may discriminate against applications and services which do not fit with their revenue generation plans. If the owners of last-mile broadband access facilities differentiate their networks, and discriminate or place limits on consumer choice, the result will be a dramatic reduction in competition and the variety of Internet services, content, and applications which consumers currently utilize. Furthermore, a highly tilted playing field will be created, where the owners of last-mile broadband access facilities will be able to hamstring their competitors, undermining innovation and investment in what, to date, has been a highly competitive market for Internet content, applications, and services.

⁴ For further discussion, see Roycroft, *op. cit.*, pp. 3-5.

Policy makers must carefully consider the impact of any decision which might alter the current structure of the Internet, a structure which allows Internet users to access the content and applications of their choice, and has encouraged competition and substantial investment by firms which produce Internet content, services, and applications. At the heart of the arguments against network neutrality, which are typically offered by telephone and cable companies and their advocates, are claims that the Internet's true potential can only be achieved if multiple last-mile broadband access facilities are constructed. This alternative has been called "network diversity,"⁵ or has been associated with calls for "differentiated last-mile networks." Thus, the focus of the policy debate, as framed by those that advocate for the ability of telephone and cable companies to differentiate their networks, and exclude and discriminate, often turns on the alleged negative impact that network neutrality will have on incentives for alternative last-mile facilities to be constructed.⁶

A recent addition to the argument that network neutrality can undermine last-mile broadband competition is a white paper by George S. Ford, Thomas M. Koutsky and Lawrence J. Spiwak titled "Network Neutrality and Industry Structure"⁷ (hereinafter "Ford *et al.*"). The major policy recommendation offered by Ford *et al.* is that policymakers "should avoid network neutrality mandates that have the intent or effect of 'commoditizing' broadband access services since such a policy approach is likely to deter facilities-based competition, reduce the expansion

⁵ See, for example, "Dueling Network Buzzwords: 'Neutrality' Versus 'Diversity'," National Journal's Telecom Insider, February 6, 2005. <http://www.njtelecomupdate.com/lenya/telco/live/tb-MBSE1139339451850.html>

⁶ A discussion of the prospects of last-mile broadband competition is contained in Roycroft, *op. cit.*, pp. 26-39.

⁷ The paper is sponsored by the Phoenix Center for Advanced Legal and Public Policy Studies. See, George S. Ford, Thomas M. Koutsky and Lawrence J. Spiwak, "Network Neutrality and Industry Structure," April 2006. Available at: <http://www.phoenix-center.org/ppapers.html>

and deployment of advanced communications networks, and increase prices.”⁸

“Commoditizing” broadband access means any policy which limits the network owner’s ability to differentiate its network from other networks:

This restriction on network differentiation can manifest itself in several ways. For example, rules may require broadband providers to offer access services separate and apart from affiliated content (i.e., privacy, security, packet prioritization, VoIP services) or limit the manner in which they can charge for various ancillary services.⁹

Ford *et al.* note that “policies that promote commoditization of broadband access could lead to the monopoly provision of advanced broadband services in many markets.”¹⁰ The authors conclude that “allowing broadband firms to differentiate their products may make entry more likely, thereby leading to a less concentrated industry structure.”¹¹ Ford *et al.* offer support for the proposition that network neutrality may harm social welfare,¹² and their conclusions may encourage policy makers to tread on network neutrality principles.¹³

Ford *et al.* support their position with a “rather technical economic model.”¹⁴ Economists frequently rely on economic models to simplify complex market problems, and economic models

⁸ Ford, *et al.* p. 1.

⁹ Ford, *et al.* p. 8.

¹⁰ Ford, *et al.* pp. 2-3.

¹¹ Ford, *et al.* p. 3, footnote omitted.

¹² Social welfare, as defined by economists, includes both the profits of the supply side of the market and the “consumer surplus” of the demand side of the market.

¹³ Ford *et al.* assert that they “argue neither for nor against the need for Network Neutrality legislation. . .” (p. 2.) It is difficult, however, to interpret their analysis, which purports to show social harm from network neutrality, while legislation on network neutrality is being debated in Congress, as a “neutral” contribution to the debate.

¹⁴ Ford *et al.*, p. 3.

have the potential to enable a clearer view of the potential impact of various policy alternatives. However, it is also true that complex economic models may be used to obfuscate and confuse.¹⁵ It is important to examine the conclusions offered by Ford *et al.* in the context of their economic model, as absent the economic model, Ford *et al.* offer policy recommendations which have no foundation. Ford *et al.* indicate that their analysis is “focused,”¹⁶ however, their approach is too narrow to provide any useful conclusions. As will be discussed in detail below, Ford *et al.*’s analysis is based on a highly restrictive set of assumptions, and these limiting assumptions prevent any general conclusions from being drawn from their analysis. However, it is important to examine their claims as it is all too likely that their findings will be utilized by others to support *broad arguments* against network neutrality principles.

II. Evaluation of Ford *et al.*’s economic model

Economic models have the potential to provide insight for policy makers. However, it is all too easy to abuse economic models and economic theory in policy discussions. To quote a recent observation by an economist of note on this issue:

Economic theory is often abused in practical policy-making. There is frequently excessive focus on sophisticated theory at the expense of elementary theory; too much economic knowledge can sometimes be a dangerous thing. Too little attention is paid to the wider economic context, and to the dangers posed by political pressures. Superficially trivial distinctions between policy proposals may be economically significant, while economically irrelevant distinctions may be politically important.¹⁷

As will be discussed in detail below, Ford *et al.*’s analysis does not have sufficient “economic

¹⁵ See, for example: Klemper, Paul. “Using and Abusing Economic Theory,” *Journal of the European Economic Association*, April-May 2003, p. 272-300. Available at: <http://www.nuff.ox.ac.uk/economics/papers/2003/W2/usingandabusing.pdf>

¹⁶ Ford *et al.*, p. 4.

¹⁷ Klemper *op. cit.*

context,” and as a result, they offer policy recommendations which are not supported by a reasonable application of economic theory.

My criticism of Ford *et al.*'s economic model is directed at four issues. First, Ford *et al.*'s model does not acknowledge economies of scale which are pervasive in last-mile broadband networks. Second, Ford *et al.*'s economic model assumes that policy makers are capable of eliminating all product differentiation in the provision of broadband Internet access facilities. This assumption is highly unrealistic. Third, while claiming to offer an analysis based on the evaluation of *social welfare*, they exclude important aspects of the market and develop an overly narrow “social welfare” evaluation.¹⁸ Ford *et al.* completely ignore the impact that the elimination of network neutrality will have on the production and consumption of Internet content, applications, and services. Thus, Ford *et al.*'s model ignores the substantial harm to social welfare which would arise if telephone and cable companies act as gatekeepers and interfere with competition and consumer choice, and the ability of businesses to invest and market their services over the Internet. Fourth, Ford *et al.*'s conclusions are based on the assumption that *sunk costs* associated with entry in last-mile broadband access markets are negligible. This assumption is also highly unrealistic and further undermines the credibility of their conclusions.

A. Scale economies must be considered when evaluating broadband access network policy

One notable characteristic of Ford *et al.*'s model is the absence of *scale economies* in last-mile broadband access networks. In other words, there are no cost advantages associated with firm size, the unit cost of production for the incumbent monopoly firm producing all output

¹⁸ Social welfare, as understood by economists, is the sum of *consumer surplus* and *producer surplus*.

is exactly the same as the unit cost for each firm when competition is introduced.¹⁹ This is a highly unrealistic assumption. Other writers on the subject of the alleged advantages on “network diversity” have acknowledged that entrants may face higher operating costs than incumbents, and thus need to charge higher prices than the incumbent. For example, Christopher Yoo’s recent white paper which also attacks network neutrality and provides a favorable evaluation of the prospects for “network diversity,” acknowledges that scale economies exist, and he opines that differentiated networks could overcome their cost disadvantage by charging higher prices for their differentiated services because consumers will value the differentiated services more highly.²⁰ While Ford *et al.* do mention the possibility that network differentiation increases consumer valuation of the last-mile broadband network, their evaluation of this aspect of differentiation does not consider the higher costs facing an entrant due to the entrant’s lack of scale economies.²¹

The absence of scale economies from Ford *et al.*’s analysis is a fatal flaw. Ironically, as will be discussed further below, Ford *et al.* have elsewhere addressed the negative impact of scale economies on the prospects of entry in last-mile markets.

B. Network neutrality and last-mile broadband differentiation are not mutually exclusive

It is important to note that network neutrality and product differentiation among last-mile broadband networks are not mutually exclusive as Ford *et al.* assert. Rather, the coexistence network neutrality and differentiation of last-mile facilities is an entirely reasonable prospect.

¹⁹ The cost structure assumed by Ford *et al.* results in the same unit costs for the firms in question under the cases of monopoly and duopoly, as shown in their equations (7), (17), and (25).

²⁰ Christopher Yoo, “Promoting Broadband Through Network Diversity,” *op cit.*, p. 24. For a critique of Professor Yoo’s argument, see, Roycroft, *op. cit.*

²¹ Ford *et al.*, p. 19.

Principles of network neutrality require that last-mile broadband providers do not engage in discrimination or sabotage of the offerings of competing providers of Internet content, services, and applications. However, network neutrality principles may be upheld and differentiation of last-mile access facilities may exist, especially if differentiation is associated with technical differences in the broadband platform, and is not the result in strategic manipulation of technology. Ford *et al.*'s model is flawed as it assumes that the pursuit of a network neutrality policy will prevent last-mile access providers from operating differentiated networks. It is important to keep in mind that Ford *et al.*'s economic modeling assumes that policy makers can force competing broadband networks to be *absolutely identical*.²² This assumption is highly unrealistic, and the conclusions which Ford *et al.* draw from their model are tenuous as a result.

Technology differences in last-mile broadband facilities naturally introduce product differentiation. Ford *et al.* recognized the fact that different technological delivery platforms may have inherent differentiation in a July 2005 paper, a portion of which addressed differences between cable television and direct broadcast satellite (DBS) systems:

A recent study by the General Accounting Office (“GAO”) on competition between cable television and DBS firms illustrates the importance of product differentiation. While both terrestrial and satellite multichannel video providers offer similar products, there are some meaningful forms of differentiation between the two. The differences in the delivery technology itself (i.e., inter-modality) are not lost on consumers.²³

Similar differentiation in technology resulting from “inter-modality” is associated with last-mile broadband facilities, and policy makers will not be able to eliminate this type of differentiation.

²² In the notation of their model, policy makers can force the parameter $\theta = 1$. Ford *et al.* p. 18.

²³ George S. Ford, Thomas M. Koutsky and Lawrence J. Spiwak, “Competition After Unbundling: Entry, Industry Structure and Convergence,” Phoenix Center Policy Paper Number 21, July 2005, p. 24. Available at: <http://www.phoenix-center.org/ppapers.html>

For example, last-mile broadband in cable networks are a shared resource, multiple consumers share cable broadband access networks from a point very near the customer's premises. The impact of this sharing is the delivery of variable bandwidth to end users based on how many of the end user's neighbors are also requesting bandwidth. Telephone company DSL, on the other hand, provides fixed bandwidth in the access network, and essentially bypasses the potential for "network congestion in the neighborhood" which is associated with cable systems. Marketing by DSL and cable providers enable consumers' ability to recognize the fact that DSL and cable broadband access are differentiated products. Consumers are aware that with cable broadband "actual speeds may vary and are not guaranteed,"²⁴ and that "DSL provides a dedicated connection . . . so you don't have to share your local access connection with other users."²⁵

Other technologies used for broadband Internet access have characteristics which result in differentiation. For example, fixed wireless broadband networks may offer a more scalable service, and symmetrical bandwidth.²⁶ Alternatively, mobile wireless broadband introduces mobility. These characteristics are product differentiation which will not be affected one iota by network neutrality requirements.

In addition, one of the main points of differentiation in last-mile access facilities is the amount of bandwidth which is offered to consumers. Coaxial cable, DSL, fiber to the home, and fixed and mobile wireless access services routinely use download and upload speeds as points of differentiation, and it is entirely unreasonable to expect that a policy of network neutrality would result in this fact changing. If network neutrality is consistent with some product differentiation

²⁴ Comcast broadband description.
<http://www.comcast.com/Benefits/CHSIDetails/Slot3PageOne.asp>

²⁵ Verizon broadband description.
<http://www22.verizon.com/forhomedsl/channels/dsl/learnmore/faqs/#tech2>

²⁶ <http://www.znet.com/fixedwireless/>

among last-mile providers (which it is), then none of the conclusions derived from Ford *et al.*'s economic model are valid. Their model assumes that policy makers have the ability to eliminate all product differentiation, and this is simply not the case.

C. Ford *et al.*'s modeling ignores the tremendous impact on social welfare that broadband gatekeepers will cause

Ford *et al.* argue that network neutrality can result in lower levels of social welfare.²⁷

The reason for this reduction in welfare is the alleged inability of consumers to take advantage of broadband access *product differentiation* when network neutrality is mandated. However, Ford *et al.* analyze only one part of the picture. Failure to maintain network neutrality may dramatically decrease the competition and product variety that consumers currently enjoy with regard to Internet services, content, and applications.²⁸ Thus, one major problem with Ford *et al.*'s economic model is that they ignore the fact that elimination of network neutrality principles will reduce competition, customer choice, and product variety which currently exists for Internet content, applications, and services. The introduction of discriminatory and exclusionary practices by last-mile broadband gatekeepers will likely lead to a reduction in competition, customer choice, and product variety. Thus, Ford *et al.*'s model fails to address the substantial loss in social welfare which would likely occur should telephone and cable companies become gatekeepers and discriminate against Internet services, content, and applications which were not consistent with the gatekeepers' revenue generation plans. This loss in social welfare must be accounted for in any analysis of the alleged gains in consumer welfare arising from "differentiated" last-mile networks.

However, Ford *et al.*'s oversight is even more significant as it appears that they have

²⁷ Ford *et al.*, p. 18.

²⁸ For a further discussion of this issue, please see: Roycroft, *op. cit.*, pp. 5-11.

forgotten the basic economics of the evaluation of product differentiation, i.e., that the costs and benefits of differentiation must be thoroughly evaluated. The economics literature recognizes product differentiation as means through which firms can undermine price competition,²⁹ and the resulting reduction in price competition may harm consumers. It is notable that in another paper authored Ford *et al.* in July of 2005, they clearly recognized the importance of evaluating the benefits and costs of product differentiation, and identify issues with product differentiation which they now ignore completely:

The effect of differentiation on prices can be significant. At the extreme, two products can become so different that they no longer are substitutes for one another – while both made by General Motors, a Hummer is not really a viable substitute product for a Chevette. *Accordingly, we should expect firms to attempt to differentiate their products as much as possible in order to soften price competition.*

As to whether consumers are better off as a result of product differentiation, the answer is “it depends.” Consumers usually value variety, *so while differentiation results in higher prices, the value of increased variety may offset the reduction in consumer welfare from higher prices.* So, there is a trade-off for consumers between variety and price. Differentiation is not always beneficial to consumers, and some firms may excessively differentiate in an effort to more aggressively soften price competition. *One type of differentiation that would harm consumers is differentiation through sabotage, where one firm reduces the quality of a rival’s product instead of improving its own quality.* Product differentiation may also create entry barriers by forcing entry to incur increased sunk advertising costs to win customers.³⁰

In this previous work Ford *et al.* recognize many important facts regarding product differentiation which they now ignore. Product differentiation may reduce competition. The reduction in competition generates higher prices. As a result, consumers may not benefit from

²⁹ See, for example, Tirole, J. *The Theory of Industrial Organization*, MIT Press, 1989, p. 278.

³⁰ George S. Ford, Thomas M. Koutsky and Lawrence J. Spiwak, “Competition After Unbundling: Entry, Industry Structure and Convergence,” Phoenix Center Policy Paper Number 21, July 2005, emphasis added, p. 24, emphasis added. Available at: <http://www.phoenix-center.org/ppapers.html>

differentiation. Furthermore, firms may have the ability to differentiate their product by influencing the quality of a rival's product, an all too real prospect when considering the need for network neutrality policy.

Ford *et al.*'s current evaluation of product differentiation presents an overly simplified and unrealistic view of how a policy which abandoned network neutrality would affect consumers and firms. Ford *et al.* completely ignore the impact of the abandonment of network neutrality on current competition in markets for, and the availability of, Internet content, services, and applications of the consumer's choosing. Ford *et al.*'s analysis also ignores negative impacts on the ability of businesses operating at the network edge to innovate and invest. This aspect of network differentiation in last-mile broadband facilities will have a significant and negative impact on social welfare, but it is completely ignored by Ford *et al.*'s model. Furthermore, the very real possibility that the operators of last-mile broadband access facilities would differentiate their product by sabotaging access to Internet content, applications, and services of the user's choice is a tremendous oversight in Ford *et al.*'s current analysis of product differentiation.³¹

Ford *et al.*'s model offers a highly selective view of the impact of product differentiation on price competition. They abandon the more conventional view that product differentiation may undermine price competition, which they relied on in their July 2005 paper, and now state that product differentiation promotes price competition.³² In summary on this issue, Ford *et al.*'s model entirely fails to support their policy recommendations as they model only a portion of the overall market, and only a portion of the potential impact of the abandonment of network

³¹ For a further discussion of the potential for sabotage, see Roycroft, *op. cit.*, pp. 6-9.

³² Ford *et al.*, pp. 8-9.

neutrality principles.

D. Ford *et al.*'s modeling incorrectly assumes that sunk costs of building alternative broadband networks are negligible

It would be reasonable to dismiss Ford *et al.*'s recommendations based on the criticism above. However, it is worthwhile to evaluate Ford *et al.*'s model on its (overly narrow) basis and determine whether the policy recommendations offered by the authors have any support at all.

1. Detailed look at Ford *et al.*'s economic model

Table 1, below, summarizes the five market scenarios evaluated by Ford *et al.* The basic logic of the approach utilized by Ford *et al.* is to develop a measure of social welfare under monopoly and no product differentiation, and to compare that level of social welfare with the level of social welfare which results from the other situations summarized in Table 1.

Table 1: Market Profiles Modeled by Ford <i>et al.</i>
Monopoly without product differentiation.
Monopoly with product differentiation.
Duopoly without product differentiation (quantity competition).
Duopoly with product differentiation (quantity competition).
Duopoly without product differentiation (price competition).

Table 2, below, summarizes Ford *et al.*'s findings with regard to the modeling.

Table 2: Summary of Ford <i>et al.</i>'s Findings	
Scenario	Impact on Social Welfare Relative to Baseline
Monopoly without product differentiation (Baseline Scenario).	---
Monopoly with product differentiation.	No change, social welfare not affected as compared to baseline.
Duopoly without product differentiation (quantity competition).	Social welfare may be higher if sunk costs of entry are not too high.
Duopoly with product differentiation (quantity competition).	Social welfare may be higher if sunk costs of entry are not too high.
Duopoly without product differentiation (price competition).	If the sunk costs of entry are greater than zero, then entry will not occur.

Ford *et al.* go on to evaluate their results:

. . . Recall that E is the sunk entry cost of a potential entrant, and π is profit. Based on the analysis above, Network Neutrality rules that promote commoditization are socially inefficient under the following three conditions:

1. $\pi(\text{duopoly}, \theta = 1) < E$;
2. $\pi(\text{duopoly}, \theta < 1) > E$;
3. $W(\text{duopoly}, \theta < 1) - E > W(\text{monopoly})$.

These conditions are summarized as follows. Condition (1) states that a duopoly profit with homogeneous products ($\theta = 1$) is insufficient to cover sunk entry costs; as a result, in this case, entry would not occur. Condition (2) states that duopoly profit with differentiated products ($\theta < 1$) is larger than entry costs; as a result, in this case, entry would occur. Condition (3) states that the total welfare with differentiated duopoly is larger than total welfare with monopoly. These three conditions imply that *Network Neutrality rules are socially inefficient if they reduce the number of firms serving the market, and the excluded firms would have been efficient entrants from social perspective.*³³

Then, based on this exposition, Ford *et al.* conclude with a proof which purportedly supports the proposition that network neutrality is socially inefficient:

³³ Ford, *et al.*, p. 17, emphasis in the original.

Proposition. Suppose Bertrand competition occurs with entry and $\theta = 1$, but differentiated competition occurs if $\theta < 1$. If E is positive but not too large, then Network Neutrality is socially inefficient.

Proof. Under Bertrand competition, duopoly profit on entry with $\theta = 1$ is zero, so any positive sunk entry costs prevents entry. Without Network Neutrality requiring $\theta = 1$, a firm may enter with $\theta < 1$, whenever

$$\pi_i^* = \frac{(\alpha - c)^2}{\beta} \frac{(1 + \theta)}{(2 + \theta)^2} > E > 0$$

If so, then welfare from differentiated duopoly exceeds monopoly welfare. Recalling that monopoly welfare is invariant to the degree of differentiation in this model, Network Neutrality is socially inefficient.³⁴

This proof caps their exposition, and contributes to their conclusion that network neutrality is socially inefficient. Their conclusion ultimately hinges on the magnitude of the sunk costs of entry—specifically, it must be the case that sunk costs “are not too large.” Sunk costs which are “not too large” is, however, an unreasonable presumption.

2. Substantial sunk entry costs make it unlikely, within the context of Ford *et al.*'s model, that network neutrality is socially inefficient

The extent of sunk costs associated with broadband access networks, like other telecommunications networks, are substantial, and these substantial sunk costs make it much less likely that Ford *et al.*'s model shows that a policy of network neutrality will have a negative impact on social welfare. Ford *et al.* have acknowledged the existence and importance of high levels of sunk costs in other recent writings:

As consistently demonstrated by academic and Phoenix Center research, and again in this POLICY PAPER, given the *huge fixed and sunk costs* inherent to the construction and commercial operation of communications networks, the equilibrium level of concentration of terrestrial firms in local communications markets (voice, video, and data) will be relatively high. . . . *fewness arises because scale economies and sunk costs limit the number of firms that can profitably serve a market – and local communications networks are notoriously riddled with scale economies and sunk costs.* Any policymaker interested in local

³⁴ Ford, *et al.*, p. 18, emphasis added.

communications markets should, therefore, start from the assumption that there will, at best be only a “few” facilities-based firms.³⁵

Ford *et al.*'s previous recognition of the importance of scale economies and sunk costs has been abandoned in their approach to network neutrality. This makes their conclusion even more unrealistic. The sunk costs which are recognized by Ford *et al.* as a pervasive characteristic of terrestrial communications firms also apply to nonstandard technologies, such as wireless, fiber optics, and broadband over power lines.³⁶ The bottom line regarding Ford *et al.*'s modeling is this: the extremely high levels of sunk entry costs associated with the construction of communications networks, including last-mile broadband facilities, make it unlikely that network neutrality principles will decrease social welfare. In other words, even if one overlooks all of the other fatal flaws in Ford *et al.*'s approach, the reality of high levels of sunk costs of building last-mile broadband networks indicates that their model does not support the proposition that network neutrality will harm social welfare.

E. Summary of critique of Ford *et al.*

It is somewhat surprising to find Ford *et al.* now ignoring both data and economic principles with which they exhibited a high degree of familiarity as recently as July of 2005. While claiming that their economic model contains support for the proposition that network neutrality will be harmful to social welfare, the model does no such thing. Scale economies must be considered when evaluating the potential impact of entry on market outcomes. Furthermore, any social welfare analysis must tally the negative impact that cable and telephone company

³⁵ George S. Ford, Thomas M. Koutsy and Lawrence J. Spiwak, “Competition After Unbundling: Entry, Industry Structure and Convergence,” Phoenix Center Policy Paper Number 21, July 2005, emphasis added. Available at: <http://www.phoenix-center.org/ppapers.html>

³⁶ For a fuller discussion of the limitations of these alternative technologies, see, Roycroft, *op. cit.*, pp. 29-38.

gatekeepers will impose on consumers and firms. It is all too likely that cable and telephone companies will reduce competition in markets for Internet content, services, and applications, possibly even sabotaging sources of supply which interfere with their revenue generation plans. Ford *et al.* overlook this vital component of welfare analysis as it applies to the issue of network neutrality. Also, it is important to acknowledge the impact of substantial sunk entry costs on the prospects for competition. Again, Ford *et al.* ignore vital facts, and ultimately reach unsupported conclusions regarding alleged harms associated with network neutrality.

III. Conclusion

Ford *et al.* argue that policy makers may do harm if they attempt to enforce a policy which prevents last-mile broadband access providers from differentiating their networks, and which leads to “commoditization” of broadband access. As has been discussed above, it is unreasonable to associate network neutrality with the elimination all differentiation in last-mile networks. Furthermore, Ford *et al.*’s failure to address economies of scale and substantial sunk costs associated with last-mile broadband network also undermines the validity of their recommendations. Finally, their failure to acknowledge the impact of the abandonment of network neutrality principles on existing competition, consumer choice, and product variety associated with Internet content, services, and applications is another fatal flaw. The bottom line is that Ford *et al.*’s claims are not supported by economic theory or their model.

The Internet, operating under a regime of standardized protocols and interoperability, has resulted in expansive consumer benefits. Internet standardization is widely recognized to be beneficial to consumers, as it reduces purchase risks and expands network effects, which increase product values.³⁷ The standardization associated with the Internet operates at a

³⁷ See, for example, Carl Shapiro and Hal Varian, *Information Rules*, Harvard Business School Press, Boston, 1999, p. 233.

“wholesale level.” The standardized network protocols reside in logical network layers below the “application level,” which is associated with the Internet products used by consumers. Thus, due to the standardization of Internet protocols, consumers are presented with a wide variety of content, applications, and services. Due to the standardization of Internet protocols at the wholesale level, consumers enjoy highly differentiated retail products, and are able to benefit from competition, network effects, and the advantages of interoperability. This open-access environment allows the rise of niche market providers, which can tailor their Internet services to the needs of individuals, again adding to consumer benefits.³⁸

History provides a laboratory for the evaluation of consumer reactions to differentiated information networks—consumers have had the opportunity to experience electronic information services operating as differentiated and non-standardized “information strip malls.” Prior to the commercialization of the Internet, online service providers such as America Online, GENie, Compuserve, Prodigy, and Delphi offered consumers the ability to utilize chat and bulletin boards, access electronic news and information, and send e-mail. However, these differentiated systems were not interconnected, and users of one online service generally could not communicate with the subscribers of other online service providers.³⁹ These proprietary network service providers were, of course, free to innovate in their “network cores.” However, the commercialization of the Internet, with its open and non-proprietary standards, provides an object lesson in what consumers have deemed the superior approach—i.e., principles of openness which support innovation at the network edge. Once the expansive network effects and interoperability benefits associated with the Internet became available to any entity which

³⁸ *Id.*, p. 187.

³⁹ *Id.*

abided by the principles of the open-access Internet, the proprietary network model quickly withered. The proprietary services which were offered by online service providers were judged by consumers as inferior to the content, applications, and services, operating under the regime of standardized Internet protocols, which were competitively available over the Internet.

The fact that differentiation of last-mile broadband access networks, if that differentiation applies proprietary protocols or limits consumer choice, will undermine the diversity of Internet content, applications, and services should not be lost on policymakers. The Internet, through its governing principles of openness and nondiscrimination, has encouraged competition and expansive consumer benefits. Ford *et al.*'s flawed findings, if acted upon by policymakers who might undermine network neutrality principles, would endanger this success and risk replacing vibrant competition and extensive variety with two or three competing "information strip malls," tightly controlled by telephone and cable companies. Such an outcome is one that the U.S. can ill afford.