An analysis of options for reforming the Universal Service Fund funding mechanism

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Executive summary

The Universal Service Fund, established by the Telecommunications Act of 1996, distributes over $8 billion each year. Although the total size of the Fund has been stable over the past decade, the current trajectory for funding universal service is unsustainable. The contribution base has long been interstate and international retail (end-user) telecommunications revenue from services provided to the public. But that contribution base is shrinking, and so the contribution rate to fund universal service has increased from 11.5% in 2009 to 33.9% in 2024. In short, the current funding model is increasingly inadequate as the communications landscape evolves.

This report lays out the fundamental principles that should guide the choice of an alternative funding mechanism. Since taxes and fees have identical economic impacts, these principles are drawn from the well-developed economic literature on optimal taxation. Specifically, we consider the principles of efficiency, fairness, administrability, and salience.

Next, the report examines eight potential revenue bases for funding. For each, the potential contribution base available for a reformed Fund is estimated. Next, the report evaluates various combinations of these revenue sources in light of the principles of optimal taxation to estimate the likely tax rate, direct consumer tax burden, excess burden, and tax equity of the alternatives.

Several striking results stand out. *First*, the status quo is horrendously inefficient, with consumers bearing an excess burden of $2.1 billion, or about one-quarter the size of the $8.3 billion in revenue raised. This is a staggering amount of lost consumer benefits.

Second, the most promising options involve taxing various digital services, specifically a digital advertising tax, a Digital Services Tax (on digital advertising, cloud computing, streaming, and platform agency revenues), a Digital Natives Tax (on digital advertising, cloud computing, and Internet service revenues), and a Digital Ecosystem Tax (on digital advertising, cloud computing, streaming, platform agency, Internet service, and telecommunications revenues). Notably, all four options score highly on tax equity.

Third, if the goal is to shield consumers from the tax burden, then taxing digital advertising is likely the best option with a contribution rate of 3.2%, a direct consumer tax burden of $2 billion, and an excess burden of $1.6 million.

Fourth, if the goal is to spread the tax burden across more firms, the Digital Services Tax, Digital Natives Tax, and Digital Ecosystem Tax all excel. A Digital Services Tax would result in a 1% contribution rate, a $5.4 billion direct consumer tax burden, and a $20.2 million excess burden. A Digital Natives Tax would result in a 0.9% contribution rate, a $5.9 billion direct consumer tax burden, and a $15.4 million excess burden. A Digital Ecosystem Tax would result in a 0.8% contribution rate, a $6.1 billion direct consumer tax burden, and a $15.6 million excess burden.

Fifth, relying on appropriations instead of a special funding mechanism would only require a contribution rate of 0.06%. However, since income is already heavily taxed, this would result in a direct consumer burden of $4.6 billion and an excess burden of $1.1 billion—a high degree of tax inefficiency.

In short, reform is not just desirable but necessary given the inefficiencies of the current funding model. Well-designed reform can better align universal service funding with the evolving digital economy while reducing economic distortions.

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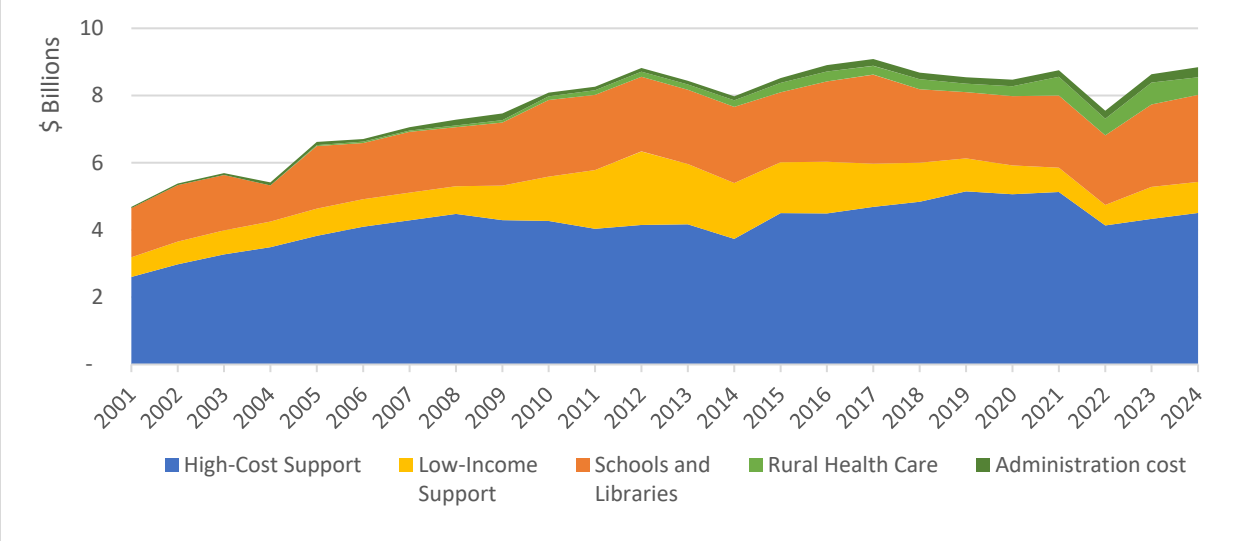
I. Introduction

This report examines options for reforming the Federal Communications Commission's Universal Service Fund contribution method. The current funding model, which is dependent on a subset of telecommunications services (mostly voice services), is increasingly inadequate as the communications landscape evolves. This report evaluates several alternative funding sources, including revenue from Internet service, digital advertising, cloud computing, streaming services, platforms, e-commerce, and general appropriations. Various combinations of these revenue streams are proposed and evaluated for a new mechanism to fund universal service.

II. Need to reform funding for universal service

The Universal Service Fund is an $8+ billion fund that stems from the Telecommunications Act of 1996 and is comprised of four support mechanisms. The High Cost program supports companies that provide telephone and Internet service to customers in high-cost rural areas. The Low Income program subsidizes directly the cost of telephone and Internet service for low-income customers. The Rural Health Care program lowers the cost of telecommunications services for rural health care providers to levels paid by their urban counterparts. Finally, the Schools and Libraries program, colloquially known as the E-Rate, subsidizes telecommunication and Internet services and related equipment for schools and libraries. As shown in Figure 1, the High Cost portion of the Fund makes about half of total spending, while the E-Rate program accounts for about a third of disbursements.

Figure 1: USF disbursements by type of funding and administration cost[1]



[1] Data on disbursements are from Table 1.10 of the 2024 Federal-State Joint Board Monitoring Report. Federal-State Joint Board on Universal Service, *Universal Service Monitoring Report* (2024), *available at* https://docs.fcc.gov/public/attachments/DOC-408848A1.pdf. Data for the administration cost and 2024 disbursements

Although the total size of the Fund has been stable over the past decade, the current trajectory for funding universal service is unsustainable because the contribution base is shrinking. From the inception of the Fund, the contribution base has been interstate and international retail (end-user) telecommunications revenue from services provided to the public. These revenues accrue mainly from offering voice service, whether provided by means of landline telephones, mobile phones, or VoIP. A small part of the contribution base additionally comes from other telecommunications services such as interstate paging services and radio dispatch services.[2] For purposes of this paper, we use the term "telecommunications revenues" to describe the current contribution base.

The specific amount each telecommunications firm must contribute is determined as follows. Four times a year, the carriers report their expected revenue for the next quarter to the Universal Service Administrative Co. (USAC). USAC projects the needed funds to satisfy the support obligations, including its administrative expenses, and sends the information on the revenue and expected disbursements to the Commission. The Commission then sets the contribution factor (effectively, the "tax rate" currently used to support universal service) for the next quarter based on the information from USAC. The first step in computing the contribution factor is to calculate the revenue base for the assessed contributions. The Commission finds the contribution base by adjusting the industry's projected interstate and international telecommunications revenue to remove projected payments to the Fund and an assumed 1% uncollectible revenue. The contribution factor is then determined by dividing the projected disbursements by the contribution base.

The difficulty with the contribution base, and therefore the contribution factor, stems from the fact that revenue from interstate and international voice calling has been declining for years. The relevant industry revenue from these telecommunications services since 2000 is shown in Figure 2. While revenue in the 2000s was between $70 and $80 billion each year, it has been declining since 2008. The adjusted contribution base is shown with the green line in Figure 2, and it has also been declining roughly in step with industry revenue.[3] Consequently, even if the total amount of universal service funding had remained unchanged, the contribution factor would have had to increase. In fact, as Figure 1 shows, payments from the Fund to recipients grew steadily until 2012, although they have largely remained stable since then. In 2024, the Fund's payments and administrative expenses totaled $8.5 billion.

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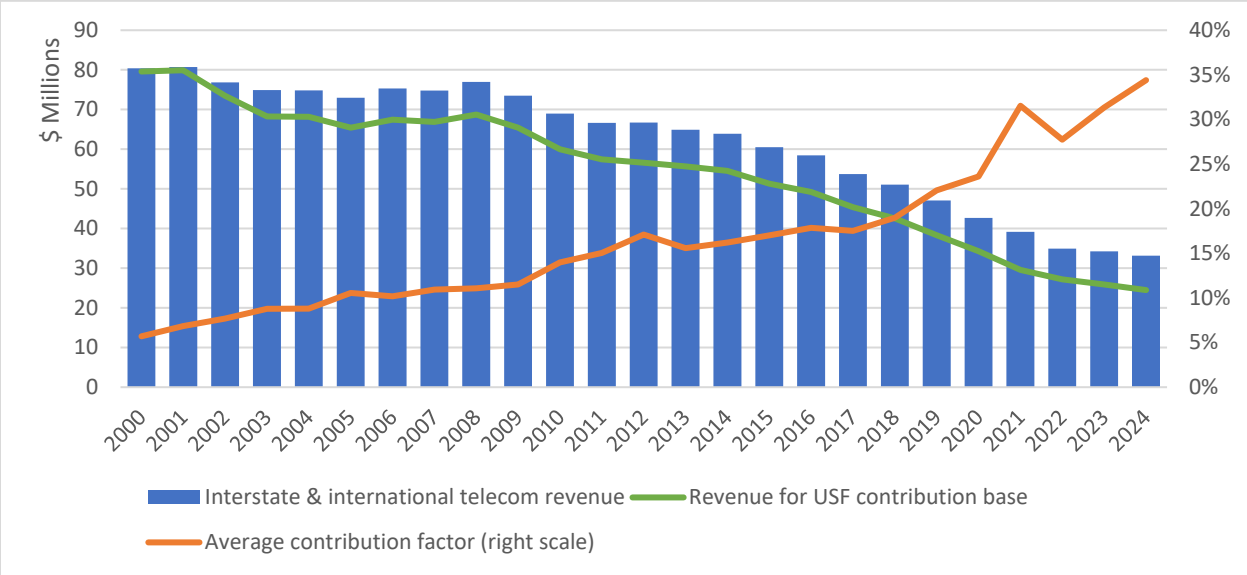
are from USAC Annual reports, various years. *See, e.g.*, Universal Service Administrative Co., *2024 Annual Report* at 17 (2024), *available at* https://www.usac.org/wp-content/uploads/about/documents/annual-reports/2024/2024_USAC_Annual_Report.pdf. Reports for other years may be found at https://www.usac.org/about/reports-orders/annual-report/.

[2] The Communications Act permits the Commission to require "any other provider of interstate telecommunications" to contribute to the funding for universal service, if such is deemed to be in the public interest. 47 U.S.C. § 254(d). It was under this authority that the Commission required VoIP providers to begin contribution to the Fund in 2006.

[3] In the first years of the program, the adjusted revenue for the contribution base was computed other ways. This explains why the contribution base did not materially diverge from unadjusted industry revenue until 2002.

Figure 2: Industry revenue (in current dollars) and contribution rates[4]



Note that the method used to determine the contribution base for the Fund requires that the base shrinks at a *faster* rate than industry revenue. As described above, the formula to compute the contribution base is:

Quarterly contribution base = (quarterly projected revenue – projected USF needs) × 99%,

where the final term reflects a 1% discount for revenue assumed to be uncollectible by the service providers. Since the base is computed from revenue by subtracting what is essentially a fixed amount in recent years—the projected disbursements from the Fund—a 10% decline in revenue implies a greater proportional decline in the base.

For example, assume the Fund requires $8 billion. If revenue is $40 billion, then the base would be $31.7 billion, and if revenue were to decline by 10% to $36 billion, the contribution base would drop to $27.7 billion, a 12.5% decline. However, if the original revenue were $20 billion, the base would be $12.9 billion, and a 10% decline in revenue to $18 billion would drop the contribution base to $9.9 billion, a 23.2% decline. The more-than-proportional decline in the base is exacerbated as revenue shrinks but the necessary contributions do not. This is why the upward slope of the contribution factor seen in Figure 2 is greater than the downward slope of revenue, particularly in recent years. The end point of this logic is clear: As industry revenue shrinks toward the amount needed by the Fund, the base shrinks to zero and the contribution factor races upward toward infinity.

[4] Data for revenue and the contribution base are from various years of the FCC Federal-State Joint Board Monitoring Reports, typically Table 1.11 in recent years (for example, *2024 Monitoring Report*, op. cit.). Monitoring reports back to 2011 are available from https://www.fcc.gov/general/federal-state-joint-board-monitoring-reports, while older reports are available from https://www.fcc.gov/general/monitoring-reports-2010-and-earlier. The quarterly contribution factors are shown as annual averages in the figure. The quarterly contribution factors for recent years are from USAC, *Contribution Factors*, https://www.usac.org/service-providers/making-payments/contribution-factors/, while older years are available from https://www.fcc.gov/general/contribution-factor-quarterly-filings-universal-service-fund-usf-management-support.

The combination of a shrinking revenue base and (in the earlier years) growing disbursements from the Fund resulted in a steadily increasing contribution factor. As shown in Figure 2, the contribution factor was only 5.7% in 2000, but the quarterly factors had risen to average 34.4% by 2024.

Figure 3 illustrates projected industry revenue through 2029 and its impact on the contribution base and factor. The forecast is based on an econometric model in which year-on-year changes in revenue are functions of revenue changes in past years and unforeseen factors. Such models, known as autoregressions, are commonly used to forecast time series such as these.[5] To explore the impact of various modeling assumptions and ensure that the main conclusions hold regardless of the details of the forecasting, three forecasts are shown here. The first forecast, shown in panel A of Figure 3, uses nominal revenue in the estimation. The second uses inflation-adjusted revenue (depicted in nominal values for comparability) to hone in better on the decline in revenue caused by real market forces (i.e., supply and demand instead of the overall price level in the macroeconomy). The results, shown in panel B, are substantially similar to those in panel A. The third forecast, shown in panel C, uses the logarithm of nominal revenue (again, the results are depicted in nominal values). Forecasting using logarithms can improve the model's fit in some cases.[6]

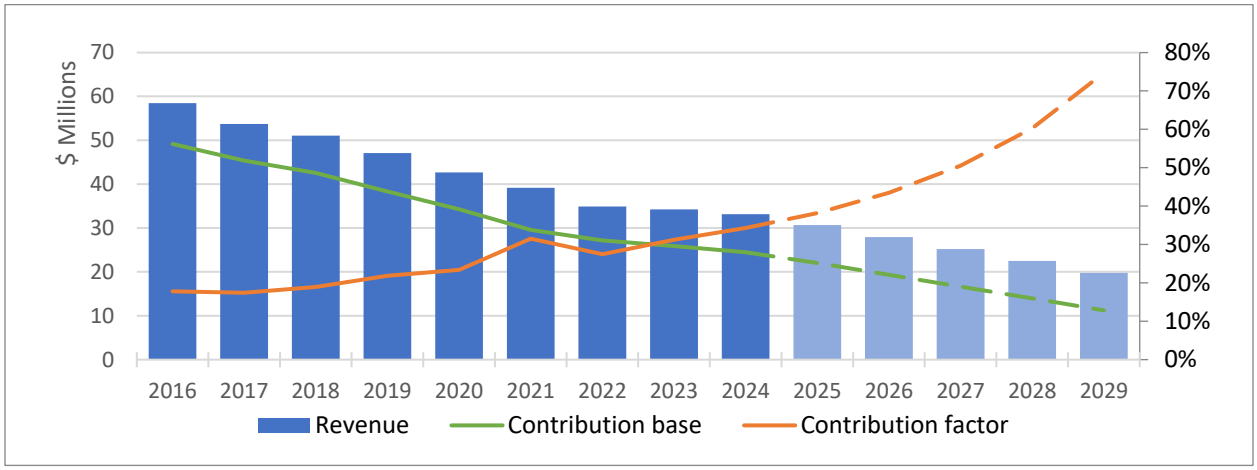
Assuming that expenditure from the Fund remains the same (i.e., no new obligations and no upward adjustments for inflation), the contribution factor is predicted to be between 50% and 75% by 2029. The first two forecasts lead to the higher figure, while the third forecast leads to the lower. Despite the inherent uncertainty in any forecasting exercise and the wide range of the predicted contribution factors, the conclusion is clear: All of these modeling assumptions lead to clearly unsustainable levies.

[5] The second-order autoregressions are fit to changes in revenue instead of revenue itself because statistical testing indicated that the revenue levels were not stationary but the revenue changes were. The assumptions of the model require that the data series be stationary, which is a concept from probability theory that implies that past values of the data are informative about future values so that they can be forecasted.

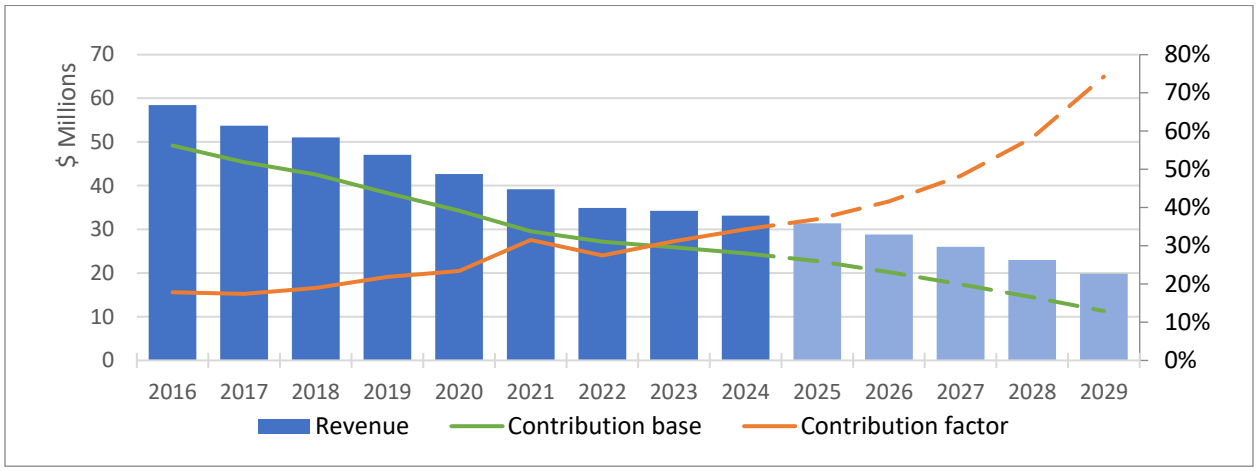
[6] A secondary benefit of forecasting changes in logarithms is that the procedure ensures that the forecasted revenue will remain positive no matter how long the forecast horizon. This is why the revenue forecasted in Panel C declines at a gentler rate than the other forecasts.

Figure 3: Forecasted industry revenue and contribution factors (in current dollars)[7]

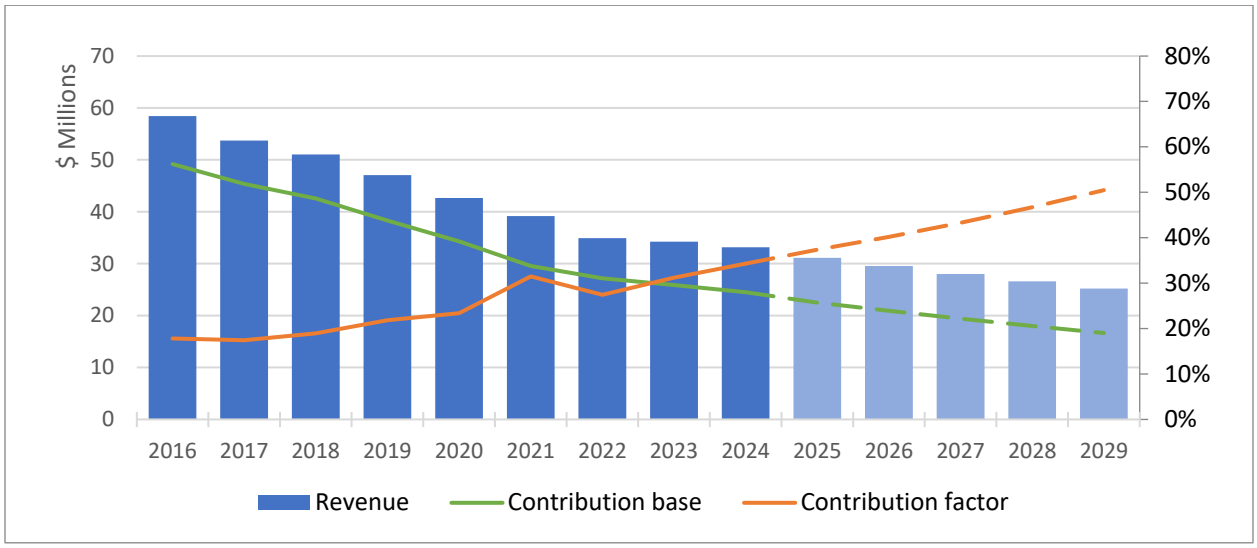
Panel A: Forecasts based on nominal revenue[8]



Panel B: Forecasts based on real revenue[9]



Panel C: Forecasts based on nominal log revenue[10]



III. Optimal taxation and tax incidence

Before analyzing particular options for reforming funding for universal service, it is important to understand the fundamental principles that should underlie the choice of funding mechanism. To do so, we draw on the well-developed economic literature concerning optimal taxation, since the economic impacts of taxes and fees are identical.[11] Specifically, we consider four main principles of optimal taxation: efficiency, fairness, administrability, and salience. We begin with a review of the economic incidence of a tax since it is the foundational concept underlying at least the first two principles.

While there may be much political wrangling over which party is taxed under the law, the actual question of which side pays the tax—the buyer or the seller, a firm or its customers, etc.—does not depend on the legal incidence of the tax at all. Elementary principles of microeconomics show that regardless of which side of an economic transaction bears the legal burden to pay the tax, the actual economic incidence is determined by fundamentals of the market such as the price elasticities of demand and supply, the degree of market power of the various parties, and so forth. For example, in competitive markets with constant marginal costs of production, whether the buyer or the seller is obligated to pay a unit tax on purchases or sales does not matter. In either case, the market price will rise by the full amount of the tax and the consumer bears the entire burden. Conversely, if demand is completely price-elastic in a competitive market (as would be the case if only one out of a set of perfectly substitutable goods were taxed), then the market price would not change at all, and firms would bear the entire burden of the tax,[12] regardless of the legal incidence.

[7] It is assumed that USF needs remain at 2024 levels, with no new funding obligations or inflation adjustments. All figures shown are in nominal (current) dollars.

[8] In Panel A, forecasts are based on a second-order autoregression fit to differenced nominal revenue (an AR(2) process).

[9] In Panel B, forecasts are based on a second-order autoregression fit to differenced real revenue (an AR(2) process) and a first-order autoregressive-moving-average process fit to the differenced producer price index (PPI) (an ARMA(1,1) process). Nominal revenue is converted to real revenue by dividing by a composite producer price index for wired and wireless telecommunications services (using data from the BLS). The composite PPI is a weighted average of the PPIs for wired service (2/3 weight) and wireless service (1/3). The weights were chosen to approximate the composition of revenue eligible for determining the contribution base for the USF in recent years. To convert the forecasted real revenue back to nominal dollars, the figures were multiplied by the forecasted PPI.

[10] In Panel C, forecasts are based on an AR(2) process fit to differenced log nominal revenue. The forecasts are converted to levels from log with the exponential transformation (adjusting for the forecast error per Lütkepohl, H., & Xu, F., The role of the log transformation in forecasting economic variables, *Empirical Economics*, 42, 619-638 (2012)).

[11] Although the Commission has characterized USF contributions as "fees", the 5th Circuit Court of Appeals ruled in July 2024 that instead they are in actuality "taxes." *See Consumers' Research et al v. FCC*, No. 22-60008 (5th Cir. en banc 2024).

[12] In this case, the firms would supply less in total, moving down the industry supply curve until the marginal cost of production was reduced by the amount of the tax. The firms would receive take-home revenue of the original price less the tax for each unit sold.

For the case of competitive markets, the economic incidence of a tax of $\$t$ per unit is a function only of ε_D, the price elasticity of demand, and ε_S, the price elasticity of supply:[13]

$$\boldsymbol{PT_C = \frac{\varepsilon_S}{|\varepsilon_D| + \varepsilon_S}} \qquad \boldsymbol{PT_F = 1 - PT_C} \tag{1}$$

where PT_C is the fraction of the tax passed through to consumers and PT_F is the fraction borne by firms.[14] This formula may be more complex in cases where buyers or sellers have market power, but even in such cases the general insight remains: Other things equal, when the buyers' demand is relatively more sensitive to price than the sellers' supply function, the firms will bear most of the tax burden. Conversely, if the firms' supply function is more elastic than the demand function, consumers will bear most of the tax burden.

A. Economic efficiency of a tax

The first principle of optimal taxation, and by far the most studied in the economic literature, is efficiency. Efficient taxation avoids distorting market activity away from the quantities produced and sold in the no-tax equilibrium. Since real-world taxes inevitably distort some economic behavior, they create an *excess burden* for society (also known as *deadweight loss*), a monetary measure of economic inefficiency. The excess burden of a tax puts a price tag on the forgone economic benefits to all parties—the sum of lost consumer benefits and lost profits—from the tax-distorted price. Given any particular need for tax revenue, the efficiency principle states that the best tax is the one that creates the least excess burden.

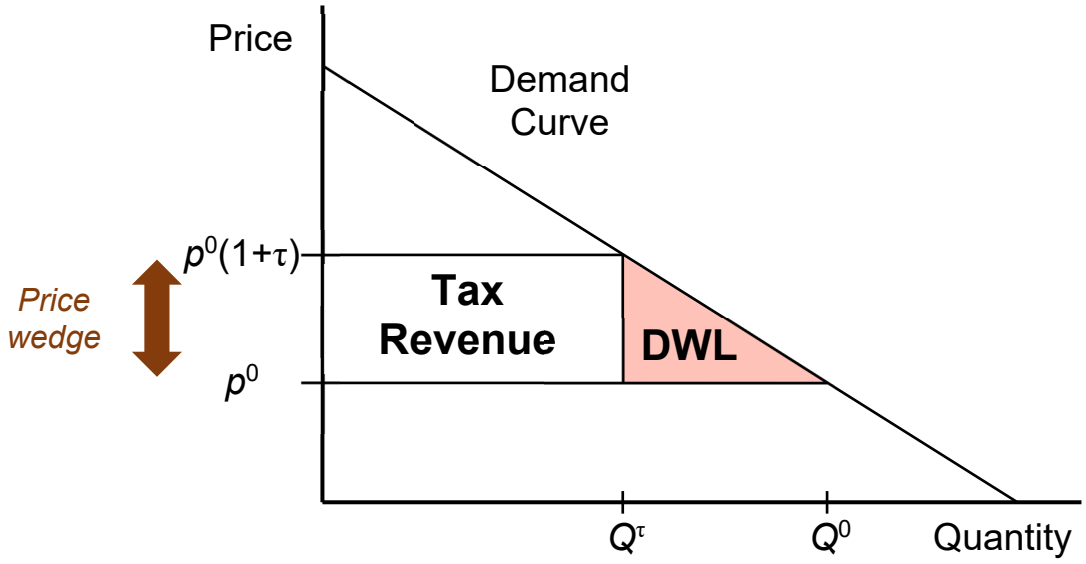
The inefficiency from a tax in a simplified market with pre-tax price p^0, an ad valorem tax at rate τ, and 100% passthrough of the tax to consumers is shown in Figure 4. The direct burden of the tax, labeled as tax revenue in the figure, is shown as fully borne by the consumer, although this assumption will be relaxed as needed in the empirical analysis that follows. The excess burden discussed above—the portion proportional to the square of the tax rate—is the area (the deadweight loss known to economists as the *Harberger triangle*) labeled DWL.[15]

[13] The price elasticity of demand is the percentage change in the quantity demanded from a 1% increase in price: $\varepsilon_D = \%\Delta Q_D / \%\Delta P$. The price elasticity of supply, ε_S, is defined similarly but with the quantity supplied (Q_S) appearing in the numerator.

[14] *See* R. Pindyck and D. Rubinfeld (2012), *Microeconomics*, 8th ed., Pearson.

[15] The initial price p^0 may be above marginal cost because of firms' market power, existing distortionary taxes, or both. When service prices are above marginal cost, as they must be in industries with large fixed costs and economies of scale such as telecommunications, there is another source of inefficiency. The tax creates an additional excess burden from lost surplus from producers when the higher after-tax price causes fewer sales to be made r (the change in quantity from Q^0 to Q^τ in the figure). In this report we focus on consumers, and therefore triangle *DWL*.

Figure 4: Excess burden on consumers from a tax on a market with full passthrough



While formulas for tax-induced excess burden can be quite complex, depending on market specifics, one general feature holds across all types of markets: The excess burden rises more than proportionally with the tax rate. Specifically, in competitive markets, excess burden rises with the *square* of the tax rate. If the market shown in the figure is competitive, then the formula for deadweight loss, represented by the Harberger triangle labeled DWL in Figure 4, is:

$$\boldsymbol{DWL = \frac{1}{2}\tau^2 R|\varepsilon_D|} \qquad \textbf{(2)}$$

where τ is the *ad valorem* tax rate as in Figure 4, R is market revenue, and ε_D is the price elasticity of demand.[16] The formula implies, for example, that doubling a tax will create *four times* as much economic inefficiency. Conversely, halving a tax reduces the economic harm to consumers from excess burden by 75%. The more-than-proportional dependence of excess burden on the tax rate has a simple, practical implication for fiscal policy: Other things equal, the tax *base* should be chosen to be as broad as possible to keep the tax *rate* low.

B. Tax fairness

Most people would agree that taxation should be fair. However, there is no single definition of what constitutes an equitable tax. We therefore discuss the main ideas found in the legal and economic literature.[17] Strict adherence to any one of these principles could lead to outcomes less

[16] This formula assumes 100% passthrough of the tax to consumers, which is the relevant case in most of the scenarios analyzed below. For example, with reference to the figure above, the formula applies to the case in which p^0 is equal to the marginal cost of the industry, marginal cost is constant, the tax is fully passed through to consumers, and therefore triangle *DWL* is the only excess burden. The formula also applies to initial prices above marginal cost (i.e., some degree of market power by the industry) as long as tax passthrough is 100%; in this case the formula measures only the part of excess burden borne by consumers.

[17] This section draws heavily on Prieger, J. E., Sexton, T. A., & Nellen, A. M., The Taxation of Telecommunications in California in the Information Age. State Tax Notes, 29, 765ff (2003).

favored by others. However, there are several points of commonality in the conclusions reached under the various criteria discussed below.

The Benefit Principle.—A leading concept of equity among taxed consumers is the benefit principle: The burden of a tax should be distributed according to the benefits that taxpayers receive from the government activities it finances. Hence, drivers pay gas taxes to maintain the roads, and those who benefit the most from the roads (by driving a lot) pay the most (since they use more gas). The benefit principle applies to two dimensions. Applied to questions of horizontal equity, the benefit principle implies that parties who benefit equally should bear an equal burden of the tax. Applied to vertical equity, the principle implies that entities receiving different benefits from the uses of the tax should be taxed differentially.[18]

The Ability-to-Pay Principle.—The second main concept of tax equity is the ability-to-pay principle: Entities should be taxed according to their ability to bear the burden of the tax. From this principle, a tax scheme that disproportionately burdens those members of society least able to pay it (e.g., large lump sum or "poll taxes" levied equally on all households) is to be rejected in favor other schemes that bring the tax burdens more in line with ability to pay (e.g., proportional income taxation). For taxes on goods and services, the natural inclination is to place the burden on firms, particularly those with market power and high profit margins, rather than on consumers, especially those in lower-income households. Ultimately, anything that affects firms' profits also affects individuals, whether owners, shareholders, workers whose labor is now slightly less valuable to the firm (leading to pay cuts or job losses), or CEOs who lose bonuses or take pay cuts.[19] Therefore, the ability-to-pay principle is not really about consumers vs. firms but instead about the individuals who bear higher prices for taxed goods vs. the individuals who are the claimants on the supplying firms' profits (which will be lowered by the tax).[20]

Any tax affecting the price of a generally consumed good or service disproportionately harms low-wealth households. Commodity taxes are notoriously regressive, at least as long as they are not on luxury items: Excise taxes average 1.6% of income for the poorest households but only 0.1% for the wealthiest households.[21] On the other hand, wealthier households disproportionately hold corporate ownership through shareholding.[22] In light of these two facts, the ability-to-pay principle

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[18] *See* Howell H. Zee, "Taxation and equity," pp. 30-34 in *Tax Policy Handbook*, P. Shome (ed.), International Monetary Fund (1995).

[19] "Although corporations send checks to the U.S. Treasury, economists do not regard corporate entities as bearing the real burden of taxation. That burden is borne by people in their role as shareholders, workers, … etc." J. Goodman, "Fact checking claims about taxes," Goodman Institute (2024), https://www.goodmaninstitute.org/2024/10/07/fact-checking-claims-about-taxes. One may also wish to add the customers of the firm to the list if their prices rise (and indeed the quotation goes on to do so), but since we are speaking of the economic burden of the tax, not the legal incidence, this does not occur in the case we are discussing. That is, if the tax burden falls on the consumers through higher prices, then we have not in fact directed the burden toward the firm.

[20] It is important to recognize that even in cases of full passthrough of a tax to consumers, the industry's profits may be affected.

[21] *See* Institute on Taxation & Economic Policy, *Who pays? A distributional analysis of the tax systems in all 50 states: Fifth edition* (2015), *available at* https://itep.sfo2.digitaloceanspaces.com/whopaysreport.pdf.

[22] *See, e.g.*, R. Gebeloff, "Who Owns Stocks? Explaining the Rise in Inequality During the Pandemic," *New York Times (Online)*, Jan. 26, 2021, stating that the top 1% of households own 38% of the value of financial account holding stocks. Conversely, the bottom half of the wealth distribution in the U.S. holds only 1% of corporate equities and mutual fund shares (statistic is from Board of Governors of the Federal Reserve System,

calls for the tax burden to be shifted toward services offered by large public firms. In particular, the principle suggests placing the greatest burden on firms with the claimants with the highest income (or wealth). Since household wealth is positively correlated with risk in financial portfolios[23]—wealthier people seek higher returns by taking on more financial risk—companies with riskier ventures have wealthier stockholders on average.

The Social-Cost Creator Principle.—A third principle of fairness is to place the burden of the revenue collection on the parties creating the need for the tax. For example, a trucking company with high-mileage drivers causes highway wear and tear and should therefore contribute to its maintenance. In many situations, this principle overlaps to a large degree with the benefit principle. Again, that trucking company derives much benefit from vehicular travel. This principle has been discussed recently in the context of broadband Internet networks and which parties the network providers can or should be allowed to charge for use of the network.[24]

There are two aspects to the cost-recovery principle. If the costs created are external to the private parties engaged in the economic transactions, then this discussion can be placed back into the standard economic concern of efficiency, not just tax equity. Taxation to correct for misalignment between private and social incentives caused by external cost creation, or *externalities*, is a long-standing solution in public economics to improve social welfare.[25]

However, a second aspect of the cost-recovery principle stems not from traditional externalities but from poor public policy or inadequate bargaining power on the part of smaller industry players that prevent efficient cost recovery. Under usual market conditions, firms are free to set prices for users in any manner they see fit, and competitive pressure drives the price structure to conform to the cost structure. That is, competitive forces lead to prices that allow for efficient cost recovery. Whenever regulation, inefficient legacy arrangements among industry participants, or unequal bargaining power disrupts the natural competitive forces, the resulting price structure may not efficiently reflect cost causation. When this occurs, some firms will free ride on the investments of others.

C. Administrability

The third pillar of good tax design, after efficiency and equity, is administrability, the ease with which a tax system can be implemented, managed, and enforced. Factors included in

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https://fred.stlouisfed.org/series/WFRBSB50203); *see also* Curcuru, S., Heaton, J., Lucas, D., & Moore, D., "Heterogeneity and portfolio choice: Theory and evidence," in *Handbook of financial econometrics: Tools and techniques* (pp. 337-382), North-Holland, 2010.

[23] "Surveys of household finances reveal a striking fact: The share of wealth invested in stocks, or risky assets more generally, rises in wealth. The portfolio share [i.e., the share of wealth invested in stocks] rises in wealth even among stockholders." J. Wachter & M. Yogo, Why do household portfolio shares rise in wealth? *The Review of Financial Studies*, 23(11), p. 3929 (2010); *see also* Calvet, L. E., & Sodini, P., Twin picks: Disentangling the determinants of risk-taking in household portfolios, *The Journal of Finance*, 69(2), 867-906 (2014).

[24] See the several studies from Strand Consult on "fair cost recovery," for example, arguing that video streaming creates much of the Internet's middle-mile network cost and suggests that large streaming firms be charged for it, whether through private negotiations with broadband network providers or through contribution to the USF. *See* Layton, Roslyn and Potgieter, Petrus H., *Rural Broadband and the Unrecovered Cost of Streaming Video Entertainment*, ITS Gothenburg (June 2021), https://ssrn.com/abstract=3820644; Strand Consult, *Broadband Cost Recovery: A Study of Business Models for 50 Broadband Providers in 24 US States* (June 2023).

[25] Such taxes are often termed *Pigovian taxes*, after economist A.C. Pigou.

administrability include tax simplicity, low compliance cost and high compliance rates, reasonable administrative cost, clear legal standing, and overall administrative feasibility. Generally, compliance is higher and less costly when taxation targets fewer, larger firms rather than many smaller ones. Large firms find it more difficult to "hide" from tax authorities, and their compliance costs typically represent only a small portion of their operating expenses. Regulatory and tax compliance burdens weigh more heavily on small firms.

D. Salience of the tax

Salience refers to taxpayers' awareness of a particular tax and their ability to understand it. Less-salient taxes are mostly ignored by consumers, often because the taxes are buried somewhere in the supply chain and do not appear on the receipts that consumers receive upon purchase. Taxes are highly salient when they are explicit and therefore actively considered by taxpayers when making market decisions—such as the sales tax at a retail store. Excise taxes on alcohol and cigarettes are examples of low-salience taxes, since they are levied on distributors in the supply chain and not explicitly noted at the point of retail sale. Income taxes may have high salience, but taxpayers often have little understanding of their connection to any particular government program, as they cannot directly link their taxes to specific expenditures.

Tax salience may be desirable in a democratic society. Taxpayers should understand why, how, and to what extent they are taxed, to participate effectively in the political or regulatory processes that determine the level, scope, and complexity of the taxes.

Political salience is also important. Political salience is high when a tax generates public debate and media coverage.[26] Due to political salience, policymakers may prefer policies that least affect consumer prices (especially if they believe that consumer harm poses a greater risk to their electoral support than harm to firms). Furthermore, taxes with low taxpayer and political salience tend to escape public scrutiny, and thus avoid the heightened expectations of efficiency, fairness, and administrability necessary for maximizing social benefit.

IV. Reforming the contribution base

Having discussed the unsustainability of the current Fund and the principles that should guide the design of any scheme to fund universal service, we can now turn to identifying and evaluating alternatives. In part A of this section, we discuss eight potential sources of revenue along with their estimated revenue bases: traditional telecommunications, Internet service, digital advertising, cloud computing, streaming services, platforms, e-commerce, and general appropriations. Evaluations of the efficiency, fairness, administrability, and salience of taxing each revenue source are presented in part B below. In part 0, various packages of funding sources are proposed, along with the resulting tax rates and estimated excess burden. For example, it is increasingly common around the world to tax all digital services. Digital service taxes can be levied on social media platforms, Internet search, online marketplaces, video streaming, online advertising, sales of user

[26] *See* Sam Dallyn, "An examination of the political salience of corporate tax avoidance: A case study of the Tax Justice Network", *Accounting Forum*, Vol. 41, No. 4, pp. 336-352, 2017.

data, and other platforms such as ride-hailing services.[27] Part C also analyzes such combinations of funding sources.

A. Revenue options

1. Telecommunications Revenues.—Doing nothing to reform the Fund is an option, if not a good one. Indeed, this option has been exercised (passively) for years. As described above, the current contribution base comprises interstate and international end-user telecommunications revenue from services provided to the public. Such services include voice service provided by means of landline telephones, mobile phones, or VoIP, as well as other services such as interstate paging and radio dispatch. Revenue from these services was approximately $33.1 billion in 2024 and has been declining, as shown in Figure 2. However, that figure includes universal service surcharges that carriers bill to end-users. To determine the contribution base for the Fund, the Commission subtracts the contributions that carriers are required to submit to the Fund from the end-user revenue, to avoid "taxing the taxes" (this is known as the circularity adjustment). After this adjustment, end-user revenue left to form the contribution base was only $24.5 billion in 2024.[28]

2. Internet Service Revenues.—Internet service providers (ISPs) do not contribute to the Fund.[29] If ISPs were added to the set of contributors to the Fund, that would bring an additional $222.9 billion of revenue to the tax base. That figure is for residential and business broadband services by wired, terrestrial fixed wireless, and satellite ISPs, wireless data services from mobile telecommunications carriers, dial-up Internet access provided by wired ISPs, and narrowband service for IoT provided by wireless ISPs in the U.S. (2024 estimates).[30]

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[27] It is important to note that the present search for an alternative tax base to fund USF materially differs from the motivations behind Digital Service Taxes in Europe and elsewhere outside the U.S. Those taxes in Europe were implemented to extract tax revenue from U.S.-domiciled Big Tech firms, since providers of online platforms such as Amazon, Ebay, Apple's app store, etc. lack the locus of business activity in other countries that is required, under traditional tax law, to subject them to taxation on their European activity. Thus many of the arguments about Europe's Digital Service Taxes (whether they are unfair to U.S. firms, whether tariffs on imports to the U.S. should be erected in response, etc.) are irrelevant for present purposes.

[28] No such circularity adjustment is necessary for the other revenue sources to be discussed. This is because none of the other services currently levy universal service surcharges that would need to be backed out at this time. For telecommunications services, backing out the Fund contributions from end-user revenue results in approximately the revenue that would be earned in the absence of contributions (under the assumed 100% passthrough to consumers of the tax, to be discussed in section IV.B below). More precisely, the adjusted revenue would be an upper bound on the counterfactual revenue earned in the absence of the Fund, since some services would not be purchased by end-users without direct or indirect support from the Fund. But not many—one early study found that household telephone penetration rates would have fallen by only 0.5% without the Fund (G. Rosston & B. Wimmer (2000), The "State" of Universal Service, *Information Economics & Policy*, 12(3), 261-283).

[29] Even when the Commission reclassified broadband Internet access service as a telecommunications service, it forbore from requiring ISPs to contribute to the Fund. The Commission's reasoning was that the contribution system for USF was already undergoing reform through efforts at the FCC and Congress and that, therefore, potential contribution by ISPs should be "addressed holistically in those ongoing discussions of USF contribution reform." *Safeguarding and Securing the Open Internet; Restoring Internet Freedom*, WC Docket Nos. 23-320, 17-108, Declaratory Ruling, Order, Report and Order, and Order on Reconsideration, FCC 24-52, para. 366 (2024).

[30] The figures for wired ISPs are from IBISWorld (*Industry Report 51711D: Internet Service Providers in the US*, Sept. 2024. Data for fixed wireless broadband Internet access service are from *Industry Report OD5955: Wireless Internet Service Providers in the US* (for the pure-play fixed terrestrial wireless providers such as Rise Broadband and Towerstream) and the author's computations for AT&T, Verizon, and T-Mobile based on an assumed ARPU of

3. Digital Advertising Revenues.—Digital online advertising is big business in the United States. We estimate the assessable revenues from digital advertising at $259 billion.[31] The top six companies profiting from digital advertising (Google, Meta, Amazon, Comcast, Microsoft, and Apple) alone garnered $217.8 billion in U.S. ad revenue for 2023.[32] Given the dominance of these firms in the market, $259 billion appears to be a reasonable estimate.

Other sources or calculations indicate that the total assessable market ranges from $225 billion[33] to $319 billion.[34] The former figure appears to be far too low given the revenues of the six largest advertising platforms. The latter estimate is an extrapolation based on the questionable assumption that the top five companies hold only two-thirds market share in advertising, resulting in a figure that is much larger than any published estimate we have encountered.

4. Cloud Computing Revenues.—Cloud computing services enable businesses and organizations to access computing resources, storage, and applications over the Internet without maintaining their own on-premises infrastructure. The cloud industry comprises Software as a Service for ready-to-use applications, Infrastructure as a Service for basic computing resources, Platform as a Service for development environments, and Business Process as a Service for complete business process outsourcing such as human resources, accounting, or customer service. Major cloud computing providers include Amazon Web Services, Microsoft Azure, and the Google Cloud Platform. Cloud computing revenue has grown markedly, with annual growth rates of 20-30% in recent years. Statista estimates that public cloud revenues were $388.5 billion in 2024.[35]

5. Streaming Revenues.—The streaming industry comprises video, audio, and video game streaming. The five largest video streaming entertainment providers are Netflix, YouTube,

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$45/month and subscription figures from Leichtman Research Group (*Research Notes: 1Q 2024*, https://leichtmanresearch.com/wp-content/uploads/2024/03/LRG-Research-Notes-1Q-2024.pdf) and Broadband Breakfast (*AT&T's Fixed Wireless Access Shows Solid Growth In Second Quarter*, https://broadbandbreakfast.com/at-ts-fixed-wireless-access-shows-solid-growth-in-second-quarter). Data for satellite broadband Internet access service is from Spherical Insights (*United States Satellite Internet Market Size, Share, and COVID-19 Impact Analysis, By Band Type (C-band, X-band, L-band, K-band, and Others), By End User (Commercial Users and Individual), and the United States Satellite Internet Market Insights Forecasts 2023 – 2033*; https://www.sphericalinsights.com/reports/-united-states-satellite-Internet-market), forecasted for 2024 based on their 2023 estimate and their estimated 15.3% CAGR over the subsequent 10 years. Figures for mobile wireless data are from IBISWorld (Industry Report 51721: Wireless Telecommunications Carriers in the US, Oct. 2024). The revenue total does not include other revenues of wired ISPs (for example, for services such as managed wi-fi).

[31] This figure is from Magna, collected from Bloomberg Intelligence. Datum is from Bloomberg ticker MGEUTNET for 2023.

[32] Figures were collected from 10-K filings, and were adjusted where necessary to reflect estimated ad revenue only from the U.S. For Meta, this involved scaling the reported figures for U.S. and Canada down in line with the countries' number of Facebook users (per Statista.com). For Amazon, this involved scaling the reported figures for North American down in line with the three countries' number of monthly visits (per https://worldpopulationreview.com/country-rankings/amazon-users-by-country).

[33] *IAB/PwC Internet Advertising Revenue Report 2024*, Apr. 16, 2024, https://www.iab.com/insights/Internet-advertising-revenue-report-2024.

[34] eMarketer estimates that in 2024, Alphabet, Amazon, Apple, Meta, and Microsoft had 65.6% of the digital advertising market. If the same percentage was true for 2023, then the ad revenue indicated in those companies' 10K filings ($209 billion) would imply a total U.S. online ad market of $319 billion.

[35] Statista, *Cloud Computing in the United States,* 2024, https://www.statista.com/study/169085/cloud-computing-in-the-united-states/.

Amazon Prime, Disney+/Hulu, and Microsoft Xbox. Revenue from video streaming services can be grouped into a few main categories. First is subscription-based video on demand, with leading examples including Netflix, Amazon Prime, Disney+, Hulu, YouTube Premium, Paramount+, Max, etc. Next is transactional video on demand, more commonly known as pay-per-view, which includes rental or purchase of shows from Amazon Prime Video, YouTube Premium, Apple TV+ and iTunes, and Google Play. Free ad-supported television is a third type of video streaming. Examples include The Roku Channel, Pluto TV, Tubi, and Freevee. Closely related to free ad-supported television is ad-supported video on demand, with YouTube as the leading example. Some free ad-supported television platforms, such as Tubi and Freevee, also offer ad-supported video on demand. The final main type of video streaming is social video, which includes watching content on Facebook, Instagram, Snapchat, TikTok, and other social platforms. YouTube—specifically its free collection of videos—is often placed in this category as well. Revenue from these services comes from advertising, which can be substantial.

Audio streaming is responsible for most digital music revenue today. Most revenue comes from subscription-based and streaming digital music services, with over 70% coming from paid subscriptions to services such as Spotify Premium, Apple Music, and Pandora Plus. Ad revenue from podcasts is much smaller.

Video gaming revenue in this category includes streaming content and services only, not hardware.

Revenue from all these sources totals $156.1 billion,[36] with all but $64 billion of that coming from digital advertising.[37]

6. Platform Agency Revenues.—Online platforms have become major forces in commerce in the past decade. Three main types of platforms are considered here: online marketplaces such as

[36] In 2023, subscription-based video on demand generated $39 billion in revenue in the U.S. (see Statista, *Market Insights: Digital Media - Video On Demand - Video Streaming SVoD (United States)*, Sept. 2024, https://www.statista.com/outlook/dmo/digital-media/video-on-demand/video-streaming-svod/united-states?-currency=USD). TVoD providers collected $2.3 billion in 2023 (Statista, *Market Insights: OTT Video - Pay-per-View (TVoD) (United States)*, n.d., retrieved January 13, 2025, https://www.statista.com/outlook/amo/media/tv-video/ott-video/pay-per-view-tvod/united-states). Revenue from free ad-supported television was $4.5 billion in 2023, nearly all of which was presumably from advertising (Statista, *Market Insights: OTT Video - Free ad-supported streaming TV (FAST) (United States)*, (n.d.), retrieved January 13, 2025, https:// www.statista.com/outlook/amo/media/tv-video/ott-video/free-ad-supported-streaming-tv-fast/united-states). Alphabet earned revenue of $14.8 billion in 2023 from advertising on YouTube, based on its 10K report and an assumed revenue share for this category in line with Alphabet's U.S. share of its total worldwide revenue. Altogether, online video (whether FAST, AVoD, or SVoD) garnered $19.6 billion in advertising revenue in 2023 (Magna, op. cit). Online advertising revenue in the social media category (which would include the platforms mentioned above but not YouTube) was $71.1 billion in 2023 (Magna, op. cit). In 2023, subscription and streaming revenue for digital music generated $14.4 billion of revenue (see Matthew Bass, *Year-End 2023 RIAA Revenue Statistics*, n.d., retrieved January 13, 2025, https://www.riaa.com/wp-content/uploads/2024/03/2023-Year-End-Revenue-Statistics.pdf). Digital music revenue is for streaming only (paid subscriptions, ad-supported services, digital and customized radio, music on social media platforms and digital fitness apps, and other sources) and excludes digital downloads and sales of physical media. Most music streaming revenue (over 70 percent) is from paid subscriptions to services such as Spotify Premium, Apple Music, and Pandora Plus. For other audio streaming types, podcast ad revenue was $1.9 billion in 2023 (IAB & PwC, *U.S. Podcast Advertising Revenue Study: 2023 Revenue & 2024-2026 Growth Projections*, May 2024, https://www.iab.com/wp-content/-uploads/2024/05/IAB_US_Podcast_Advertising_Revenue_Study_FY2023_May_2024.pdf). Finally, video gaming revenue from Xbox (i.e., not including hardware) was $12.8 billion in Microsoft's FY2023. Revenue from PlayStation and other platforms was unavailable.

[37] The latter figure encompasses revenue from SVoD, TVoD, music streaming, and Xbox video gaming.

Amazon, eBay, Walmart, and Etsy; ride-hailing platforms such as Uber and Lyft; and hospitality industry platforms such as Airbnb, Booking.com, and Expedia. For this option as a funding source, only agency revenues are considered—not the revenue earned by sellers on these platforms (which will be counted under e-commerce revenue in the next subsection).

Such agency revenue includes fees from Amazon's third-party seller services, eBay's commissions from sales, the portion of ride-hailing payments that does not go to taxes or the drivers, and the agency fees that hospitality platforms charge to listing property owners and managers. The major companies involved in these three types of platforms earn agency revenue of around $130.9 billion, more than three-quarters of which comes from online marketplaces.[38] If platform agency revenue were tapped to contribute to the Fund and only a *de minimis* exemption applied, revenue from more companies would be included and there would be a modestly larger tax base, although how much larger is unknown.[39]

7. E-Commerce Revenues.—E-commerce encompasses all commercial transactions conducted electronically across digital platforms, including retail, services, and B2B sales through websites, mobile apps, and online marketplaces. The U.S. e-commerce market reached approximately $1.2 trillion in 2024,[40] with Amazon commanding the largest market share, followed by Walmart and other major retailers, none of which have more than a 4% market share.[41] Despite market maturation, the sector continues to grow at double-digit rates annually. The distribution of market shares and revenue among e-commerce companies has a very long tail. If only companies with 2023 market share greater than 1.5% are included—Amazon, Walmart, Apple, eBay, Target,

[38] Agency revenue from online marketplaces from Amazon, Etsy, Ebay, and Walmart is estimated to be $104.7 billion (Amazon: 10K reports; Etsy: Statista, *Revenue of Etsy Inc. from 2012 to 2023*, https://www.statista.com/statistics/409371/etsy-annual-revenue; Ebay: 2023 10K report, https://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_EBAY_2023.pdf; Walmart: estimated to be proportional to Ebay's agency revenue in line with the two companies' market shares (Walmart has 2.1 times as much revenue as Ebay), as found from Statista, *Market share of leading retail e-commerce companies in the United States in 2023*, https://www.statista.com/statistics/274255/market-share-of-the-leading-retailers-in-us-e-commerce). Agency revenue from ride hailing platforms is $15.5 billion, nearly all from Uber and Lyft (Matthew Buchko, *Ride-Sharing Services in the US*, Report OD6158, IBISWorld, https://www.ibisworld.com/united-states/market-research-reports/ride-sharing-services-industry). The hospitality platforms Airbnb, Booking.com, and Expedia, the big-three such platforms in the U.S. market, garnered $10.7 in agency fees (see Statista, https://www.statista.com/statistics/1193565/airbnb-revenue-by-region-worldwide; Booking Holdings Inc., https://www.bookingholdings.com/wp-content/uploads/2024/02/BKNG-Earnings-Release-Final.pdf; and Expedia's 2023 10K filing). All figures are for 2023.

[39] The revenue figures here for platform agency services would be lower than stated, since the figures for Etsy and Ebay include advertising revenue. However, Ebay states that "net revenues *primarily* include final value fees, feature fees, fees to promote listings, payment service fees, listing fees, and store subscription fees from sellers on our platforms" (emphasis added).

[40] See Statista, *Revenue of the e-commerce industry in the U.S. 2019-2029*, February 25, 2025, https://www.statista.com/statistics/272391/us-retail-e-commerce-sales-forecast

[41] See eMarketer, & Business Insider, *Market share of leading retail e-commerce companies in the United States in 2023,* April 3, 2023, in Statista https://www.statista.com/statistics/274255/market-share-of-the-leading-retailers-in-us-e-commerce.

Home Depot (in order of market share)—then the U.S. e-commerce sector would constitute a revenue base of $334.5 billion.[42]

8. Appropriations.—Universal service could be funded from the general government purse, as are many other social assistance programs. Setting aside Social Security and Medicare taxes, 92% of the remaining half of total U.S. federal tax revenue comes from individual and corporate income taxes.[43] The base for those taxes was around $15 trillion in 2024.[44]

* * *

Summary.—The following table summarizes the options for levying contributions for universal service. Any option other than continuing with the current contribution base of certain telecommunications services would greatly increase the Fund's revenue base.

Table 1: Summary of alternative revenue bases

Line item	Option	Revenue base ($ billion)
1	Status quo (telecommunications services)	24.5
2	ISPs	229.9
3	Digital online advertising	259.0
4	Cloud computing	388.5
5a	Streaming services (excluding digital ads)	63.5
5b	Streaming services (total)	156.1
6	Platform agency fees	130.9
7a	E-commerce (largest firms)	334.5
7b	E-commerce (total)	1,222.9
8	Appropriations (federal income tax base)	15,000.0

B. Evaluation of taxing the revenue sources

In this section, the four principles of efficiency, fairness, administrability, and salience are discussed for each of the revenue sources delineated above. Regarding efficiency, the size of the excess burden depends on the tax rate, which in turn depends on the exact set of services to be taxed. In section C below, various combinations of revenue sources will be proposed and examined

[42] Revenue from Amazon includes North American revenue from online sales only (no third-party seller services, to avoid double-counting platform agency revenue).

[43] Statistic is for the 2024 fiscal year to date (11 months), with data from the U.S. Treasury Department (https://fiscaldata.treasury.gov/americas-finance-guide/government-revenue).

[44] The latest statistics from the IRS show that in 2022, taxable income was $11.4 trillion for individuals while it was 2.4 trillion for corporations in 2021. Given the assumed growth rates in these figures, chosen to be in line with GDP growth, the total today would be roughly $15 trillion. For individual income statistics, see https://www.irs.gov/pub/irs-soi/22in11si.xls; for corporate income statistics, see https://www.irs.gov/pub/irs-pdf/p5108.pdf.

to fund universal service. Thus, with respect to efficiency, only the key market characteristics affecting excess burden, namely, demand elasticity and tax passthrough, will be discussed in this section. Estimates of the magnitude of excess burden are deferred to the discussion in section 0 below of the proposed packages of services for policymakers to consider.

1. Telecommunications Revenues.—The price elasticity of demand is a key quantity that greatly affects the inefficiency resulting from a tax. Finding an appropriate figure for the demand elasticity for telecommunications services is challenging. Given the shrinking relevance of a "long-distance phone call" to most consumers, available estimates of demand for interstate telecommunications services are decades old. For example, an elasticity of -0.7 for interstate long distance calling was used in studies around the time of the Telecommunications Act of 1996.[45] It is expected that elasticity for interstate and international calling is higher today, given the many (untaxed and, in some cases, essentially free) options modern consumers have, such as IP voice and video communication apps (e.g., WhatsApp, Discord, Telegram, Signal, Zoom, Teams, and Facetime).

In the absence of external estimates, a simple regression analysis was performed on how revenue for services contributing to the Fund responds to changes in the contribution factor. The results indicate an overall estimated demand elasticity for such services of about -1.5.[46] This figure is in the elastic region of the demand function,[47] and therefore will lead to a large excess burden.

As discussed above, the formula for excess burden in equation (2) assumes that taxes are fully passed through to consumers. For telecommunications services, passthrough of taxes or costs to customers is most often estimated or assumed to be 100%. Much of the economic literature is old, as with the demand elasticity studies (and for the same reason). Nevertheless, full passthrough to consumers has been found to be consistent with evidence from cost changes in interstate long-

[45] *See, e.g.*, James E. Prieger, Universal service and the Telecommunications Act of 1996: The fact after the act, *Telecommunications Policy*, 22(1), 57-71 (1998).

[46] The elasticity was estimated as follows. The derivative of the logarithm of revenue with respect to the ad valorem tax rate τ is $\frac{d \ln R}{d\tau} = \frac{1}{R}\frac{dR}{dP}\frac{dP}{d\tau} = \frac{1}{R}(Q[1+\varepsilon_D])p^0$, where R is revenue, P is the current price when the tax is τ, Q is the current quantity sold, p^0 is the pre-tax price (as shown in Figure 4), and ε_D is the price elasticity of demand. Since the term Qp^0 is approximately equal to current revenue (where the approximation is best for low tax rates), the derivative is therefore approximately equal to $1+\varepsilon_D$. To estimate the elasticity, note that in a linear regression of log revenue on tax rates, the coefficient on the latter variable may be identified with the derivative above. That is, in the linear regression we have $E(\ln R_t) = \alpha + \beta\tau_t$ (where the time subscripts marks the observations in the data), which has derivative β. Thus $\beta = 1+\varepsilon_D$, or $\varepsilon_D = \beta - 1$. To accurately estimate β, one must control for the fact that revenue from telecommunications services would be trending downward even if the Fund's contribution rates were unchanged. Controlling for such a trend leads to the following regression equation with log-linear time trend (with rate γ% per year): $E(\ln R_t) = \alpha + \beta\tau_t + \gamma t$. Estimating the equation in first differences leads to the final form for the regression: $E\Delta(\ln R_t) = \beta\Delta\tau_t + \gamma$, where Δ is the first-difference operator. Using quarterly data on revenue and contribution rates (N = 57), the resulting regression estimate of β is -0.521 (with Newey-West standard error [robust to first-degree autocorrelation in the regression errors] of 0.114). The estimate is statistically significant at the 0.1% level. Using the relationship between the coefficient and elasticity found above, the final estimate for demand elasticity is $\widehat{\varepsilon_D}$ = -1.521 (s.e. = 0.114). This estimate has a 95% confidence interval of (-1.74, -1.29).

[47] Demand is *elastic* if the price elasticity is greater than one (in absolute value) and *inelastic* if less than one.

distance wireline calling markets,[48] intrastate long-distance markets,[49] and reductions in local network access charges by interexchange carriers.[50] Full passthrough of taxes to consumers has also been assumed for mobile telephone service.[51] Full passthrough occurs in three situations: when firms operate in competitive markets with constant marginal costs (so that the supply curve is perfectly elastic), when consumers continue buying the same amount regardless of price changes, or when firms with market power find it profit-maximizing to do so. In the first situation, full passthrough to consumers occurs even if demand is highly elastic.[52]

Visual evidence for a high degree of passthrough for services contributing to the Fund can be seen in the producer and consumer price series for the relevant basket of services. These price series are shown in Figure 5. The producer price series (labeled PPI in the figure), which is the average revenue carriers earn on sales of telecommunications services, is an index of prices received for a basket of wireless and residential wired telecommunications service prices.[53] The consumer price series (labeled CPI in the figure), represents the retail prices residential consumers pay for the same basket of services. Note that the producer price index rarely falls as the contribution factor increases over time, as would occur if the suppliers were absorbing part of the tax increases. Instead, at least until the general inflationary pressures after 2022, producer prices are relatively constant and the prices consumers pay take the hit instead, most noticeably after 2019.

[48] Beard, T. R., Ford, G. S., Hill, R. C., & Saba, R., The flow through of cost changes in competitive telecommunications: Theory and evidence, Empirical Economics, 30, 555-573 (2005).

[49] Aron, D. J., Burnstein, D. E., Danies, A. C., & Keith, G., "An Empirical Analysis of Regulator Mandates on the Pass Through of Switched Access Fees for In-State Long-Distance Telecommunications in the US," SSRN w.p. 1674082 (2013).

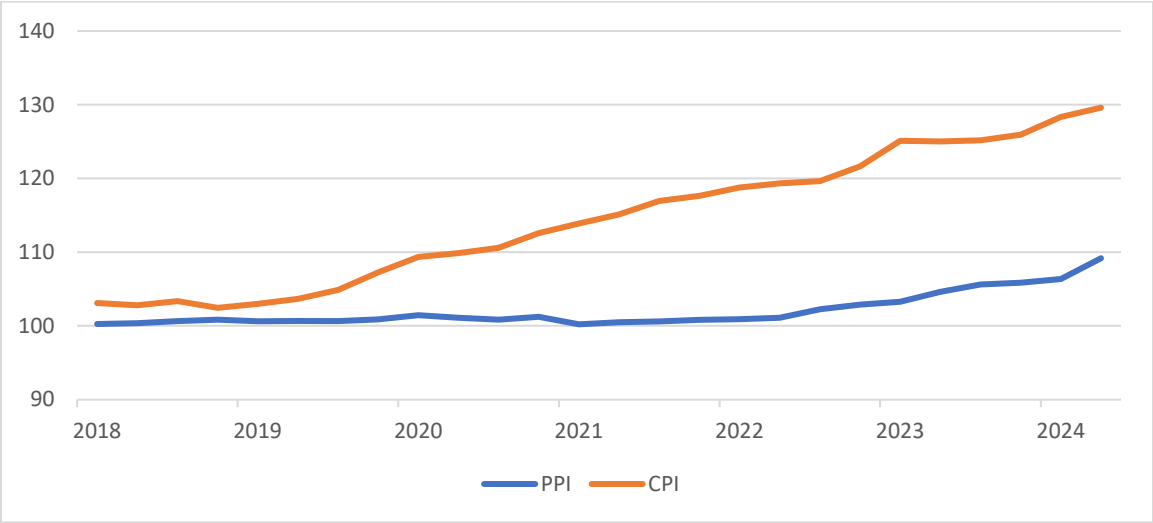
[50] *See* study cited in footnote 37 of *The Fact After the Act*, op. cit.

[51] *See, e.g.*, for mobile telecom: Coleman Bazelon, Paroma Sanyal, and Yong Paek, *The Economics of Universal Service Fund Reform*, Brattle Group (for INCOMPAS) (Aug. 24, 2023), *available at* https://www.brattle.com/insights-events/publications/the-most-economically-efficient-option-for-universal-service-fund-reform-brattle-economists-discuss-in-a-new-report-for-incompas/.

[52] Considering the passthrough formula again, this can be seen mathematically. The limit of the passthrough expression as the supply elasticity goes to infinity is one (i.e., the consumers pay 100%), regardless of the elasticity of demand.

[53] For comparability with the basket of services that compose the contribution base for the USF, the basket is composed of one-third wireless service (BLS series CUUR0000SEED03 [Wireless telephone services in U.S. city average, all urban consumers, not seasonally adjusted] for consumer prices and series WPU371 for producer prices) and two-thirds wired service (BLS series CUUR0000SEED04 [Residential telephone services in U.S. city average, all urban consumers, not seasonally adjusted] for consumer prices and series WPU371 for producer prices).

Figure 5: Producer and consumer price indexes for telecommunications services subject to contributions to the Fund[54]



With a relatively elastic demand curve and 100% passthrough of taxes to consumers, the excess burden of taxation for consumers will be large.[55] Furthermore, full passthrough implies that consumers bear all the direct tax burden of contributing to the Fund as well, an amount representing lost consumer benefits above and beyond any they lose to excess burden.

Turn now to fairness. Taxing only traditional long-distance telecommunications services when the Fund uses the money in part to subsidize Internet usage violates the benefit principle. This principle calls for the tax burden to fall more heavily on parties gaining the most from the expansion of the user base of telecommunications services and the Internet. Setting high tax rates for telecommunications services but a contribution factor of zero for Internet services and the revenues of corporate digital service providers and sellers of digital ads—who profit greatly from the Fund's support for Internet infrastructure and its users—is a gross violation of the benefit principle and tax fairness.

For application of the ability-to-pay principle to funding universal service by taxing telecommunications services, recall that the principle calls for the tax burden to be directed toward large public firms, and in particular those engaged in riskier business ventures. Much of the contributions for the Fund come from large publicly held telecommunications firms such as AT&T and Verizon. However, by the nature of their business, the large companies that create or stream much Internet content, such as Alphabet (Google), Meta (Facebook), Amazon, Disney, and Netflix, have riskier stocks than the traditional telecommunications firms.[56] In any event, with a

[54] The indexes are normalized to zero for 1Q 2010, so that the time series show the change in nominal consumer prices since that time in percentage terms. The constituent price series used to compute these indexes are one-third wireless services and two-thirds wired services (see note 53).

[55] *See* Section IV.C, *infra*.

[56] As measured from five-year monthly data, as of October 10, 2024 the betas of Disney, Netflix, Meta, Amazon, and Alphabet were 1.40, 1.26, 1.22, 1.15, and 1.04, resp. Thus, all were riskier than the market as a whole. The only company among the top five largest video entertainment content streamers with a beta less than 1.0 is Microsoft (Xbox), at 0.90. Conversely, the stocks of AT&T ($\beta = 0.74$) and Verizon ($\beta = 0.41$) were both less risky than the market portfolio and lower than all these other companies.

high passthrough, consumers of the telecommunications services, not the shareholders of the firms supplying them, bear the burden of the taxation. For these several reasons, taxing telecommunications services to support (in part) Internet infrastructure and usage scores low on the ability-to-pay principle.

In contrast to fairness, the current system scores relatively highly on administrability. Most notably, the administrative infrastructure to collect and distribute the universal service funds is already in place.[57]

The salience of the tax under the current funding mechanism is debatable. The Commission allows service providers to itemize the part of customer's total bill that goes to fund universal service, and so in principle consumers see the tax on the bill. On the other hand, since the Fund-related line items may be buried (for example) on page eight of a ten-page monthly bill that the consumer never looks at, the tax is likely invisible to many customers.

2. Internet Services Revenues.—Consumers' elasticity of demand for broadband service is a key parameter determining the outcomes if revenue from broadband Internet access service were to be included in the contribution base for the Fund. There is a moderately well-developed empirical literature that provides estimates of the price elasticity of demand for broadband, although many of the studies are from earlier years. Examining the econometric estimations and how they have changed over time shows that consumer demand for broadband service has become more inelastic. This change is likely a result of more households and individuals viewing broadband Internet access as a necessity for work, school, entertainment, and online shopping.[58]

By the 2000s, price elasticity had already dropped into the inelastic region, variously measured at -0.69 for non-rural areas and -0.21 for rural areas.[59] The four available more recent studies that estimate demand elasticity are summarized in Table 2. As can be seen, all the elasticity estimates are less than one in magnitude, and therefore are in the inelastic region of demand. Given the differences in the years studied, methodology, and target populations, the estimates vary quite a bit, from -0.08 to -0.62. For the excess burden computations below, a price elasticity for broadband Internet access service of -0.4 will be used, chosen to reflect the presumed continued declining elasticity since Ford's estimates of around -0.46 for 2019. This figure also falls comfortably between the extreme estimates shown in the table.

[57] While the Universal Service Administrative Company has incurred much higher administrative costs in recent years than in the past, that is likely due to general cost pressures or Company-specific inefficiency rather than anything particular to the current structure of the Fund.

[58] Several authors discuss why broadband has changed to be seen as a necessity, including Dutz et al. (Dutz, M., Orszag, J., and Willig, R. (2012), "The Liftoff of Consumer Benefits from the Broadband Revolution," *Review of Network Economics*, vol. 11(4), Art. 2) and Glass and Stefanova (Glass, V., Stefanova, S. (2010), "An empirical study of broadband diffusion in rural America," *Journal of Regulatory Economics*, vol. 38, pp. 70–85.).

[59] The former estimate is for top 100 MSAs (Dutz et al., op. cit.) while the latter is for the service areas of rural telecommunications companies (Glass & Stefanova, op. cit.).

Table 2: Recent econometric studies of demand for broadband Internet access service

Study	Data year	Estimated elasticity of demand	Notes
Carare et al. (2015)[60]	2011	-0.62	Stated preference methodology. Survey of households without broadband Internet access in 7 states. Peer reviewed.
Rosston & Wallsten (2020)[61]	2011, 2015	-0.10 or -0.13	Revealed preference methodology. General population, CPS data. Peer reviewed.
Ford (2021)[62]	2019	-0.46 or -0.47	Revealed preference methodology. General population, ACS data. Peer reviewed.
Williams & Zhao (2020)[63]	Not stated, presumably 2019 or 2020	-0.08	Stated preference methodology. General population Internet survey. Not peer reviewed.

Next is the related but separate issue of passthrough. Given the proprietary nature of data on ISPs' costs, it is difficult to estimate price elasticity on the supply side. Thus, there are no econometric estimates of supply elasticity for broadband services in the economic literature, although some studies argue on other empirical grounds that supply elasticity is high in this industry.[64] Even in the absence of econometric estimates of supply elasticity to use in the passthrough formula in equation (1), it is reasonable to assume that passthrough will be high, for two reasons. First, there is no compelling reason to assume that there is much upward slope to the broadband Internet access service industry's marginal cost curve. If marginal costs are nearly flat, then supply elasticity is very large and passthrough to consumers is near 100%, per equation (1). Due to economies of scale in such network industries, marginal cost may even be declining as the number of households

[60] Octavian Carare, Chris McGovern, Raquel Noriega, and Jay Schwarz, The willingness to pay for broadband of non-adopters in the U.S.: Estimates from a multi-state survey, 30 *Information Economics and Policy*, 19-35, (2015).

[61] Rosston, G. L., & Wallsten, S. J., Increasing low-income broadband adoption through private incentives. *Telecommunications Policy*, 44(9), 102020 (2020).

[62] Ford, George S., "Assessing Broadband Policy Options: Empirical Evidence on Two Relationships of Primary Interest," *SSRN* (July 28, 2021), https://ssrn.com/abstract=4159867.

[63] Michael A. Williams and Wei Zhao, *NTCA-USF Study*, (May 7, 2020), https://www.ntca.org/sites/default/files/documents/2020-05/2020-05-07%20-%20Williams-Zhao%20report%20Final.pdf.

[64] *See, e.g.*, R. W. Crandall, J. G. Sidak, & H. J. Singer, "The empirical case against asymmetric regulation of broadband Internet access," *Berkeley Technology Law Journal*, Vol. 17, No. 3, pp. 953-987 (Summer 2002).

served rises.[65] Thus, the situation depicted in Figure 4 would be a good approximation of the market and the outcome from taxation. Second, there is little reason to assume that the situation for ISPs would differ significantly from that of telecommunications carriers, which the evidence discussed above indicates appear to pass cost or tax increases fully through to consumers.[66]

Since higher-income households typically pay more for broadband on average by selecting higher speed tiers, etc.,[67] this proposal is an improvement over the status quo according to the ability-to-pay principle. However, failing to tax other firms that provide services deriving their value from the existence of the Internet without contributing much to support it, lessens the tax equity of this proposal in terms of the benefit principle.

Since many Internet service providers already report to the Commission and USAC, there may not be a sizeable administrative obstacle for this option. The salience of a tax on broadband Internet access service may be expected to be about the same as the status quo, since in many cases the same companies that offer the telecommunications services already taxed also offer Internet access.

3. Digital Advertising Revenues.—The analysis of deadweight loss for digital advertising taxation differs from that of taxes on typical goods, labor income, or corporate profits. Advertisements, generally speaking, are not consumption goods or services; rather, they are means to an end for advertisers. Consumers do not generally gain benefits directly from viewing or hearing ads; if they do not find them a nuisance, they may at most view them as informative about other goods or services that provide satisfaction upon consumption. Any benefits they provide are thus indirect and require further actions by consumers to be realized. Furthermore, digital ads operate in "two-sided" markets—platforms that generate revenue by connecting audiences with advertisers. The possible negative externalities caused by ads, their location on platforms, and their lack of direct connection to consumption all change the nature of the analysis regarding excess burden and passthrough.

Consider, for example, free ad-supported services such as ad-supported video on demand, free ad-supported television, social video, and free audio streaming. Clearly there will be no excess burden (or even direct tax burden) for consumers of the free service; the price to consumers remains zero. In the ad market on the platform, however, some party must pay the tax: either the platform provider's profit will be reduced by the amount of the tax revenue or ad buyers will have to pay more for ads. When the marginal cost of displaying an ad on a platform is zero (as it essentially is for digital platforms), then taxing ad revenue is the same as extracting a percentage of the operating

[65] Furthermore, although there may be sharply rising marginal cost to connect the few remaining unconnected households to the Internet, with fiber for example, in such cases there are a variety of high-cost state and federal programs specifically designed to offset that cost for service providers.

[66] Full passthrough has been found for some other markets with a limited number of firms. For example, the overall pattern seen in tobacco markets in high-income countries in response to excise tax increases is full passthrough, or even price increases larger than the tax increase ("overshifting"). *See* Sheikh, Z. D., Branston, J. R., & Gilmore, A. B., "Tobacco industry pricing strategies in response to excise tax policies: a systematic review," *Tobacco Control*, 32(2), 239-250 (2023).

[67] See, for example, the study of Liu et al., who find the willingness to pay for higher broadband speed tiers rises with household income. Y. H.Liu, J. Prince, & S. Wallsten, Distinguishing Bandwidth and Latency in Households' Willingness-to-Pay for Broadband Internet Speed, *Information Economics and Policy*, 45, 1-15 (2018).

profits of the platform.[68] In this case, since the ad seller is already charging the profit-maximizing price for ads, it will not pass any of the tax onto ad buyers, as doing so would reduce profit further.[69] Even if ad prices do rise, the secondary question is whether the ad buyers' customers will see prices rise as the advertiser tries to recoup its higher ad expenditure.

Continuing with the theme of focusing primarily on impacts on consumers, consider the latter question. Advertising is not like typical production costs, where increases in marginal cost must cause prices to increase. In some circumstances, the cost of advertising does not affect the price of the advertised good at all. In this case, buying more ads just increases the amount of sales revenue without affecting the profit-maximizing margin per sale.[70] Under different market conditions, other outcomes are possible. If advertising is more persuasive than informative, then taxes on ads in imperfectly competitive markets can actually *lower* consumer prices.[71] In other situations, prices may rise. Empirical evidence shows that when taxes on advertising change, some consumer prices rise and others fall.[72]

Consider now the case of advertising as a negative externality. That is, if being forced to watch or listen to ads is just an inescapable annoyance to the consumer, then taxing ads can improve welfare. Negative externalities from ads can stem from more subtle causes as well. In search markets where advertising takes the form of paying for placement at the top of the search results (as on Google), sponsored search can lead to greater product market concentration, higher prices, and less value to consumers. Taxing such advertising could thus improve consumer welfare.[73]

Based on this discussion, it appears unlikely that taxing digital advertising would lead to any meaningful increase in consumer prices. Even if prices rise, the overall impact in terms of excess burden would likely be small. There is only one available estimate in the economic literature on the impact of a national tax on digital advertising. Using data from Austria, it is estimated that the 5% tax on ads caused prices for the advertised goods to rise by 0.25% overall (although prices for many categories of goods actually fell).[74]

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[68] *See* D. Agarwal and W. Fox, "Taxing goods and services in a digital era," *National Tax Journal*, 74(1), 257–301 (2021).

[69] That is, a 10% tax on ad revenue under such circumstances causes the firm to set ad prices to maximize 90% of profit rather than all profit. But the same price that maximizes profit also maximizes any percentage of profit, too.

[70] Hal Varian shows that if advertising is primarily informative, and the firm paying for advertising has constant marginal cost for the good it produces, then the profit function is separable in the amount of advertising chosen and the product price. The latter part of the profit-maximization problem establishes the profit margin for each unit sold, which is then invariant to the amount of advertising chosen. Thus, changes in the cost of advertising (e.g., due to a tax on it) will not affect the margin and hence the consumers' prices. *See* Varian, Hal "Advertising Costs and Product Prices," Journal of Law and Economics: Vol. 65: No. 6, Article 4 (2022).

[71] In this case, taxing persuasive ads reduces demand and increases substitution between products, thus lowering the market power of firms and hence prices. *See* Rauch, F., Advertising expenditure and consumer prices, International Journal of Industrial Organization, 31(4), 331-341 (2013).

[72] Rauch, op. cit.

[73] *See* Akhil Ilango, Sponsored Search: Theory and Evidence on How Platforms Exacerbate Product Market Concentration, unpublished manuscript, https://akhililango.github.io/pages/projects/SponsoredSearch/PlatformProductMarketConcetration_Akhil-Ilango.pdf.

[74] Rauch, op. cit.

On the question of tax equity, buyers and sellers of digital advertising undoubtedly benefit tremendously from the Internet, since that activity would not exist otherwise. Most of the tax burden will remain with the buyers and sellers of digital advertising, and so those parties would both contribute to and benefit from funding universal service.

There may be an additional consideration regarding both equity and efficiency in taxing digital ads on certain platforms. The cost-recovery principle applies social media platforms such as Facebook and X and social video services such as YouTube, since social media may create externalities. Nobel prize-winning economist Prof. Paul Romer has argued that dominant digital platform creators such as Facebook and Google have created negative social externalities. He claims these platforms provide a "haven for dangerous misinformation and hate speech that has undermined trust in democratic institutions" and therefore should be subject to tax on their digital advertising revenue.[75]

If the State of Maryland's experience with taxing digital advertising is illustrative, then successful implementation requires that several details must be worked out in advance. Maryland had to delay its digital advertising tax by a year to the 2022 tax year due to vagueness in the original legislation over which entities were actually subject to the tax.[76] Well crafted, specific, and clear rules should remove such difficulties to implementation. Despite the new issues that a tax on digital services and advertising might raise, relative to more familiar forms of taxation, they have received support in at least some of tax literature. For example, one legal article found that taxing gross receipts of digital advertising as in Maryland "provides administrative simplicity."[77] If the revenue or market share threshold were set high enough to exclude all but the largest platforms making money from digital advertising, the administrative burden would be lighter. Almost all firms would be exempt from the administrative burden and there would be only a few firms to audit. However, since all digital advertising firms benefit from the Internet, the benefit principle argues against taxing only large firms, and the nature of a revenue tax already assesses contribution in proportion to benefits (revenue) gained.

The salience of the tax would be low, essentially nonexistent, for consumers of the advertised products; however, the prices of those products will change little. Salience would be much higher for the parties bearing the tax (sellers and particularly buyers in the digital advertising markets).

4. Cloud Computing Revenues.—Markets for cloud services are still developing, and there is no econometric literature that estimates the price elasticity of demand. Elasticity likely varies significantly among the various types of cloud services. For commoditized infrastructure-as-a-service elements such as basic computing and storage, demand may be relatively elastic. Many customers could be price-sensitive enough to switch providers—or even switch back to pre-cloud forms of secure storage—if one firm raised its prices. Indeed, when one major provider (AWS, Azure, or Google Cloud) cuts prices, others typically follow quickly, suggesting that the providers

[75] Paul Romer, "A tax to fix big tech," *New York Times*, May 7, 2019, p.A-23.

[76] *See Maryland tax on digital-ad services still in effect*, Grant Thornton (May 18, 2023), https://www.grantthornton.com/insights/alerts/tax/2023/salt/k-o/md-decides-state-digital-advertising-services-tax-to-be-in-effect-05-18.

[77] Kim, Y. R., & Shanske, D., State Digital Services Taxes: A Good and Permissible Idea (Despite What You Might Have Heard), *Notre Dame L. Rev*., 98, p.800 (2022).

believe their customers' demand is elastic.[78] Of course, even if firm-specific demand is highly elastic, overall demand for the industry may be much less elastic. While no study has formally estimated the demand for cloud services, it is suggestive of a high degree of elasticity that cloud storage prices fell by over 80% from 2010 to 2019 while revenue rose over 600% during that time.[79] These figures cannot be used directly to compute an approximate elasticity, however, since demand for cloud storage was increasing overall during that time.[80] For other types of cloud services, particularly highly customized forms (such as machine learning platforms and custom applications programming interface gateways, which require investment in provider- or customer-specific coding, models, or tools), demand elasticity may be expected to be lower due to user lock-in from high switching costs. Given the lack of demand elasticity estimates, a compromise figure of -1.0 will be used. Using this figure implies that on average, demand is neither elastic nor inelastic.

More information is available to assert that the degree of passthrough of costs and taxes to customers is high in the cloud services industry. Informal investigation of hard drive costs and AWS's cloud storage prices show a high correlation. In the 2010s, AWS largely passed its lower capital costs on to its customers via lower prices.[81] Both this anecdotal evidence and findings from other digital service industries, support assuming high or full passthrough to cloud services customers. The businesses purchasing those services therefore see their input prices rise for the commerce they engage in and will at least partially pass those cost increases on to their own customers, retail consumers. The degree of ultimate pass-through to consumers thus depends on the general cost pass-through behavior of businesses. Research shows that cost pass-through varies by industry, input type, the transience or permanence of the cost increase, and the time allowed for adjusting prices. Estimates generally range from 60% to 100% cost pass-through;[82] we use a midpoint figure of 80% in our subsequent analysis.

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[78] Anecdotal evidence is available from several price-cutting instances involving cloud storage, one of the most commoditized elements of infrastructure as a service. *See, e.g.*, S. Mlot, "Amazon Follows Google With Cloud Storage Price Drop," *PCMag.com* (Mar. 27, 2014), https://www.pcmag.com/news/amazon-follows-google-with-cloud-storage-price-drop; S. Ranger, "The cloud price war continues: Amazon cuts its cloud storage prices, again," ZDNet.com (Nov. 22, 2016), https://www.zdnet.com/article/the-cloud-price-war-continues-amazon-cuts-its-cloud-storage-prices-again. See also the statement that "Price reductions used to be announced every year, sometimes twice a year, as the cloud service providers fought for market share", another indication that at least firm-specific demand elasticity was large and customers' switching costs were low. C. Evans, "Is AWS passing on the benefits of storage media price reductions?", Architecting.it (July 26, 2019), https://www.architecting.it/blog/aws-price-reductions).

[79] For S3 storage prices on AWS, see *Is AWS passing on the benefits*, op. cit. For revenue growth, *see* C. Slingerland, *101+ Cloud Computing Statistics That Will Blow Your Mind (Updated 2025)*, Cloudzero.com, https://www.cloudzero.com/blog/cloud-computing-statistics.

[80] That is, while price elasticity measures movements along a demand curve holding all other factors constant, over time the entire demand curve for cloud services has been shifting out. The observed increase in cloud revenue commingles the effects of reduced prices and increased demand due to factors other than price.

[81] *Is AWS passing on the benefits*, op. cit.

[82] The lower figure is from a survey of U.S. businesses. *See* K. Dogra et al., "Estimates of Cost-Price Passthrough from Business Survey Data," *Federal Reserve Bank of Atlanta Working Paper Series* No. 2023-5 (June 2023), https://doi.org/10.29338/wp2023-05. Analysis of actual data (instead of surveys) tends to lead to higher estimates of cost pass-through, although one survey of German firms found that "firms fully pass through inflation expectations to prices in times of high inflation." P. Dörrenberg et al., "Followers or Ignorants? Inflation Expectations and Price Setting Behavior of Firms," *Accounting for Transparency Working Paper Series* No. 125 (July 24, 2023), *available at* http://dx.doi.org/10.2139/ssrn.4520501. One study found the energy cost pass-through by firms was 80-90% after

The equity considerations for taxing cloud service providers match those for digital advertising taxation. Cloud services would not exist without Internet infrastructure. Thus, the benefit principle indicates that taxing cloud service providers is equitable. Regarding administrability, implementing a tax on cloud services presents unique challenges, particularly when it comes to defining the scope and application of the tax. As discussed above, lessons from Maryland's digital advertising tax suggest that clarity and precision in rule language are crucial to avoid delays or confusion. Several jurisdictions already tax, or could tax under their laws, cloud services, including Iowa, Louisiana, Maine, Massachusetts, and the city of Chicago.[83] The experience of these jurisdictions could also be scrutinized for best practice in administering such a tax.

Regarding salience, if cloud service providers follow responses to other taxes on digital services, we may expect that they will announce why their prices are rising and call out the tax on their bills.[84] While end-user consumers may notice little impact, the tax burden would be most salient to the businesses operating within the cloud services ecosystem.

5. Streaming Revenues.—Because streaming revenue is earned in several different ways—from advertising, subscriptions, and spot transactions—the implications of taxation for passthrough and excess burden are nuanced.

As with many other forms of digital services, there are no reliable estimates of demand elasticity. In the absence of estimates, it will be assumed that demand for such services has elasticity of -1, as for cloud services. For services earning revenue from subscriptions and transactions (those types of video on demand, some music streaming, and video gaming), we should expect passthrough to consumers to be at or near 100%. For one historical instance, consider that when Chicago passed its "Netflix tax" (an online amusement tax) in 2015, a Netflix spokesman stated that the company would pass it all through to end-users.[85] Evidence from other digital markets also indicates that the baseline expectation should be a high or full passthrough of a tax.[86]

Well over half of streaming revenue comes from advertising, namely ads on social video, free ad-supported television, ad-supported video on demand, and subscription video on demand. For these platforms, the passthrough discussion above regarding taxing digital advertising is relevant. As

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15 months, *see* L. Dedola, M. S. Kristoffersen, & G. Zullig, "The extensive and intensive margin of price adjustment to cost shocks: Evidence from Danish multiproduct firms," unpublished manuscript (2021), https://gabrielzuellig.ch/wp-content/uploads/2021/04/CostPassthrough.pdf, while another found 100% pass-through of energy prices, *see* R. Lafrogne-Joussier, J. Martin, & I. Mejean "*Cost pass-through and the rise of inflation,*" *French Council of Economic Analysis, Focus*, no.97 (May 2023), *https://cae-eco.fr/staticfiles/pdf/focus-94-inflation-en-230509.pdf*). A final econometric study of a global manufacturer and retailers selling its products in the U.S. concluded that the manufacturer reached nearly-full pass-through within two months of a cost change and that retailers did the same in five to six months. *See* S. Alvarez, A. Cavallo, A. MacKay, and P. Mengano, "Markups and Cost Pass-through Along the Supply Chain (Jan. 3, 2025), *available at* http://dx.doi.org/10.2139/ssrn.4935032.

[83] *See* E. A. Ivers, "Taxing Cloud Computing Proves to Be Just That—Taxing, *Boston College Law Review* E. Supp., 62, II.-165-II.-184 (2021).

[84] The response of Netflix to Chicago's variously called the "cloud tax" or "Netflix tax" is discussed in the section on taxing streaming revenue below.

[85] A spokesperson stated to a media outlet that "We will be adding it to the cost we charge subscribers." See https://www.digitaltveurope.com/2015/07/07/netflix-to-pass-on-cloud-tax-to-subscribers.

[86] The Congressional Research Service, in a report on Digital Service Taxes, stated that "There is also empirical evidence that these taxes will be passed on." CRS, *The OECD/G20 Pillar 1 and Digital Services Taxes: A Comparison*, p.13 (Apr. 1, 2024), https://crsreports.congress.gov/product/pdf/R/R47988.

explained there, passthrough to the prices paid for the advertised goods may be negative, zero, or positive. If the streaming ad market responds as assumed for digital advertising in general, then the discussion above indicates that excess burden from this part of the tax is likely to be low.

Considerations of equity for taxing streaming companies are largely similar to those for taxing digital advertising. In particular, the benefit principle indicates that taxing streaming service providers—firms that rely not just on the existence of the Internet, but also on fast broadband service—is equitable under both the benefit and ability-to-pay principles.

With respect to the social-cost creator or cost-recovery principle, it is important to note that significant investment in broadband networks is required to handle the video streaming traffic demanded by users.[87] By one estimate, traffic from the five largest video streaming entertainment providers—Netflix, YouTube, Amazon Prime, Disney+/Hulu, and Microsoft Xbox—accounts for a staggering 90% of new network operating costs.[88] Unlike in competitive markets, in which competitive forces lead to a price structure that mimics the cost structure, there is no efficient infrastructure cost recovery from streaming firms. The market for broadband Internet service provision differs from efficient cost recovery in two respects. First, due to the nature of peering arrangements among broadband network operators, providers of video streaming entertainment do not pay the terminating broadband network provider for accessing their middle-mile and last-mile networks. Yet, as mentioned above they contribute significantly to the cost of operating and upgrading the network. Since ISPs operate in a two-sided market, they could, in principle, recover these costs from end-users. However, ISPs have not attempted to pass their costs on to major streaming platforms, regardless of whether net neutrality rules were in effect. One key reason appears to be market forces: customers, accustomed to paying flat rates for Internet access, would likely object to such changes. Second, small ISPs, most often in rural areas, lack the bargaining power to force the giant video streaming companies to the negotiating table.[89]

Of course, only a portion of total investment in broadband networks is supported by the Fund. Nevertheless, the cost-recovery principle still applies to the more limited issue of funding universal service. And here, the implication is clear. The Fund supports programs to lower the cost of accessing the Internet on the supply side (through the High Cost Fund) and the demand side (through Lifeline). Clearly, large video streaming companies are responsible for much of that cost and under the cost-recovery principle could be required to fund most of the expenditure on universal service. Additionally, creating such costs for ISPs diverts revenue that otherwise could be used to expand broadband access in underserved rural areas. This would provide an additional rationale for taxing the cost creators to fund universal service.

The discussion of administrability for taxing streaming companies mirrors that of other digital services such as cloud computing and platform agency services. It is worth noting that Florida and Kentucky administer a "Netflix tax" on streaming services as part of their utility excise taxes, and their experiences could be examined to help determine implementation details. The city of Chicago also taxes streaming via its amusement tax.

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[87] See the sources cited in note 25.

[88] Layton and Potgieter, *Rural Broadband*, op. cit.

[89] *See, e.g.*, R. Layton and P. Potgieter, *Rural Broadband and the Unrecovered Cost of Streaming Video Entertainment*, paper presented at the 23rd Biennial Conference of the International Telecommunications Society (ITS) (2021), https://hdl.handle.net/10419/238035.

6. Platform Agency Revenues.—There are many types of services offered on platforms that would be included in an agency revenue tax, and many of these are relatively novel services for which few or no econometric studies of demand have been performed. We will assume the overall demand for digital services on platforms is unit elastic for purposes of calculating the excess burden.

Demand for some platform-provided services is more inelastic than that. Demand for rides on Uber has price elasticity measured as falling between -0.77 and -0.26.[90] The price elasticity of demand for Airbnb rentals is about -0.5.[91] A more elastic figure than these estimates, -1, is chosen based on studies showing that sales taxes on platform goods and services "can lead to a quite elastic change in demand."[92] Choosing a higher figure for digital services overall could potentially inflate the excess burden resulting from taxing these services. However, section 0 below shows that even assuming a higher elasticity than for broadband Internet access, the excess burden from a tax on digital services would be much smaller than from taxing telecommunications or broadband services (due to the broader tax base). If demand for digital services is inelastic overall, then the excess burden from taxing these services would fall proportionally.

Given the lack of econometric estimates of elasticity for composite demand and supply of digital services, trying to estimate passthrough based on equation (1) is unpromising. Instead, we rely on direct evidence of tax passthrough. Evidence from both theory and data suggests that taxes levied on services provided via digital platforms (apart from advertising) are largely passed through to the consumer. Note that in two-sided markets such as eBay or Uber, there are two steps of passthrough to consider. In the first step, the taxed platform provider adjusts the prices it charges suppliers on the platform (e.g., the sellers on eBay or the drivers on Uber). This is the upstream passthrough. Then, those suppliers decide how much to pass along to their buyers (downstream passthrough). A theoretical investigation of a European digital services tax found that upstream passthrough is likely to be high, potentially even 100%.[93] This is in accord with anecdotal evidence from taxes on Netflix in various locations.[94]

For downstream passthrough, much of the empirical literature again considers the case of Uber. One study found average passthrough between 75% and 98%,[95] while another found that

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[90] For the range of estimates, *see* Cohen, P., Hahn, R., Hall, J., Levitt, S., & Metcalfe, R., *Using big data to estimate consumer surplus: The case of uber*, National Bureau of Economic Research, No. w22627 (2016). For the latter estimate, see Tarduno, Matthew, Should Cities Tax Uber and Lyft?, *available at* https://ssrn.com/abstract=4780394, http://dx.doi.org/10.2139/ssrn.4780394. Another study found elasticity between −0.6 and −0.4. *See* Cohen, Peter, Robert Hahn, Jonathan Hall, Steven Levitt, and Robert Metcalfe, "Using big data to estimate consumer surplus: The case of uber," National Bureau of Economic Research (2016).

[91] Bibler, A. J., Teltser, K. F., & Tremblay, M. J., Inferring Tax Compliance from Pass-Through: Evidence from Airbnb Tax Enforcement Agreements, Review of Economics and Statistics, 103(4), 636–651 (2021).

[92] *See* D. Klein, C.A. Ludwig, & C. Spengel, "Taxing the Digital Economy: Investor Reaction to the European Commission's Digital Tax Proposals," *National Tax Journal* 75, no. 1: 61-92 (2022), and citations to the literature therein.

[93] Julien Pellefigue, *The French Digital Service Tax: An Economic Impact Assessment*, Deloitte and Taj (Mar. 22, 2019), https://blog.avocats.deloitte.fr/content/uploads/2020/03/dst-impact-assessment-march-2019.pdf.

[94] *French Digital Service Tax*, op. cit.

[95] *Should Cities Tax Uber*, op. cit.

passthrough exceeded 100%.[96] For Airbnb, passthrough has been measured to be 76% to renters. As an average scenario for consumers, therefore, we assume passthrough to be 88.5% for platform services (the midpoint between 75% and full passthrough).

As for the cases of taxing digital advertising and streaming, the benefit principle strongly supports taxing agency revenue from platforms instead of the status quo of taxing a shrinking base of telecommunications services to fund universal service. These platforms exist only because of investment in Internet infrastructure.

Taxes on revenues from digital services such as platform agency fees are relatively new, but they have been adopted by numerous countries, states, and cities. By examining their experiences, we could identify best practices to design a tax to fund universal service that is both administratively efficient and effective. The salience of such taxes would be similar to the cases of streaming and cloud computing.

7. E-Commerce Revenues.—Taxing revenue from e-commerce would have different impacts than taxing digital advertisements or services. Taxing e-commerce for universal service would add a new tax on top of the myriad state and local sales taxes already applied to online sales. The average combined local and state sales tax on e-commerce is about 9%. Thus, even though the contribution factor for the Fund would be relatively low, given the very large tax base, the marginal all-source tax rate on e-commerce revenue would be much higher. Since there is such a large e-commerce revenue base, and deadweight loss is proportional to revenue (see equation (2)), the excess burden from the additional tax would be substantial.[97] This inefficiency would likely be much larger than many of the other options, particularly those involving taxing digital advertising and services, and so we do not consider taxing e-commerce further in this report.

8. Appropriations.—To evaluate the impact of adding the Fund to the general revenue obligations of the federal government, it is assumed here that income taxes will be raised by the necessary amount to offset the additional spending. If income is to be subject to additional taxation to fund universal service, the labor market is the primary area to look for the economic effects. The formula for excess burden in equation (2) is inappropriate for this case, since the supply curve of labor is not perfectly elastic. While the formula can be adjusted for a partially inelastic supply curve, it is easier in this case to rely on direct estimates of the social cost of public funds. The marginal cost of public funds, incorporating the standard deadweight loss triangles, is between $1.20 and $1.30 per dollar raised.[98] In other words, the consumer and producer benefits lost to the excess burden of a tax are 20 to 30% beyond the tax revenue raised. A compromise figure of $1.25 for the marginal cost of public funds will be used in the computations below. These would be very high rates of inefficiency due to the high existing labor taxes and the additionally distorted incentives for workers and employers.

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[96] Leccese, Mario, Asymmetric Taxation, Pass-through and Market Competition: Evidence from Ride-sharing and Taxis (April 12, 2021), *available at* https://ssrn.com/abstract=3824453.

[97] For example, an incremental tax of 0.4% on top of an assumed average existing sales tax rate of 9% would lead to an incremental excess burden of about $450 million, which is much higher than for the other packages of digital services examined in section 0.

[98] Spackman, M., Social Discounting and the Cost of Public Funds: A Practitioner's Perspective. *Journal of Benefit-Cost Analysis*, 11(2), 244-271 (2020).

The loss of economic benefits would be shared by workers and the firms that employ them; the portion taken from workers (i.e., the quantity analogous to the tax passthrough to consumers analyzed for the other options) can be estimated as follows. As one might imagine, the labor market is complex but well-studied by economists. While reducing the entire U.S. labor market to a few parameters is simplistic, the following results can be summarized from the literature. The elasticity of labor supply is about 0.1 for primary wage earners but higher for secondary wage earners.[99] We adopt a figure of 0.2 for overall supply elasticity.[100] For labor demand, the elasticity is about -0.25 in the long run.[101] Using the passthrough formula from equation (1), workers would bear a bit more than half of the additional income tax burden from funding universal service (56%, or $4.6 billion of the $8.3 billion total); employing firms would bear the rest.

As with other uses of the income tax, there is little direct connection between the tax and the benefits derived from it. Furthermore, unlike government-provided public goods such as public safety, roads, schools, and parks—which all directly benefit each neighborhood to some extent—the connection between tax and benefit received is more tenuous with the Fund.[102] Middle- and high-income households in locations that are not costly to serve with broadband—i.e., the households paying almost all the income tax in the nation—derive little benefit from the Fund, apart from, perhaps, a minor degree of indirect positive externalities gained from others added to the network.[103] The case for tax equity is stronger here under the *ability-to-pay* principle due to the progressive nature of income taxation.

Since income is already taxed, there would be no new issues regarding the administration of the tax on the collections side. Regardless, USAC or a similar organization would still be required to determine the necessary contributions and administer disbursements. The salience of the tax would be low, as universal service funding would be only a small drop in a very large bucket of tax obligations.

[99] *See* Jonathan Gruber, *Public Finance and Public Policy* (6th ed.), New York: Worth Publishers, p.660.

[100] As, for example, also chosen by the congressional Joint Committee on Taxation for its analysis of the TCJA. See Table 3 of Macroeconomic Analysis of the "Tax Cut and Jobs Act" as Ordered Reported by the Senate Committee on Finance on November 16, 2017, Joint Committee on Taxation, JCX-61-17 (Nov. 30, 2017).

[101] This is the publication bias-corrected, preferred estimate of the authors of a meta-analysis of labor demand studies. A. Lichter, A. Peichl, & S. Siegloch, The Own-Wage Elasticity of Labor Demand: A Meta-Regression Analysis, *European Economic Review*, 80, 94-119 (2015).

[102] That is, while many schools and parks funded by tax dollars do not benefit any given neighborhood, that area most likely *does* have some that do.

[103] Such network externalities are oft claimed by proponents of broadband but never, as a rule, empirically measured.

C. Taxation options, tax rates, and excess burden

We propose eight options for funding universal service through different tax bases. These options combine various revenue sources discussed in the previous sections. The options are:

1. Status quo (current system)
2. Telecommunications and Internet services
3. Digital advertising
4. Cloud computing services
5. All digital services (including digital ads, cloud services, streaming, and platform agency revenue)
6. Digital natives services (combining broadband, digital advertising, and cloud services)
7. Digital ecosystem tax (all revenue sources examined above except e-commerce and appropriations)
8. Appropriations.

For each option, we calculate both the required tax rate and its economic burden, assuming the Fund needs to raise $8.3 billion.

1. Status Quo.—Maintaining the current system would continue the problematic trends discussed in section II. The shrinking subset of the telecommunications revenue in the contribution base is causing the contribution factors to skyrocket upwards. The tax rate to fund universal service averaged 34% in 2024. Using a demand elasticity estimate of -1.5 for telecommunications services and the deadweight loss formula from equation (2), we calculate an excess burden of $2.1 billion. Thus, for every four dollars raised for the Fund, the economy loses one dollar in potential benefits through reduced telecommunications usage, a very large excess burden. This loss, shown in region A of Figure 4, represents economic value that consumers would have gained from telecommunications services in the absence of the tax. Moreover, since companies pass through the entire tax to consumers, they ultimately bear both this efficiency loss and the direct $8.3 billion tax burden.

The rising contribution rates in the current Fund create two major problems. First, they claim an ever-larger share of telecommunications revenue. Second, and more importantly, these ballooning contribution factors create substantial economic inefficiency. This inefficiency will only worsen as rates continue to climb.

Figure 6 illustrates how rising contribution factors have affected prices by showing the price wedge—the difference between what consumers pay for telecommunications services and what carriers earn from these sales (the producer prices).[104] As shown in Figure 4, this wedge is the difference between the after-tax price $p^0(1+\tau)$ and producer price p^0. Since the Bureau of Labor Statistics presents these price series as indexes rather than absolute price levels, the price wedge is set to zero at the beginning of our analysis (first quarter of 2010). The price wedge has also been adjusted to remove the effects of general inflation.[105] The widening gap shown in the graph primarily reflects increasing taxes and fees, with the Fund's contribution factor being the fastest-growing component and main driver of this long-term trend. It is important to note that the price

[104] These prices series are described in section IV.B and note 53.

[105] Before computing the price wedge, both the CPI and PPI for the telecom service basket were adjusted by dividing by the CPI-U (the all-items urban consumer price index).

wedge shown here is mainly due to taxes and excludes industry's profit margin (which would be the difference between producer price and cost).

Figure 6: Inflation-adjusted price wedge between consumer and producer prices for telecommunications services

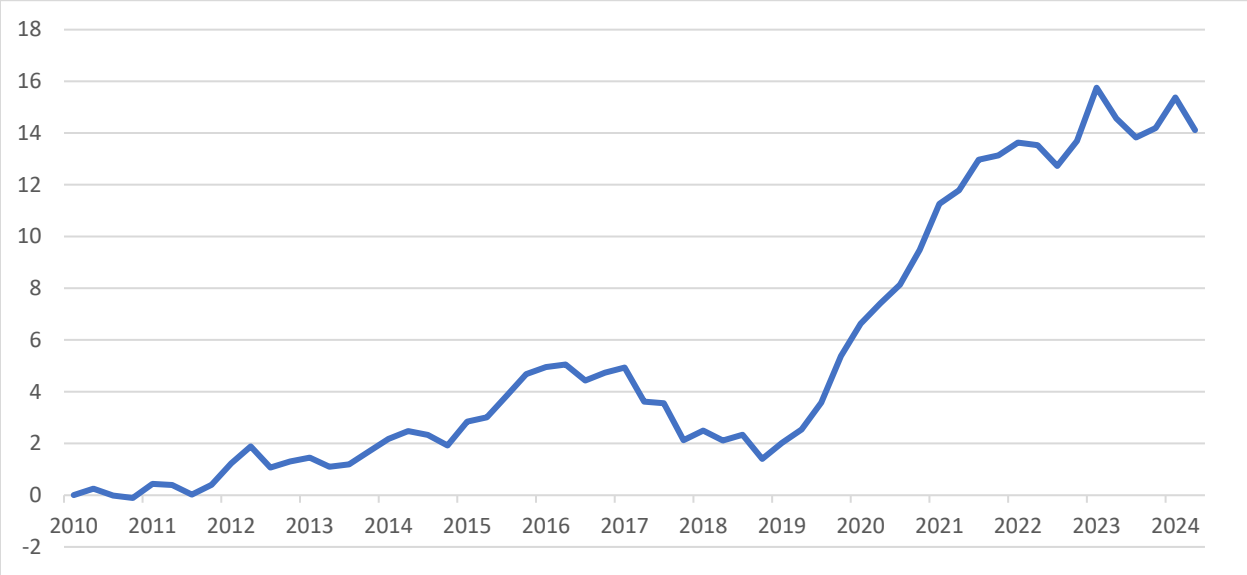

Figure notes: The price wedge is normalized to zero for 1Q 2010, so that the time series shows the excess growth of real consumer prices in percentage terms (net of producer prices). The constituent price series used to compute the price wedge (the CPI and PPI for telephone services; see note 53) were adjusted to remove general inflation (see note 105).

The price wedge grew steadily until 2016, and then resumed growing in 2019. During 2017-2018, the wedge declined as major carriers embraced unlimited pricing plans, driving down prices for wireless services.[106] From 2019 to the present, the price wedge increased dramatically, with excess consumer price growth rising from 2% to over 14% compared to 2010 levels. We tested the relationship between the price wedge and universal service contributions by regressing the log price wedge on both the log telecom producer price index and the Fund's contribution factor. The results showed that a 1% increase in the contribution factor is associated with a 1.1% increase in the wedge. To remove potential bias from confounding trends in the time series, we repeated the regression in differenced form, finding that a 1% increase in the contribution factor is associated with a 0.9% increase in the wedge. Theory suggests that if universal service taxes drive the price wedge, its coefficient should be 1.0 in the regression model. Our statistical tests do not reject this hypothesis in either estimation.[107] Thus, the price wedge caused by the increasing contribution

[106] *See* https://www.forbes.com/sites/greatspeculations/2017/06/27/u-s-wireless-price-wars-having-a-big-impact-on-consumers. When price levels fall, any ad valorem tax or fee decreases per unit sold.

[107] Since the price wedge w is $P_0\tau$ (see Figure 4), we have $\ln(w) = \ln(P_0) + \ln(\tau)$. The first term on the right is the log producer price index for the telecom services subject to USF contributions, and the second is the log tax rate (contribution factor). Note that the coefficient on the log tax rate thus implied by theory is 1.0. The first regression is based on this equation, and yields an estimated coefficient of 1.11 (with autocorrelation-consistent s.e. = 0.546). However, there is evidence that these time series are not stationary, and so the regression was re-estimated in

factor is not just a theoretical, textbook curiosity. Instead, it creates a real financial burden for consumers, beyond the excess burden previous discussed.

2. Telecom + Broadband.—A second option is to include revenue from broadband Internet access service in the existing revenue base subject to the universal service tax. If contributions were required from broadband Internet access service providers, to raise $8.3 billion for the Fund from revenue of $254.4 billion (lines 1 and 2 in Table 1) would require a contribution rate of only 3.3%.

Using the demand elasticities for telecommunications and broadband Internet access services discussed above, one can estimate using equation (2) that the excess burden on consumers from raising revenue for the Fund would be $68.5 million. This represents an additional 8% loss of economic benefits for consumers beyond the $8.3 billion direct burden.

3. Digital Online Advertising.—Another option is to tax digital advertising. Based on the $259 billion figure for the online ad industry (line 3 in Table 1), the tax rate would be 3.2%. If only the top five digital advertisers are included, the contribution factor would rise only a small amount to 3.8%, since these firms garner the lion's share of the market.

If the same degree of downstream passthrough observed in the study discussed in section B[108] applies to the $1.2 trillion of e-commerce revenue listed in line 7b of Table 1, the direct burden on final-goods consumers from a digital ad tax of 3.2% would be $1.9 billion. Additionally, the excess burden they would bear would be only $1.6 million.[109] Since not all e-commerce sales involve products that are digitally advertised, these figures could be viewed as an upper bound, and the actual effects on consumers could be much smaller.

4. Cloud Computing.—Taxing the $388.5 billion of revenue from cloud computing services would result in a tax rate of 2.1% to fund universal service. If 80% of increased cloud computing costs are passed through to final consumers, the excess burden on them would be $56.7 million.[110]

5. Digital Service Tax (Digital ads, cloud, streaming, platform agency).—Another option would be to impose a broad tax on revenue from various digital services. Many European countries levy Digital Service Taxes. Although the criteria vary by country, these taxes typically apply only to *online* digital services (mainly B2C services) and exclude broadband Internet access services. Thus, although Internet service provision and linear video programming over cable networks are digital services, they are excluded from the tax base. Unlike European Digital Service Taxes,

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difference form, yielding a coefficient of 0.922 (s.e. = 0.686). In neither case is the hypothesis that the coefficient is 1 rejected.

[108] Rauch, op. cit. See the discussion on p. 25.

[109] The computation of excess burden assumes that aggregate demand for goods sold via e-commerce is unit elastic. The elasticity of a consumer's total expenditure on all goods (broadly defined to include savings and all other uses of money) is -1.0, since if all prices rise by 1% then total quantity purchased must fall by 1%. Thus, any sufficiently large enough category of goods such as "all goods and services sold via e-commerce" should have price elasticity close to -1.

[110] If passthrough is higher or lower than 80%, the excess burden changes accordingly. Assuming passthrough of increased cloud computing costs to final consumers is only 60%, the low end of the typical range found in the literature, the excess burden for consumers is $31.9 million. Full passthrough to consumers leads to an excess burden of $88.7 million.

which target only Big Tech, a broad tax base for funding universal service could include all firms offering covered services, subject to a *de minimis* exemption.

We propose that a Digital Service Tax include revenue from digital advertising as well as from cloud computing, streaming, and platform agency services. The tax would not cover telecommunications services, broadband Internet access services, or e-commerce. The total revenue base would be $841.9 billion (the sum of lines 3, 4, 5a, and 6 in Table 1), yielding a tax rate of just 1.0%. Given the assumptions on elasticity and passthrough for these revenue sources, this tax rate results in a direct burden on consumers of $5.4 billion. The excess burden on consumers is $20.2 million.[111] Of these totals, taxing digital advertising contributes only $600 million to the direct consumer burden and $150,000 to the excess burden.

6. Digital Natives Tax (Broadband + Digital ads + Cloud computing).—Rather than adopting a European-style digital services tax, a Digital Natives Tax could instead draw revenue from broadband Internet access service, digital advertising, and cloud computing services. With a revenue base of $877.4 billion (the sum of lines 2, 3, and 4 in Table 1), the tax rate would be 0.9%. The direct burden on consumers would be $5.9 billion and the excess burden would be $15.4 million.[112]

7. Digital Ecosystem Tax (Telecom + Broadband + Digital Services Tax).—The most expansive tax on telecommunications and broadband-related or -enabled services is a full ecosystem tax covering telecommunications and broadband Internet access services revenues along with the revenue base for the Digital Services Tax. Adding revenue from lines 1-4, 5a, and 6 from Table 1, the tax base totals $1.1 trillion, resulting in a tax rate of 0.8% to fund universal service. The assumptions about elasticity and passthrough imply that the direct burden of the tax would be $6.1 billion for consumers. The excess burden borne by consumers would be $15.6 million.[113]

8. Appropriations.—With an income tax base of $15 trillion, a flat contribution factor of approximately 0.055% (i.e., $5.50 per $10,000 of taxable income) would be required to raise the $8.3 billion needed for universal service. Using the estimated social cost of general public funds discussed in the previous section, the incremental excess burden from the universal service tax would be $2.1 billion. However, that amount includes deadweight loss taken from the economic

[111] Calculations assume downstream passthrough for taxing platform services is 88.5% and passthrough of increased cloud services costs is 80%. Other assumptions above the various passthrough rates yield other results. Examine first the case in which figures at the low end of the plausible ranges of passthrough discussed in section B are used. When downstream tax passthrough for platform services is assumed to be 75% and cost passthrough for cloud services is 60%, the direct tax burden on consumers is $4.5 billion and the excess burden on consumers is $13.6 million. On the other hand, with full upstream and downstream passthrough for platform services and full cost passthrough of cloud services input costs to consumers, the direct burden on consumers is $6.3 billion and the excess burden is $28.5 million.

[112] Calculations assume passthrough of increased cloud services costs is 80%. With 60% passthrough of increased input prices for cloud services, the direct burden on consumers would be $5.1 billion and the excess burden would be $10.5 million. Under the alternative assumption of full cost passthrough, the direct burden rises to $6.7 billion and the excess burden to $21.6 million.

[113] Calculations assume downstream passthrough for taxing platform services is 88.5% and passthrough of increased cloud services costs is 80%. With alternative assumptions regarding passthrough, the direct burden of the tax would be $5.4 billion for consumers when there is 75% downstream passthrough for platform services and 60% cost passthrough for cloud services costs. This figure rises to $6.8 billion with 100% passthrough for both. The excess burden would be $11.7 million in the former scenario and $20.5 million in the latter.

benefits of both workers and firms. To make the excess burden calculation comparable to the other options, which focused on consumers, only the excess burden from lost surplus accruing to workers should be included. Revising the above figures for excess burden to reflect only the share borne by workers leads to a revised total of $1.2 billion. Adding the excess burden to the direct tax burden for workers leads to an estimated $5.8 billion in total lost economic benefits for workers.

V. Summary and conclusions

The discussion and computations evaluating the options are summarized in the following table. Although no single option dominates all others by every criterion, several striking results stand out. It is immediately apparent that the status quo is horrendously inefficient, creating an excess burden about one-quarter the size of the revenue raised. This is a staggering amount of lost consumer benefits. Given the clear need to reform the funding of universal service, along with the adverse efficiency and equity consequences of the status quo, another option should be chosen moving forward.

The most promising options involve taxing various digital services. If the policy goal is to shield consumers from the tax burden, then taxing digital advertising is likely the best option. With this option, consumers would likely bear only a small share of the direct tax burden and face only a modest excess burden. If the goal is to spread the tax burden across more firms, the Digital Natives Tax and the Digital Ecosystem Tax have the lowest excess burden, although the Digital Services Tax performs nearly as well. All four options also score highly on equity, primarily but not exclusively according to the benefit principle.

While some economists and other commentators have argued for funding universal service from general federal tax revenue, most of that comes from personal income, which is already heavily taxed. Thus, although the tax rate would be relatively low, the marginal cost of public funds would be high. Appropriations are only half as damaging to consumer/worker welfare in terms of deadweight loss, but the lost benefits still represent a high degree of tax inefficiency.

There are several caveats to consider when reviewing Table 3. All revenue bases are approximate, and in some cases (notably for platform revenue) only the largest companies were included due to a lack of information on an entire industry. On the other hand, depending on the threshold set for de minimis revenue in contribution obligation, industry revenue in a particular tax base may be lower than assumed. Given that the largest firms typically dominate in digital services markets, we do not expect these considerations to affect the numbers significantly.

Furthermore, these figures provide only a snapshot of the present situation. The forecasting presented in section II showed that the situation for the status quo is becoming increasingly grim. Conversely, revenue in each of the other areas, most notably from the services included in the Digital Service Tax option, is growing rapidly. Thus, if these other markets were forecast into the future, the universal service tax rate would decline over time (assuming a modicum of fiscal discipline for the Fund) and the excess burden from the taxation would decrease even more.

Finally, apart from the appropriation scenario, the excess burden calculations assume away existing digital services taxes. If more cities and states began taxing digital services, the marginal harm from further taxation to fund universal service would increase. Regardless, the tax rates for

the Fund would remain relatively low compared to the other options, which would likely keep the excess burden relatively low compared to the status quo and appropriations scenarios.

Given the inefficiencies of the current funding model, reform is not just desirable but necessary. While each alternative has trade-offs, taxing digital services appears to offer the most efficient and equitable path forward, minimizing excess burden while ensuring a stable revenue source. Policymakers must weigh these options carefully, but what is clear is that the status quo is unsustainable. A well-designed reform can better align universal service funding with the evolving digital economy while reducing economic distortions.

Table 3: Tax base, tax rates, tax burdens, and equity[114]

Option	Tax base ($ billion)	Tax rate (%)	Direct consumer tax burden ($ billion)	Excess burden ($ million)	Tax Equity
Status quo	24.5	33.9	8.3	2,108.9	Low
Telecom and broadband tax	254.4	3.3	8.3	68.5	Moderate
Digital advertising tax	259.0	3.2	2.0	1.6	High
Cloud computing tax	388.5	2.1	6.6	56.7	High
Digital Services Tax	841.9	1.0	5.4	20.2	High
Digital Natives Tax	877.4	0.9	5.9	15.4	High
Digital Ecosystem Tax	1,096.3	0.8	6.1	15.6	High
Appropriations	15,000.0	0.06	4.6	1,152.8	Low/ moderate

[114] Revenue figures are for 2023 unless noted otherwise in the text. *Direct consumer burden* is the fraction of the tax revenue paid out of consumer surplus (or, in the case of federal income tax, rents earned by workers). *Excess burden* is the deadweight loss from the tax, again only the part borne by consumers or workers. In the case of options involving digital ads, the direct and excess burdens include those from final consumers of advertised goods, as explained in the text.