



IN RESPONSE...

May 2006

NETWORK NEUTRALITY AND SCALE ECONOMIES: A RESPONSE TO DR. ROYCROFT

I. Introduction

In PHOENIX CENTER POLICY PAPER NO. 24, *Network Neutrality and Industry Structure*,¹ we looked into one of the most heated debates in the current efforts to re-write the Communications Act—whether the federal government should impose “Network Neutrality” requirements on broadband service providers. While we argued neither for nor against the need for Network Neutrality legislation in that POLICY PAPER, our analysis showed 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 and deployment of advanced communications networks, and increase prices. Our theoretical argument hinged on the well-known relationship between commoditization and price competition in the presence of fixed costs (*i.e.*, economies of scale). Since communications networks require significant capital expenditures (fixed costs), limiting firms to price-only competition will reduce the number of firms that can successfully serve the market.² An increase in the equilibrium number of broadband providers is promoted by service differentiation, since firms can compete in both price and non-price dimensions. As such, we concluded that given the economic characteristics of local communications networks, policies that promote commoditization of broadband access could lead to the monopoly provision of advanced broadband services in many markets. This outcome would obviously harm consumers substantially.

¹ George S. Ford, Thomas M. Koutsky and Lawrence J. Spiwak, *Network Neutrality and Industry Structure*, PHOENIX CENTER POLICY PAPER NO. 24 (April 2006) (available at <http://www.phoenix-center.org/pcpp/PCPP24Final.pdf>).

² We discuss this point in detail (particularly at Sections III.3 and III.4) in George S. Ford, Thomas M. Koutsky and Lawrence J. Spiwak, *Competition After Unbundling: Industry Structure and Convergence*, PHOENIX CENTER POLICY PAPER NO. 21 (July 2005) (available at <http://www.phoenix-center.org/pcpp/PCPP21Final.pdf>).

Shortly thereafter, Dr. Trevor Roycroft, of Roycroft Consulting,³ released a critical response to the paper. Upon our request, Dr. Roycroft agreed to allow the Phoenix Center to post his comments on our website.⁴ In his critical review of our work, Dr. Roycroft's analysis is "an examination of [our] economic model."⁵ Dr. Roycroft lists what he believes are four "fatal" flaws in our economic model:

1. the "economic modeling does not address economies of scale in last-mile broadband access networks";
2. the "economic modeling assumes policy makers, by pursuing a policy of network neutrality, can completely eliminate product differentiation among broadband access providers";
3. the model "fail[s] to acknowledge the impact of the abandonment of network neutrality on the consumption and production of Internet content, service, and applications";
4. "the conclusions ... depend on the existence of low levels of sunk costs associated with constructing new last-mile access networks."

In an effort to ensure the accuracy and legitimacy of all analysis performed and released by the Phoenix Center, we have evaluated carefully Dr. Roycroft's response to see if he presents any legitimate criticisms or offers any material improvements to the analysis in POLICY PAPER NO. 24. At the Phoenix Center, we appreciate criticism and comment, since such review can be used to either affirm or improve our analysis, thereby making our work more useful for policy decisions. In some cases, comments on our work provide direction for future research. By all accounts, Dr. Roycroft's comments confirm the relevance and importance of the general theme of POLICY PAPER NO. 24.

Curiously, none of the "flaws" claimed by Dr. Roycroft are actually present in our analysis. In fact, all of the alleged errors and omissions claimed by Dr. Roycroft are dealt with squarely in our paper. For example, the very purpose of our model is to argue that because scale economies are present, service differentiation is necessary for entrants to successfully enter the market. Yet Dr. Roycroft claims we "do not address economies of scale" and that we "ignore[] the fact that new entrants ... will likely need to charge higher prices [] than incumbents." As

³ <http://www.roycroftconsulting.org>.

⁴ Available at: <http://www.phoenix-center.org/RoycroftRespPCPP24.pdf>. Dr. Roycroft, and any other interested party, is, of course, free to provide further substantive comments which we will post on the website.

⁵ Roycroft critique at 1.

such, this criticism has no merit. Dr. Roycroft's other arguments, to the extent they address key issues in the Network Neutrality debate, are in fact not criticisms of our model at all and are, in fact, specifically incorporated into our analysis, either formally or informally.

II. Discussion

A. Issue One: Economies of Scale

Dr. Roycroft claims that our model "does not address economies of scale." Without question, this criticism is the most puzzling. In fact, economies of scale are at the core of our model. We set out to analyze how Network Neutrality rules would affect industry structure in a market that is characterized by economies of scale, and fixed and sunk costs. Consider, for example, the statement from the introduction (selectively quoted by Dr. Roycroft):

Economic theory suggests that product differentiation is an important component of competition, particularly in industries with large fixed and sunk costs.⁶

and

economic forces inherent to communications networks tend to promote concentrated equilibrium industry structures (i.e., few firms).⁷

and

price competition is desirable, but when price is the only choice in a market with larger fixed/sunk costs and low marginal costs (like local broadband networks), the result of permitting price-only competition is a tendency toward monopoly.⁸

Clearly, from this dictum and many more quotes like it from our POLICY PAPER, it is apparent that economies of scale are not only "addressed," but play a key role in the analysis.

Dr. Roycroft states his analysis is focused on the economic model, and not the text of the document, which are quoted above. However, an evaluation of our economic model unequivocally shows that economies of scale play a constant and important role in our model. In Section III.A of POLICY PAPER NO. 24, we outline the supply-side mathematical framework of

⁶ POLICY PAPER NO. 24 at 3.

⁷ *Id.*

⁸ *Id.* at 8.

our economic model. In these equations, we state there is some constant marginal cost c , a fixed entry costs E for the entrant, and fixed cost F for the incumbent. Whenever there is a constant marginal cost (c) and fixed costs (F), economies of scale are present.⁹ By definition, then, economies of scale are present in the economic model. In fact, economies of scale are so pronounced in the model, that if complete commoditization of broadband Internet access services is mandated, the market would be a natural monopoly due to economies of scale.

Indeed, it is because of scale economies in our model that we were forced to deal with the issue of efficient entry. For industries with extreme scale economies, entry is not necessarily “efficient” because the inefficiency of higher per-unit production costs from multiple firms supply might outweigh the benefits consumers derive from multiple providers (i.e., price cuts). This concept is only relevant if scale economies are significant; there would have been no need for us to examine efficient entry if we our model did not “address” scale economies, as Dr. Roycroft charges.

As part of his criticism, Dr. Roycroft states that because of economies of scale, “new entrants in broadband last-mile markets are likely to face higher costs, and will likely need to charge higher prices, than incumbents.”¹⁰ While Dr. Roycroft appears to believe we ignore this logic, *it is in fact the very essence of our analysis.* As we state,

the analysis turns on the degree to which relaxation of net neutrality rules allow potential entrants to differentiate their offerings sufficiently from rivals to recover sunk entry costs.¹¹

If firms are restricted to competition only on price, then high cost firms have no hope of survival. However, differentiated goods competition gives smaller firms a change to survive by softening price competition.¹² While Dr. Roycroft claims we ignore this point, this argument is, in fact, exactly what our paper is about.

⁹ Stated simply, the cost function is $C = F + cq$, where q is output. Average cost is $AC = F/q + c$, which is always declining in q . As a result, scale economies are present over the entire range of output. While we could have specified economies of scale in the form of declining marginal costs (either with zero or positive fixed costs), this alternative cost structure makes the welfare comparisons very complex. We suspect that the difference in our conclusions this change would make is to render efficient entry much more difficult, thereby implying that monopoly is the ideal market structure for broadband service provision.

¹⁰ Roycroft critique at 2.

¹¹ POLICY PAPER NO. 24 at 19.

¹² We state this condition with mathematical precision in the paper. At page 16, we list the condition $\partial p / \partial \theta < 0$ [the unnumbered equations after Equation (24)], which, in words, says that as the products or services become more differentiated (θ gets smaller), prices rise (p gets bigger).

Finally, on this point, Dr. Roycroft points to Equations (7), (17), and (25) as “evidence” that we ignore scale economies. These equations are expressions of equilibrium gross profit levels, and are thus functions only of *marginal* cost, not *average* costs. These gross profit levels must then be compared to the fixed/sunk entry costs to determine whether entry occurs, and this comparison is made in Equation (29). Dr. Roycroft copies this equation in his comment, so he should be aware of its purpose. Perhaps Dr. Roycroft missed the qualifier to the profit formulas stating “Equations (17) and (19) would need to be adjusted for the presence of fixed or sunk costs.”¹³ Or, perhaps we could have been clearer about this qualification and repeated it *ad infinitum*.

In summary, the primary thesis and purpose of PHOENIX CENTER POLICY PAPER NO. 24 was to study how Network Neutrality proposals would industry structure by focusing on interaction between economies of scale, product differentiation, and entry. Dr. Roycroft seems to have missed the very essence of our argument and economic model.

B. *Issue Two: Effectiveness of Public Policy in Eliminating Product Differentiation*

In his second criticism, Dr. Roycroft contends that our “economic modeling assumes policy makers, by pursuing a policy of network neutrality, can completely eliminate product differentiation among broadband access providers.” As with the scale economies argument, Dr. Roycroft is wrong again, and we can illustrate this with the precision of the mathematics included in the paper.

In describing our model, we describe the parameter θ (the Greek letter “Theta”) as a “production differentiation parameter where $0 \leq \theta \leq 1$.”¹⁴ We also observe “if $\theta = 0$ we have the pure monopoly case; $\theta = 1$ we have identical goods; and for intermediate cases we have $0 < \theta < 1$.”¹⁵ In other words, our economic model can contemplate the full range of differentiation, from identical goods ($\theta = 1$) to completely differentiated goods ($\theta = 0$), and everything in between. Thus, Dr. Roycroft’s criticism is inapplicable to our economic model. Our model does account for the fact that policies might not completely eliminate all potential for product differentiation. The fact that our model allows one to establish different degrees of permissible differentiation does not take away from our fundamental point—that policies that make differentiation less likely will lead to increased industry concentration.

¹³ *Id.* at 15.

¹⁴ *Id.* at 11.

¹⁵ *Id.*

As a secondary point, Dr. Roycroft's point says more about his skepticism of policymakers than it does about our paper. Essentially, Dr. Roycroft asserts that even if a law mandated that local broadband services only be sold as a commodity "bitstream" service, that policy would be a failure because "policy makers will not be able to enforce 'commoditization' of broadband access."¹⁶ He bases this assumption on a type of technological determinism – that "technology differences in last-mile broadband facilities naturally introduce product differentiation."¹⁷ But simply because different technologies are involved does not mean that government is entirely incapable of mandating a commodity service or price structure on the industry if it so desires. Indeed, proposals, such as the Network Neutrality Act of 2006 (H.R. 5273), and the Internet Freedom and Nondiscrimination Act of 2006 (H.R. 5417), affirmatively prohibit all broadband providers, regardless of technology used, from imposing a "surcharge" for prioritization or preferential treatment for particular forms of content. The fact that Dr. Roycroft's paper is cited by proponents of those bills is curious because Dr. Roycroft has basically asserted that those bills are unenforceable.

C. *Issue Three: Consideration of "Upstream" Competition*

In his third criticism, Dr. Roycroft claims that we "fail to acknowledge the impact of the abandonment of network neutrality on the consumption and production of Internet content, service, and applications." We understand that Network Neutrality proposals involve a trade-off of the risks in the local broadband access market and competition in the "upstream" content, service and applications markets. Our research on this topic has stressed the cost-benefit analysis in which policymakers must engage.¹⁸ As we state in the paper,

In considering various Network Neutrality proposals ... policymakers should be aware of *the need to balance concerns about discrimination with the danger that commoditizing the market for broadband Internet access services may lead to the monopoly provision of broadband Internet access service in many markets.*¹⁹

Also, we propose that

¹⁶ Roycroft critique at 7-10.

¹⁷ *Id.* at 8.

¹⁸ See George S. Ford, Thomas M. Koutsky and Lawrence J. Spiwak, *The Efficiency Risk of Network Neutrality Rules*, PHOENIX CENTER POLICY BULLETIN NO. 16 (May 2006) (available at: <http://www.phoenix-center.org/PolicyBulletin/PCPB16Final.pdf>).

¹⁹ POLICY PAPER NO. 24 at 4 (emphasis supplied).

The development of Network Neutrality principles by policymakers *must necessarily be nuanced and flexible because of these competing concerns*, particularly given the economic characteristics of local broadband networks.²⁰

We plainly acknowledge the concerns regarding anticompetitive behavior, and advise that such concerns be “balanced” against the adverse effect of commoditization on industry structure. Thus, while Dr. Roycroft’s point that the impact of Network Neutrality on competition “upstream” is an important one, his criticism is misplaced, as we recognized these concerns and argued that they need to be balanced against the harm to “downstream” industry structure identified by our model.

D. *Issue Four: Allegedly Low Sunk Costs*

In his final criticism, Dr. Roycroft claims “the conclusions [of our model] ... depend on the existence of low levels of sunk costs associated with constructing new last-mile access networks.” It is a mystery how Dr. Roycroft can make this criticism of our paper. Our paper is based almost exclusively on the role of high fixed and sunk costs have on industry structure. (Indeed, almost all Phoenix Center research is based on the role of sunk costs on industry structure.) It is a *non sequitur* to read our paper and assert that that an essential ingredient of our analysis is that sunk costs are low.

Dr. Roycroft crafts his invalid criticism from the mathematical proof in Section IV.A, which states:

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.²¹

In POLICY PAPER NO. 24, we then provide a proof that this Proposition is true. Dr. Roycroft replicated this entire discussion in his comment. Dr. Roycroft focuses on the statement “ E is positive but not too large,” where E is the sunk costs of entry in arguing that we have assumed low sunk costs.

As an initial matter, the statement to which Dr. Roycroft objects merely discusses where entry costs are “not *too large*” (emphasis added). Our conclusions do not depend on “low levels of sunk costs,” but only on levels of sunk costs that are not “too large.” By “too large,” we meant in the context of the model and the discussion of it that in some instances, the sunk costs

²⁰ *Id.* at 8 (emphasis supplied).

²¹ *Id.* at 18.

of entry may be too high so that entry is undesirable, regardless of the effect it has on consumers. Say, for example, that it costs \$11 trillion in sunk investments to build a broadband network. Since this is roughly the size of Gross Domestic Product in the United States, it probably would not be beneficial for the country to have this network built. Thus, sunk costs of \$11 trillion are probably “too large” in that the gains to consumers from lower prices will never exceed this amount.

The notion of sunk costs being “too large” is expressed clearly in the paper:

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.*²²

Thus, sunk costs are “too large” if they make the excluded firm an inefficient entrant from a social perspective. We engaged in this discussion in the paper because of our concern that certain Network Neutrality rules would deter entry, and proving this proposition was important because entry is not always socially beneficial, because entry in the case of markets with sunk costs of entry that are “too large” may not be socially beneficial.

Accordingly, our economic model does not assume a low level of sunk costs associated with constructing new last-mile access networks, and Dr. Roycroft is inaccurate in his assessment of the economic model. In stating in this proposition is dependent upon sunk entry costs not being “too large,” we did not mean to state or assume that entry costs in this industry were “low.” Equation (29) in fact specifically provides a method to determine how small or large entry costs (E) need to be for Network Neutrality rules to be inefficient. Our diction perhaps could have been more specific, and while we perhaps could have described textually this condition *ad infinitum*, we trust that most readers would have found such a discussion excessively pedantic and pedagogical.

III. Conclusion

In sum, none of the “fatal errors” claimed by Dr. Roycroft are present in PHOENIX CENTER POLICY PAPER NO. 24. To the contrary, the very concerns raised by Dr. Roycroft were directly and thoroughly addressed. It would seem, therefore, that Dr. Roycroft’s perceptions of the key issues for Network Neutrality are in line with ours, particularly the importance of scale economies, and fixed and sunk costs and the role they play on industry structure. We appreciate the cross-check of our work.

²² *Id.* (emphasis in original).