**The Digital Divide and other Economic Considerations for Network Neutrality**

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**Abstract**

Earlier this year, the Federal Communications Commission (FCC) released its 2016 Broadband Report. In the report, the FCC recognized that a rural/urban digital divide remains prevalent, especially with respect to broadband adoption. It also highlighted several policies that the FCC has undertaken to purportedly reduce the divide, including the 2015 Open Internet Order (OIO) whose stated intent is to enforce “network neutrality”. However, long before the OIO, studies have raised concerns that network neutrality policies will discourage investment by Internet Service Providers in broadband infrastructure, to the detriment of broadband accessibility, and may increase average consumer costs, both of which would only further exacerbate the digital divide. In this paper, we provide a holistic analysis of the effects of net neutrality on the digital divide, drawing from recent economic research on this issue. Our goal is to present the range of economic considerations that should be taken into account when considering the overall impact of the OIO, with particular attention to its impact on the digital divide.

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# I. Introduction

In its 2016 Broadband Progress Report, the Federal Communications Commission (FCC) highlights that a digital divide remains prevalent, especially with respect to broadband access; “… there continues to be a significant disparity of access to advanced telecommunications capability across America with more than 39 percent of Americans living in rural areas lacking access to advanced telecommunications capability, as compared to 4 percent of Americans living in urban areas, and approximately 41 percent of Americans living on Tribal lands lacking access to advanced telecommunications capability.” [[2]](#footnote-2) The 2015 Digital Divide Survey conducted by Pew Research found that 21% of households in the US do not have internet in their households.[[3]](#footnote-3)

The 2016 Broadband Report signaled the FCC’s intention to reduce this divide by expediting broadband deployment and fostering infrastructure investment through direct subsidies, removing obstacles and promoting competition. The 2015 Open Internet Order (OIO) is the latest among the FCC’s stated strategies to promote infrastructural investment and reduce the digital divide.[[4]](#footnote-4) In both of these dimensions however, there are strong economic arguments suggesting that OIO will accomplish neither, and in fact, will likely have the exact opposite effects. Some scholars have described such purported benefits of the OIO as “speculative” ([Hylton, 2016](#_ENREF_17)). In fact, there is already potential evidence that investment by Internet Service Providers (ISPs) has fallen due to the introduction of the OIO.[[5]](#footnote-5) Moreover, among existing models which allow for consumers to enter and exit the market for internet service based on price and/or content value, there is a clear argument that the 2015 OIO may in fact worsen the digital divide rather than reduce it as claimed in the OIO.

A reasonably large theoretical literature already exists focusing on the welfare effects of different possible regulatory applications of the concept of net neutrality. Many have direct implications for investment and general welfare impacts.[[6]](#footnote-6) Unfortunately, many existing models are insufficiently rich in their structural underpinnings to incorporate the possibility of a digital divide, much less consider how it might be impacted by the FCC’s Open Internet Order.[[7]](#footnote-7) Here we highlight a few models which incorporate at least some factors relevant to the digital divide. We also suggest additional dimensions within previous models that have not yet been explicitly considered but would yield a more robust analysis of the various dimensions through which net neutrality regulation may impact this divide.

Hence, while not reviewing all existing models, we hope through a few models to illustrate not only what existing models suggest, but also where they are either limited or robust in their ability to address issues of relevance to broadband infrastructure investment and social welfare, with particular attention to the digital divide.

One thing to note is that the concept of net neutrality has been around since it was first coined by Christopher Wu in 2003. However, the regulatory application of this concept could have taken many forms. For example, early discussions of net neutrality envisioned requiring identical pricing or identical qualities of service from Internet Service Providers to all end customers. Other discussions envisioned not allowing ISPs to charge any prices to content service providers even for differentiated service like priority lanes, etc. We leave a detailed discussion of the 2015 Open Internet Order to others (*give some citations here*). Here we simply wish to note that one of the primary decisions within the 2015 Order was to prohibit ISPs from charging any fees to any content service providers, no matter how that CSP’s service impacted network congestion, etc. Since much of the literature on the economic impacts of net neutrality were written before the FCC’s 2015 order, existing models consider somewhat different regulatory applications of net neutrality. Still, results from pre 2015 papers nonetheless illustrate key outcomes possible once market transactions between internet service providers, content service providers, and end users/consumers are regulated.

# II. Content Service Providers

It is also important to point out that in more recent years, much of the data traffic on the internet has been coming from video content, especially as content service providers like Netflix and YouTube have grown and started displacing traditional television services. Brennan (2016) points out that as of March 2015, over 52 percent of all downstream Internet traffic came from videos from just Netflix and YouTube. BitTorrent made up 2.76 percent, while Facebook made up 2.65 percent of downstream internet traffic. Brennan underscores that while “…it has been a slogan that BIAS providers should not be allowed to turn the Internet into cable TV, subscribers have already turned the Internet into the next video delivery mechanism.”[[8]](#footnote-8)

Beyond demonstrating that not all content service providers have the same impact on congestion for internet service providers, these facts also make it obvious that not all content service providers are identical in type of content provide, type of service provided, size, or value to consumers. This empirical fact is crucial to understanding the validity of any welfare results derived from models which assume that all content service providers are identical in terms of the value that they provide to consumers and models which assume that the total value of internet content will therefore increase monotonically with the number of content service providers. Such assumptions are both unrealistic and severely bias welfare results in favor of any market interventions which artificially encourage additional entry by content service providers.

# III. The Digital Divide

The term ‘digital divide’ is commonly used to refer to the disparity in access to and/or use of digital technology across households based on urban vs. rural locations and on socioeconomic differences across households. This divide is of concern to society since these technologies have the potential to shape an individual’s access to economic opportunities ([Norris, 2001](#_ENREF_25)); among other things, unequal access to such technological tools can maintain or even worsen existing inequalities. The digital divide is not a recent occurance. Even during the mid-1990s, the [National Telecommunications and Information Administration (1999)](#_ENREF_23) recognized that the digital divide is “one of America’s leading economic and civil rights issues.” As noted in the introduction, governmental agencies such as the FCC have since adopted policies in an attempt to reduce this divide. Despite these efforts, we continue to grapple with with the digital divide, especially with respect to broadband adoption ([Federal Communications Commission, 2016](#_ENREF_11)).

Many studies, including the [National Telecommunications and Information Administration (1999)](#_ENREF_23) report, note that demographic factors, such as income and urbanity, contribute to the digital divide. This is supported by the [Pew Research Survey (2015)](#_ENREF_26) which reports that the disparity in internet use is correlated with age, income, educational attainment, urbanity, and Spanish-speaking preference. For example, internet in the home stands at 48.5% among households less than $25,000 income, and 92.7% for households with more than $100,000. The disparity in the ability of households to afford computers and internet subscriptions is a commonly cited reason for this phenomenon. Another explanation is the disparity in quality (or even the availability) of broadband infrastructure across geography ([Greenstein, Peitz, & Valletti, 2016](#_ENREF_15)). However, beyond price (cited by 19 percent of those without internet) and accessibility due to infrastructure (cited by 7 percent of those without internet), there exists other commonly overlooked reasons for the digital divide. In fact, a majority of Americans who do not have internet explain that this is because they do not find the internet relevant (34 percent), or lack digital literacy (32 percent) ([Pew Research Survey, 2015](#_ENREF_26)). In other words, the digital divide appears to be primarily driven by issues related to broadband adoption rather than broadband access.

**Table 1. Pew Research Survey: Digital Divide 2015**

Reasons Given by Respondents for Lack of Internet in the Home

|  |  |
| --- | --- |
| **Reason** | **Percentage of Responses** |
| Price – Unable to Afford | 19% |
| Accessibility – Lack of Infrastructure | 7% |
| Lack of relevance – Content | 34% |
| Lack of digital literacy | 32% |

Whether the FCC’s 2015 Open Internet Order ameliorates or worsens the digital divide will depend on how it impacts these factors. We focus on the first three of these factors. Section III analyzes the effect of net neutrality on the price to the end consumer of accessing the internet. Section IV examines how net neutrality impacts investment in broadband infrastructure and therefore access. Section V looks at the potential impact of net neutrality on content quality and diversity, which in turn impacts the relevance of the internet to individuals. Our analysis has little to offer on how net neutrality might affect digital literacy. Section VI discusses our findings and lays out possible areas for future research. Section VII concludes.

# IV. Price

The total price paid by an end consumer for Internet use can be separated into (1) paid services (like a subscription to Netflix), and (2) last mile fees paid to Internet Service Providers (ISPs) like Time Warner. While it is possible that the price of a certain paid service might deter an individual from signing up for broadband access, it is more likely that last mile fees constitute a consumer’s primary consideration in broadband subscription. To the extent that net neutrality affects how or even whether an ISP can charge content providers, it will impact the fees that ISPs charge end-users. Hence, last mile fees are of interest to our analysis.

The formal economic analysis of last mile fees relies on the standard two-sided market model ([Armstrong, 2006](#_ENREF_1); [Armstrong and Wright, 2007)](#_ENREF_2). In a two-sided market model, Internet Service Providers provide platforms which bring together two sides of the internet market: Content Service Providers (CSPs) and consumers. In such a setup, consumers and CSPs benefit when more members of the opposite side are participating in the same platform, and the value of the platform increases when it is better able to attract both sides of the market. This effect is known as network externalities.

[Armstrong (2006)](#_ENREF_1) shows that, in a free market, a platform will aggressively try to attract the side of the market that exerts a larger positive externality on the other side. For example, Armstrong observed that credit card companies often aggressively woo consumers with discounts and other material incentives. This is driven by the credit companies’ belief that the participation of consumers attracts retailers more than participation by retailers attracts consumers. In other words, the consumer side of the market is seen as having a larger positive externality on retailers (and their decision to accept a given credit card), than retailers are seen as having on consumers’ decision to apply for and use a given credit card. In general, platforms that are connected to more valued end users can extract a larger surplus from the opposite parties, who value the latter’s participation.

In the current market, at any point in time, each end consumer/household subscribes to a single internet service provider.[[9]](#footnote-9) Hence, ISPs act as the gateway through which CSPs’ reach end consumers. Figure 1 illustrates this relationship. In a free market, ISPs are able to extract rents from CSPs when content providers value the connection to subscribed consumers in the ISP networks more than consumers value the connection to the content provided by CSPs. Therefore, in a free market, ISPs have the incentive to transfer some surplus from CSPs to consumers in order to both retaining existing customers and attracting new customers. Specifically, ISPs could charge CSPs higher prices in order to lower the last mile fees for consumers in an attempt to maximize their end user subscriptions.[[10]](#footnote-10)

However, with current net neutrality regulation as specified in the 2015 OIO, ISPs are not allowed to charge any CSPs. Hence, ISPs are forced to generate revenue solely from last mile fees, resulting in the likely increase of average price paid by end consumers. This rebalancing of the tariff is termed the waterbed effect ([Genakos & Valletti, 2012](#_ENREF_14)). While most existing literature does not dispute the validity of this effect, some papers claim that such a price increase for consumers may still result in overall welfare gains because of other potential benefits associated with net neutrality, such as increased content creation. The later sections in this paper will discuss the likelihood that such claims hold.

**Figure 1.** **Two-Sided Market of Internet Provision in the Status Quo.**

Arrows represent connections with a platform and the direction indicates the flow of content.

**CSPs**

**Consumers**

**ISPs**

Besides increasing last mile fees, the waterbed effect can have other secondary impacts on consumers. [Hermalin and Katz (2007)](#_ENREF_16) examine the consequences of net neutrality policies which might force ISPs to provide a *single* speed of Internet connection at the same price to end consumers. Their model demonstrates that this results in (1) the crowding out of users who can only afford Internet access with a lower quality of service, and (2) an average quality of service which is inadequate in meeting the needs of high-end users willing to pay more for a higher quality of service. Although the conditions tested by [Hermalin and Katz (2007)](#_ENREF_16) are somewhat different from the pricing restrictions imposed by the current OIO, their work underscores the tendency of price or quality regulations to affect both the quality of the service provided and market participation by consumers. In this example, low-end users who are only able or only willing to pay for a cheaper, albeit lower quality service, end up choosing to have no service at all once regulations force a single tier of service. Clearly, this would widen the digital divide.

Price restrictions on ISPs’ ability to charge content service providers that cause network congestion on network, can lead to higher prices charged to all end users, regardless of whether or not the end user subscribes to the content service causing congestion. (Hylton, 2016). At the margin, this would cause the lowest-end users to simply stop subscribing to internet services, further exacerbating the existing digital divide. And for low-end users who choose to continue subscribing, they are now paying a higher price all else equal, essentially because of demand for particular CPS from higher-end users. (Hylton, 2016).[[11]](#footnote-11)

Given the 2015 OIO, ISPs are forced to accept such negative externalities caused by only one or two current CPS and compensate by instead extracting rent solely from end consumers. Within the existing net neutrality regulations, there exist multiple ways of tariff rebalancing which can have reduced negative impacts on end consumers. As previously mentioned, ISPs may simply increase the price to end consumers. Alternatively (or in addition), they may choose to increase profitability by either lowering the quality of Internet service provided, restricting service to more profitable clients, or imposing data caps on subscriptions. For example, if an ISP is not allowed to charge a service like NetFlix, whose streaming service uses disproportionate amounts of data relative to other types of content on the internet, an ISP can increase rent extraction from end consumers by charging customers based not just on speed tiers, but also on data traffic usage tiers.*[[12]](#footnote-12)*[[13]](#footnote-13)

# V. Investment in Broadband Infrastructure

Internet usage in the United States has grown steadily over the past few decades. This growth was made possible with the expansion of broadband infrastructure largely initiated by profit-seeking ISPs. Prior to 2010, the FCC did not interfere directly with these infrastructural developments; the commission had only established four principles of net neutrality in 2005, which existed essentially in name only until the passing of the Open Internet Order in December 2010 ([Federal Communications Commission, 2005](#_ENREF_10)). This hands-off approach contributed to the ten-fold increase in high-speed broadband lines since 2002, giving more than 87.4% of individuals and 79% of households in the United States access to the internet ([Pew Research Survey, 2015](#_ENREF_26); [World Bank, 2015](#_ENREF_31)).

Still demand for high-speed connectivity continues to increase both with increased adoption by new households and with the growth of new services, such as Internet-TV, web conferencing and peer-to-peer sharing, which consume greater bandwidth than original internet content and services. Moreover, broadband infrastructure has not been developed uniformly across the country ([National Broadband Map, 2011](#_ENREF_22); [U.S. Census Bureau, 2013](#_ENREF_29)). Unlike major metropolitan areas, many rural areas, where ISPs do not find it profitable to build alternative lines, still do not have broadband backup systems and are vulnerable to service outages ([Malecki, 2001](#_ENREF_21)). These regions also have the lowest rate of Internet adoption. For example, in Mississippi, only about 62.3% of residents have access to the web ([U.S. Census Bureau, 2013](#_ENREF_29)). This is the urban-rural digital divide that the FCC has suggested that the OIO will help reduce.

To understand how net neutrality affects the digital divide, we need to examine the abilities and incentives of ISPs to pursue network investment given the imposition of pricing rules. Failure to expand broadband infrastructure to meet increasing demand can lead to five consequences ([Becker, Carlton, & Sider, 2010](#_ENREF_3)):

1. Reduction in geographic scope of broadband

2. Fall in the Internet’s backbone capacity

3. Increase in congestion and fall in quality of service (QoS)

4. Decrease in the number of ISPs in a given area

5. Rise in the price to connect to the net.

In response to recent calls for tougher net neutrality rules, ISPs have warned that they will have to suspend investments in broadband infrastructure and innovation due to the lack of profits. *The key argument here is that the ability to invest is a necessary condition for innovation. Without net neutrality rules, service providers are able to extract surplus from CSPs (*[*Njoroge, Ozdaglar, Stier-Moses, & Weintraub, 2013*](#_ENREF_24)*). All else being equal, this enables innovation for better quality of service, including in geographical areas that have low returns on investments. [Add citation of Economides and ? paper which admits that infrastructure effects will occur…..]*

Some models, assuming a monopoly pricing structure, suggest a different possible outcome. In such a setting, ISPs may be inclined to scale back innovation in order to create artificial scarcity. In this case, if ISPs innovate to increase overall content delivery, the relative value of its own priority lane is diminished. On the other hand, by restricting access to delivery speed, ISPs can increase their profits since more users will be inclined to purchase the speed upgrade. Under this scenario, ISPs have increased incentives to expand under net neutrality, contrary to the rhetoric of broadband service providers ([Cheng, Bandyopadhyay, & Guo, 2011](#_ENREF_5)). [Choi and Kim (2010)](#_ENREF_6) expanded upon this model by restricting the number of CSPs which can subscribe to high priority bandwidth at any one time. This ensured that the high priority bandwidth necessarily meant a speed upgrade in relation to an existing lower standard. Furthermore, their model identified two distinct effects which influence the level of ISP investment: the network access fee effect and the rent extraction effect. The network access effect implies that ISPs may want to expand capacity to speed up content delivery so they can charge consumers more for access. Rent extraction effect means that ISPs have incentives to invest in broadband infrastructure so that content service providers can create more profitable content for ISPs to “sell” at a higher price to consumers.

Many models have theoretically assumed a world in which all content providers are essentially the same. This assumption of homogeneity across CSP is unrealistic as demonstrated by the fact that Netflix content represented over 36% of downstream internet traffic in 2015 and offers completely different content and services from other providers such as Facebook or match.com or the Wall Street Journal Digital Edition. Ignoring heterogeneity among content service providers impacts the findings of these models. For example, different content service providers are impacted by congestion or network speed differently; interactive gaming services are going to be impacted by congestion differently from Netflix, and both will be impacted differently from the Wall Street Journal.

Such heterogeneity would lead to demand from congestion sensitive CSPs for priority lanes. In turn, ISPs would make different infrastructural investment decisions from those predicted by models with homogeneous content service providers. In particular, [Krämer and Wiewiorra (2012)](#_ENREF_19) suggest that there will be more incentive to invest in the absence of net neutrality regulation if ISPs believe that new congestive-sensitive CSPs will enter the market seeking the priority lanes which can be made even faster after broadband expansion. Moreover, the [Krämer and Wiewiorra (2012)](#_ENREF_19) model finds that under net neutrality, infrastructure upgrades could be insufficient to bring the mean speed up to a level that attracts these congestive-sensitive CSPs.

All in all, it is important to recognize that investment decisions by ISPs are not driven by any single factor alone. Regulation is only one of many influences affecting broadband infrastructural development. Other factors include prevailing interest rates and ISPs’ expectation of service demand ([Ford, 2015](#_ENREF_12)). *The various models we have cited are often designed with the objective of analyzing the ceteris paribus effect of regulation. As such, they are not particularly useful in forecasting future outcomes and should not be discredited simply because they appear inconsistent with certain empirical observations.* Instead, models should be evaluated *a priori* according to the validity and applicability of their assumptions. *With that in mind, existing literature has yet to examine in-depth the role of market structure effects in determining the pursuit of innovation both in broadband and in content*. A market that consists of many small players may not be most suitable for encouraging those investments which require high startup fees, since each firm would not individually have the necessary capital. Broadband provision is an example of an industry which may require market concentration to support expensive infrastructure investments, such as the building of landlines. Insofar as net neutrality has the effect of reducing ISPs’ monopoly power, it will also have an impact on infrastructure investments.

# VI. Content Quality and Diversity

The internet is valuable by virtue of its ability to connect people, to deliver content and services from one party to another. Whether the internet is relevant to individuals depends on whether it provides content and services that they value. To date, much work has been completed on content quality and diversity, which we believe serve as useful proxies for relevance to especially when considering *heterogeneous* consumers. This rests on the assumption that with rising content quality and diversity, more people may find information or services on the internet that are relevant to their particular interests or tastes. In our analysis that follows, we broadly define q*uality* to include (1) transmission quality, which we think of as how satisfied viewers are with the delivery of their content, as well as (2) the inherent value of the content to viewers. One interpretation of *diversity* is the variety of content types available.

A key aspect of content quality is how well it is transmitted to the end user. The effect of net neutrality on the allocative efficiency of bandwidth and congestion is therefore relevant. First, we note that different content has different demands for bandwidth. For example, content is said to be *time sensitive* if its quality is adversely degraded by delays. A common argument is that net neutrality, which prohibits the prioritization of such content over less time sensitive ones, could result in an allocative inefficient use of bandwidth ([Wu & Yoo, 2007](#_ENREF_32)). Others however, like [Economides and Hermalin (2012)](#_ENREF_8) suggests that time sensitivity of content may not translate to a higher elasticity of demand with respect to transmission time. That is, it might not be necessarily true that content that is adversely degraded by delays is also the same content that receives higher quantity demanded following a reduction in delay. Given that assumption, then non-net neutrality might in fact inefficiently allocate bandwidth (in the economic sense) by prioritizing the most time sensitive content. *However, we note that ultimately, non-net neutrality allows content service providers (CSPs) to pay for priority access if it is profitable – there is no statement about time sensitivity. If anything, net neutrality constrains the market to allocating bandwidth equally across applications, and such a setup cannot result in allocative efficiency, if the marginal utility from additional bandwidth for the applications differ. Therefore, it is unambiguous from existing research that non-net neutrality is more likely to result in a more efficient allocation of bandwidth and consequently, improve content quality in this respect.*

Another crucial dimension is the market structure and subsequent creation of content by content service providers under the net neutrality versus free market regimes. Proponents of net neutrality argue that such regulation will raise content diversity and quality by acting as a *de facto* “subsid[y] to the production of content and inventions” ([Lee & Wu, 2009](#_ENREF_20)). Similarly, [Choi and Kim (2010)](#_ENREF_6) develop a model in which the absence of net neutrality regulation will reduce CSP profit margins and incentives for investment in content (since ISPs will be allowed to potentially extract rent from CSPs for utilizing high priority channels). This would then translate into lower quantity, quality and diversity of content. A further concern brought up in the literature is that ISPs may engage in anti-competitive behavior, by prioritizing affiliated content or blocking applications that diminish their revenues sources ([Cerf, 2006](#_ENREF_4); [Frischmann & van Schewick, 2007](#_ENREF_13); van Schewick (2007); [Krämer & Wiewiorra, 2012](#_ENREF_19)). Such behavior would raise the cost of entry for and diminish the profitability of independent content providers, thereby diminishing total opportunities for content innovation.

From a policy perspective, an additional concern raised by proponents of net neutrality is that ISPs may be able to effectively censor content by significantly raising the price they charge or by reducing the bandwidth they assign to particular CSPs. Such a scenario would not only diminish the diversity of content, but also threaten the role of the Internet as a platform for free speech. However, *most economist* note that it will not be in the incentive of ISPs to censor popular content since doing so would lead to consumers switching to other ISPs that still offer this desired content ([Connolly and Prieger (2013)](#_ENREF_7), *Katz (2016), Jamison and Hauge (2007), list many others*).

Other studies that suggest that content investment decisions will not be adversely affected under net neutrality. Due to network externalities, ISPs want high value CSPs in their networks, hence it may not be their interest to rent seek to the point of driving out high value CSPs. Contrary to [Choi and Kim (2010)](#_ENREF_6), [Jamison and Hauge (2007)](#_ENREF_18) suggests that this effect might be sufficiently strong. If true, CSP investment might not be significantly affected. Whether [Choi and Kim (2010)](#_ENREF_6) or [Jamison and Hauge (2007)](#_ENREF_18) is a closer description of reality depends on the market structure of ISPs and CSPs; if ISPs have strong monopoly power while CSPs have limited market power, it is plausible that monopolies are able to rent seek. But if CSPs possess *exclusive* content that consumers value *(such as original content created for Netflix or Hulu or Amazon)*, ISPs would have less rent seeking power. The problem is complicated by the existence of CSPs with widely different market structures, from less substitutable CSPs (some might list Facebook and Google as examples) to more substitutable ones (e.g. news networks, blogs). Under this complex regime, it is not immediately obvious how market structure effects will shape ISPs’ ability to rent seek and therefore impact investment by CSPs.

Meanwhile, some studies have attempted to understand how net neutrality might affect content diversity using market structure effects. [Reggiani and Valletti (2011)](#_ENREF_27)’s modelpredicts that non-net neutrality could redirect resources to one large firm. This decreases the diversity of content, if one assumes that smaller fringe firms can now provide less unique content. However, other studies, such as [Greenstein et al. (2016)](#_ENREF_15), put forward the possibility that non-net neutrality may in fact help smaller CSPs, who unlike large CSPs, do not have “other means to deal with congestion issue”. Smaller firms might in fact invite the possibility of prioritized access without larger forms of up-front investments to address congestion issues. In addition, [Hermalin and Katz (2007)](#_ENREF_16) suggest that net neutrality restricts all CSPs to using bandwidth of the same quality – with price corresponding to that quality. This prices out applications that would only purchase low quality bandwidth – for example, email services that are less time-sensitive than video streaming services may not derive additional value from priority access. In this way, net neutrality might hurt content diversity.

We note that a key assumption made in this discussion is that content diversity depends on the number of firms, especially small ones. This assumption could be true if these smaller firms offer niche content that is not readily provided by larger content service providers. However, there are also reasons to believe why a positive monotonic relationship between the number of content service providers and the diversity of content might not hold. *For example, in the presence of economies of scale or competitive considerations where a large CSP would want to offer a wide variety of content rather than a ton of similar content in order to encourage consumers to subscribe to their service, an additional unit of investment by a large CSP could result greater diversity of content relative to an additional unit of investment by a small content provider.[[14]](#footnote-14)*

*Furthermore, we have yet to find discussion on the effectiveness of the said de facto subsidy. It should not be assumed that the CSPs must be significantly better off if they do not need to pay ISPs. In a world where we allow CSPs to interact directly with end consumers, CSPs may choose to transfer this savings to end consumers in order to encourage their continued participation in the two-sided market in spite of the waterbed effect. More research is required to thoroughly examine the likelihood of such a CSP strategy.*

# VII. Discussion

On balance, existing economic models with more flexible and realistic underlying structural assumptions, predict that the Open Internet Order is more likely to result higher last-mile prices, lower infrastructure investment, and poorer content quality and diversity. From this perspective, economic theory seems to support [Singer (2015)](#_ENREF_28)’s hypothesis that the Open Internet Order has already discouraged ISP investment. If the models hold true, the Open Internet Order might be worsening the digital divide, contrary to its intent. *That being said, the Open Internet Order also serves other social objectives. To the extent that closing the digital divide is an important objective for policymakers and our society, the economic considerations that we have raised should be weighed against these other objectives.*

Every economic model relies on restrictive assumptions. Some times this is necessary to be able to focus on other dimensions that are of particular interest and simplifying assumptions are made for aspects that are not being considered directly or can be taken as exogenous to the policy question at hand. Even assumptions that may not necessarily hold in the real world can be perfectly reasonable within models trying to focus on particular mechanisms so long as these assumptions do not bias/guarantee particular outcomes. However, many existing models which purport to find positive social welfare effects from net neutrality regulations are making restrictive, if not misleading, assumptions on issues related to market structure (including entry and exit of firms), entry and exit of consumers in the end user market for internet service, ignoring the relevance of the surplus of all economic participants (rather than just consumers and CSPs) to estimates of social welfare, and empirically and theoretically unjustified assumptions both on the relationship between number of firms and content quality and diversity and on the relationship between volume of content and consumer welfare). We would like to point out that many of the assumptions made be certain specific papers relating to a theoretical evaluation of net neutrality regulations are not appropriate for the market under consideration and much more damningly, strongly bias – when not outright guaranteeing specific findings. Examples of such assumptions were noted in previous discussions of existing models.

We have not here proposed our own model to estimate the impact of the 2015 OIO’s application of the concept of net neutrality. Our intent here is simply to warn policy makers and non economists of the shortcomings of some of the work that has been done on this topic which is often presented in a very technically impressive manner and yet lacks the scientific impartiality to point out to readers where its own limitations lie.

However, there are key aspects that any such model would need if it wishes to truly consider the dynamic and endogenous market outcomes under the imposition of these new regulations.

*Need heterogeneous CSPs, heterogeneous consumers, must consider total welfare impacts (on consumers (through pricing and quality and diversity of service), on CSPs, and on ISPs)*

First, we want to address the welfare claims of various models. Models tend to consider only consumer surplus and content provider profits in their analysis of total welfare gains (e.g. [Economides and Tåg (2012)](#_ENREF_9), [Choi and Kim (2010)](#_ENREF_6)). These models explicitly exclude ISP producer surplus when estimating “total social welfare”. With such a definition of total social welfare, any policy which simply takes all producer surplus from ISPs and hands it to either consumers or CSPs will by construct increase this erroneously titled “total social welfare”. This would not reflect a rise in *total* welfare, simply a transfer of welfare.

Second, the analysis of content quality and diversity has been restricted to *media* content. In reality, we observe that there are other gains from internet services beyond the simple consumption of content (e.g. services, labor market, legal information, matching markets, public announcements). In fact, it is these services that make the internet an empowering tool and give cause for concern about the digital divide. By assuming media content type, models make the assumption that content service providers are primarily motivated by either subscription fees or advertising revenues. Their economic decision on investment therefore varies with these considerations. However, it is plausible that alternative business models exist, or that some content providers, e.g. governments, are not motivated by profits. Given the significance of these varied internet services to the digital divide discussion, future research should take into account such nuances.

Third, we need to consider the market structure of CSPs and ISPs. As noted earlier, it is commonly assumed that ISPs enjoy monopoly power while CSPs are small and fragmented. The presence of large, influential CSPs such as Netflix, Google, and Facebook suggests that this assumption is misleading. [Armstrong and Wright (2007)](#_ENREF_2)’s analysis of two-sided markets suggests that market structure and power dynamics can considerably change the outcomes. Hence, the analytical power of current models is considerably limited by this assumption.

# VIII. Conclusion

We reviewed recent developments in the economic understanding of net neutrality, and analyzed studies relevant to understanding the effects of the Open Internet Order on last-mile price, internet infrastructure investment and content – factors that contribute to the digital divide. Existing economic theories and models allow for the Open Internet Order to act on the state of digital divide in either direction. On balance, however, they suggest that the regulation is more likely to worsen than improve the digital divide, based on the three factors we analyzed. This result is not conclusive, due to the presence of considerations yet to be accounted for by existing models. We highlighted three such considerations, namely, (1) social welfare analysis, (2) content type and (3) ISP and CSP market structure.

The FCC’s 2015 Open Internet Order is a regulation that can have profound impact on the internet industry and the consumers it serve. The welfare considerations in question are not trivial.

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1. Corresponding author. Tel.: +1 919 660 1819. *E-mail address*: [mconnoll@duke.edu](mailto:mconnoll@duke.edu) 213 Social Sciences, Box 90097, Department of Economics, Duke University, Durham, NC 27708. [↑](#footnote-ref-1)
2. 2016 Broadband Progress Report, FCC, 2016, p. 3. [↑](#footnote-ref-2)
3. The absence of internet service in a household does not necessarily result from a physical lack of access to broadband. For a majority of these households without internet it is the case that households *chose* not to subscribe to the internet for various reasons such as price, a perceived lack of relevance, or a lack of digital literacy. We detail these in Section II. [↑](#footnote-ref-3)
4. The 2015 OIO states “The record before us also overwhelmingly supports the proposition that the Internet’s openness is critical to its ability to serve as a platform for speech and civic engagement, and that it can help close the digital divide by facilitating the development of diverse content, applications, and services.” (FCC, note 77, p. 27) [↑](#footnote-ref-4)
5. Using data from U.S. Securities and Exchange Commission (S.E.C) filings, [Singer (2015)](#_ENREF_28) reports that the capital expenditure of major ISPs decreased from 2014 to 2015, including AT&T (-29%), Charter (-29%), Cablevision (-10%), Verizon (-4%), averaging -12% across wireline ISPs and -8% across all ISPs, including wireless ones. Singer calls this phenomenon ‘remarkable’, because such ‘capital flight’ was observed only twice in U.S. broadband history, during the 2001 dotcom meltdown and the 2009 recession. [Singer (2015)](#_ENREF_28) considered other factors that could have resulted in ISP reducing capital expenditure, including changes in GDP, consumer expenditure and ISP revenue. However, these considerations suggested a positive environment for ISPs, meaning that ISPs should have increased expenditure under these circumstances. Hence, after eliminating possible confounding factors, [Singer (2015)](#_ENREF_28) concludes that the decrease in ISP investment may be attributed to the introduction of the Open Internet Order. [↑](#footnote-ref-5)
6. Depending on the mechanisms that the authors choose to highlight in the creation of their models, a wide variety of welfare impacts have been suggested by different authors. We hope to choose a few key models to highlight which mechanisms drive which overall conclusions put forward by certain authors and comment on whether these can or should be considered in isolation of other mechanisms when making claims about overall welfare implications. [↑](#footnote-ref-6)
7. Most obviously, any models which consider homogeneous consumers and/or do not allow end users the choice to simply opt out of purchasing internet service, will by definition not be able to address certain aspects of the digital divide. Similarly, assumptions of homogeneous content service providers which all provide equal amounts of utility to consumers will have misleading welfare implications. [↑](#footnote-ref-7)
8. Brennen (2016), p. 6. [↑](#footnote-ref-8)
9. This holds if we ignore mobile broadband access. [↑](#footnote-ref-9)
10. It should be noted that Economides and… assume the reverse, that the externality from CSPs on consumers is greater than the externality from consumers on CSPs. This clearly impacts the social welfare outcomes in that paper. [↑](#footnote-ref-10)
11. Michael Powell also made this argument at the Free State Foundation's Fifth Annual Telecom Policy Conference on March 21, 2013. [↑](#footnote-ref-11)
12. Gryta and Ramachandran (2016) already noted the increased use of broadband data caps by ISPs: “Consumer complaints to the Federal Communications Commission about data caps rose to 7,904 in the second half of 2015 from 863 in the first half, according to records reviewed by The Wall Street Journal under the Freedom of Information Act. As of mid-April, this year’s total was 1,463. They further quote Jonathan Williams who studies internet usage as stating that broadband companies are ‘… all of a sudden bearing all the costs associated with somebody else’s service.’ (WSJ, April 22, 2016) [↑](#footnote-ref-12)
13. Katz (2016) notes that proponents of net neutrality are now arguing for ISPs to not be allowed to impose data caps… [↑](#footnote-ref-13)
14. This has to do with issues of bundling where profitability increases with the addition of dissimilar content since it increases the number of subscribers (of differing tastes) who will be willing to subscribe to a particular service like Hulu or Netflix.(cite all of the bundling literature). [↑](#footnote-ref-14)