American University Business Law Review

Volume 11 | Issue 1 Article 1

2022

Empirical Evidence on Robot Taxation: Literature Review and Technical Analysis

Bret N. Bogenschneider
State University of New York, Plattsburgh, bret.bogenschneider@cnu.edu

EMPIRICAL EVIDENCE ON ROBOT TAXATION: LITERATURE REVIEW AND TECHNICAL ANALYSIS

BRET N. BOGENSCHNEIDER*

The literature on robot taxation has continued to expand since 2018 with numerous articles now referring to empirical evidence. The evidence presented in prior studies comprises abstract modeling and statistical pattern reviews with no statistically significant findings reported to date. Notably, one article is an advocacy piece by a tech lobbyist who at one point purchased priority Google results for the search "robot taxation." In some cases, technical errors are sufficient to reverse the stated results. Examples of error in empirical analyses include (i) motivated reasoning, such as the failure to model simpler or best explanations; (ii) lack of causal analysis; (iii) tax technical errors; (iv) omission of citations to conflicting theory or results; (v) errors in accounting methods; (vi) enhanced degrees of freedom in modeling parameters; and (vii) reliance on economic theories not reflecting robots as a fourth factor of production. The empirical evidence indicates that capital investment, such as in robots, occurs largely in higher tax nations, and that robot density is positively associated with high corporate tax rates, such as in Germany, Japan, South Korea, and the Nordic states, with little or no automation occurring in tax havens where the value of tax deductions for capital investment is zero.

* PhD; J.D.; LL.M. Associate Professor of Accounting, State University of New York, Plattsburgh. Thanks to participants in the Southeastern Institute for Operations Research and the Management Sciences 2021 conference.

I. INTRODUCTION

Tax knowledge not formulated in numbers is of "a meagre and unsatisfactory kind," at least according to Lord Kelvin.[1] Tax theory, at least as it might be explained by tax lawyers or accountants in words, seems to be doubtable, dubious, or possibly even biased. In comparison to words, numbers feel more certain, clear, and unbiased. John Maynard Keynes famously disagreed with Lord Kelvin in the special value of economic knowledge formulated in numbers, however. Keynes referred to econometrics as a type of "black magic" and not in the nature of scientific inquiry.[2] As applied to robots and robot taxation, here referring to both traditional robots and other information and communication technologies ("ICT"),[3] the empirical scholar looks at the world, sees robots, posits taxes levied on such robots, then provides explanations based on statistical patterns, or abstract modeling, related to capital taxation in this particular form and its predicted effects to the broader economy. James Bessen wrote, for example: "Whether productivity-improving technology is increasing employment in some industries today can, and must, be determined empirically, of course."[4] The empirical methodologies of econometrics suffer from significant limitations reducing the reliability and

1. *See* 1 WILLIAM THOMSON (LORD KELVIN), POPULAR LECTURES AND ADDRESSES 73 (1889).

2. John Maynard Keynes, Comment, *On a Method of Statistical Business-Cycle Research*, 50 ECON. J. 154, 156 (1940) ("There is no one . . . whom it would be safer to trust with black magic. [T]hat this brand of statistical alchemy is ripe to become a branch of science, I am not yet persuaded. But Newton, Boyle and Locke all played with alchemy. So let him continue.")

3. As consistent with the usage in the prior literature, the term "robot taxation" refers to the taxation of production robots and other forms of automation, including software and other information and communication technologies.

4. James Bessen, *Automation and Jobs: When Technology Boosts Employment*, 34 ECON. POL'Y 589, 593 (2020).

meaningfulness of given results, however.[5] The few empirical studies conducted thus far, although neither statistically significant nor causal analyses in some cases, have suggested that any taxes on capital, including robot taxes, are bad or inefficient as robot taxes are taken as a tax on capital, which is always presumed to be less efficient in economic terms than wage taxes levied on labor.[6]

An initial concern is whether Bessen is correct that empirical analyses can, or must, be used to formulate economic and tax policy in respect of automation.[7] A countervailing view was given by Karl Popper in explaining the nature of science and scientific discovery, where the idea is that empirical analyses are not in the nature of bedrock and are always based on an underlying theory.[8] According to Popper, theory dominates all aspects of empirical work from data gathering to experimentation in the laboratory.[9] Data is accordingly best viewed as not independent of theory and is rather highly reliant upon it, at least as a matter of science, if not econometrics.[10] Popper wrote:

> Science does not rest upon solid bedrock. The bold structure of its theories rises, as it were, above a swamp. It is like a building erected on piles. The piles are driven down from above into the swamp, but not down to any natural or 'given' base; and if we stop driving the piles deeper, it is not because we have reached firm ground. We simply stop when we are satisfied that the piles are firm enough to carry the structure, at least for the time being.[11]

Partly out of concern that econometric figures and results might not be reliable, the Federal Reserve has previously attempted to replicate leading econometric studies reflecting a decade of econometric work but was largely unable to do so.[12] In particular, the empirical justifications for the heavy

---

5. *See infra* Part II.

6. *See infra* Part III.

7. *See* Bessen, *supra* note 4, at 593.

8. KARL POPPER, THE LOGIC OF SCIENTIFIC DISCOVERY 94 (2d ed. 2002).

9. *See id*. at 90 (citing 5 ERNST MACH, DIE PRINZIPIEN DER WAEMELEHRE: HISTORISCH-KRITISCH ENTWICKELT 438 (1896)) ("[T]he theoretician must long before [experimentation] have done his work, or at least what is the most important part of his work: [H]e must have formulated his question as sharply as possible. Thus[,] it is he who shows the experimenter the way. But even the experimenter is not in the main engaged in making exact observations; his work, too, is largely of a theoretical kind. Theory dominates the experimental work from its initial planning up to the finishing touches in the laboratory.").

10. *Id.* at 7.

11. *Id.* at 94.

12. *See* Richard G. Anderson & William G. Dewald, *Replication and Scientific Standards in Applied Economics a Decade After the Journal of Money, Credit and*

taxation of labor as opposed to capital have been disputed. Undeterred by the apparent inability to repeat results, thus defeating one of the core tenants of modern science, leading econometric scholars have taken Kelvin's Dictum even further than it was first envisaged. The titles of many empirical works in tax policy proclaim more broadly: This is what we *know* about taxation and tax policy.[13] The expanded version of Kelvin's Dictum is not just that numbers yield a more satiating form of knowledge, but that metrics are the *only* way to know. By this view, scientists look at the world, gather observations, analyze these observations (sometimes with experiments by abstract modeling), and then provide theories or explanations of what they have supposedly observed. Importantly, however, all modeling in respect of robot taxation is at the level of macroeconomic statistics and not firm-level evidence since no specific observational data has been gathered in respect of robot taxation, even in respect of South Korea, which has made various changes to its tax credit for robot taxation and would appear to be a ready case study.[14] As an illustration, if the South Korean tax credit for robot taxation allowed for both deduction and credit for the same investment, this would create a substantial incentive toward automation and might explain in part the extremely high robot density in that nation.[15]

In the neoclassical theory of taxation, all taxes on capital are taken to be suboptimal, and wage taxes levied on human workers are preferred. Ironically, empirical analyses premised on numbers are formally unnecessary to the debate rooted in neoclassical economic theory, as every economist can attest that the preference toward a non-taxation of capital in

Banking Project, 76 FED. RSRV. BANK OF ST. LOUIS REV. 79, 81 (1994).

13. *See generally* Alan J. Auerbach, *Who Bears the Corporate Tax? A Review of What We Know* (Nat'l Bureau of Econ. Rsch., Working Paper No. 11686, 2005) (examining "economic theory and evidence about who bears the burden of the corporate income tax"); Michael P. Devereux & Simon Loretz, *What Do We Know About Corporate Tax Competition?* (Oxford Univ. Ctr. for Bus. Tax'n, Working Paper No. 12/29, 2012) (reviewing "the empirical literature on competition in source-based taxes on corporate income"), eureka.sbs.ox.ac.uk/4386/1/WP1229.pdf; Dhammika Dharmapala, *What Do We Know About Base Erosion and Profit Shifting? A Review of the Empirical Literature* (Coase-Sandor Inst. for L. & Econ., Working Paper No. 702, 2014) (reviewing relevant empirical literature on "[t]he issue of tax-motivated income shifting within multinational firms — or 'base erosion and profit shifting' (BEPS)").

14. Robert Kovacev, *A Taxing Dilemma: Robot Taxes and the Challenges of Effective Taxation of AI, Automation and Robotics in the Fourth Industrial Revolution*, 16 OHIO ST. TECH. L.J. 182, 204 (2020) ("There is some anecdotal evidence that the reduction in the automation tax credit has slowed investment in robotics, new industrial robot installations in Korea decreased in 2017 for the first time since 2012. Whether this reflects a causative effect of the reduction in the automation tax credit is unclear. At any rate, Korea remains the most automated economy in the world and there is no indication of widespread abandonment of AI, robotics, or automation.").

15. *See infra* Table 2.

all forms is the current view of tax policy within neoclassical economic theory. Although economists have searched the realm far and wide for empirical evidence of the foregoing theory, no reasonable empirical evidence has ever been provided to support that idea, which is referred to as corporate tax incidence.[16] The prior literature on robot taxation has suggested to the contrary, that the preference for robot workers may be inefficient or at least problematic.[17] That conclusion is accordingly to be taken in contrast to neoclassical economic theory which says precisely the opposite and is based on a production function premised on labor, capital, and land; however, neoclassical economic theory does not directly consider robots or automated workers as a possible fourth independent factor of production. Absent any empirical evidence, we are essentially asked to take economic ideas about tax incidence on faith where the policy result is that the tax base should be assigned to labor in the form of wage taxes on economic efficiency grounds.[18] Many tax professionals familiar with the techniques of aggressive tax avoidance by multinational firms are unwilling to take these assertions on faith alone given their professional experience to the contrary, where multinational firms do nearly everything possible to avoid taxes.[19] If firms can pass on taxes to workers and customers, then it does not make sense that firms would take such pains to avoid taxes. The theory of tax incidence seems to be severely flawed, or at least it seems so to experienced tax practitioners who deal with the reality of aggressive tax avoidance by multinational firms on a daily basis.

16. *See* Arnold C. Harberger, *Taxation, Resource Allocation and Welfare*, *in* THE ROLE OF DIRECT AND INDIRECT TAXES IN THE FEDERAL RESERVE SYSTEM 25, 25, 42 (1964), http://www.nber.org/chapters/c1873.pdf; Arnold C. Harberger, *Efficiency Effects of Taxes on Income from Capital*, *in* EFFECTS OF CORPORATE INCOME TAX 114–17 (1966).

17. *See* Rod Tyers & Yixiao Zhou, *Automation, Taxes and Transfers with International Rivalry* 6–7 (CAMA Working Paper No. 44/2018, 2018) ("Payroll taxes generate more revenue than capital income taxes in many countries, and these can encourage the displacement of workers even when it is not otherwise efficient. In the US there is a further incentive to automate because firms can claim accelerated tax deductions for automation equipment, but not for human wages. Less directly, human workers are also consumers who pay consumption taxes, such as retail sales tax (RST) in the US or value added tax (VAT) in the UK. Because robot workers are not consumers, they are not subject to these indirect taxes and so firms can avoid any associated burden. Pre-existing tax policies are therefore not "neutral" as between robot and human workers, but instead [favor] automation.").

18. Hugo A. Keuzenkamp & Jan R. Magnus, *On Tests and Significance in Econometrics*, 67 J. ECONOMETRICS 5, 6 (1995).

19. *See* Kimberly A. Clausing, *In Search of Corporate Tax Incidence*, 65 TAX L. REV. 433, 438–45 (2012).

Several simple or best explanations for the economic effects of robot taxation have not been investigated by empirical researchers.[20] One simple explanation is that nations with higher tax rates appear to experience faster economic growth than nations with lower tax rates. The empirical data yields a clear trend line in favor of taxes as associated with higher GDP growth in nearly all nations and can be presented on a chart, as has been done below in Figure 1.

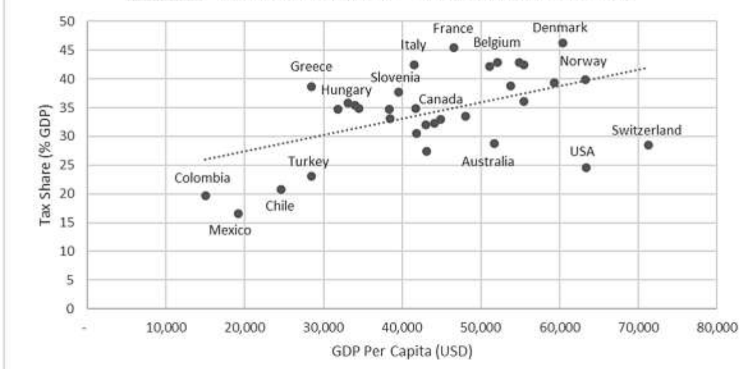

Figure 1: Tax Ratio versus GDP Per Capita (OECD, 2019)

The likely reason for this perhaps surprising data is that profitable firms obtain a tax deduction for capital reinvestment, and accordingly, tend to make capital investments into higher tax jurisdictions, such as European nations or Japan, and little or no capital investments into lower or zero-tax jurisdictions, such as Panama or the Cayman Islands.[21] If robots and automation continue to increase as a share of production, as some scholars have posited a future economy with fully automated production, then perhaps the best empirical observation is that taxes levied on robots should be presumed as necessary to facilitate economic growth. An argument to the contrary would need to explain the broader economic data, that higher taxes seem to cause or to be associated with higher per capita GDP, and then explain why robot workers should continue to be effectively exempt from taxes as a form of capital investment. As has been previously explained, an inefficient, over-investment in automation appears to have occurred as firms chased the valuable tax benefits from hiring robots rather than humans, which may also diminish the tax base and lead to fiscal problems.[22] The

20. *See infra* Figure 1.

21. *See* Bret N. Bogenschneider, *Will Robots Agree to Pay Taxes? Further Tax Implications of Advanced AI*, 22 N.C. J. LAW & TECH. 1, 39–40 (2020) [hereinafter Bogenschneider, *Will Robots Agree to Pay Taxes?*].

22. *Id.* at 4–5 ("[T]he given robot versus human efficiency model does not take into

various reasons to be skeptical about the empirical evidence offered thus far in the context of robot taxation are summarized in Part II. A comprehensive review of the empirical literature on robot taxation is provided in Part III, where the existing empirical literature is categorized based on methodology applied, technical errors, degrees of freedom, and results.

II. TECHNICAL ERRORS IN THE EMPIRICAL EVIDENCE ON ROBOT TAXATION

The field of economics is unique among the social sciences in that it views data gathering as giving rise to theory, whereas modern science views theory as giving rise to a need for data gathering. In respect of tax policy little or no data gathering has occurred, perhaps because tax returns are confidential. In the absence of comprehensive datasets, econometrics often then proceeds as a form of experimentation by abstract modeling. As explained below, such abstract modeling is premised almost exclusively on theory, so the results of modeling reflect the theory applied, which is generally neoclassical economics. The neoclassical economic theory of tax incidence suggests that corporations are always able to shift taxes to others, even if they do not behave so, and even if there has been no reliable empirical data presented to support that belief. All empirical modeling nonetheless proceeds as if that were true. From that largely theoretical premise, the tax base has accordingly been shifted inexorably toward workers in most nations, including the United States, with the notable exception of Switzerland.

A similar line of reasoning premised on neoclassical economic theory has been applied in the context of robot taxation.[23] As long as the modeling and supposed empirical evidence and results on robot taxation meet that litmus test of consistency with neoclassical economic theory, then the results are likely to be acceptable in economic circles. This is broadly true regardless of the methods applied, assuming these are even disclosed. Notably, the Tax Foundation has disclosed the theory upon which it has formulated its modeling assumptions, albeit without disclosing the modeling itself.[24] Other advocacy organizations simply post their conclusions on the internet.[25] Such results certainly will not be peer-reviewed nor replicated by the Federal

account the relative cost of robots in comparison to human labor, where human labor is less costly than automation at least some of the time. The relative cost of human labor represents the numerator of the given efficiency function (efficiency: *cost* per unit output).").

23. *See infra* Part II.

24. *See infra* Part III.B;. Hötte et al., *infra* note 46.

25. *See, e.g.*, Robert D. Atkinson, *The Case Against Taxing Robots*, INFO. TECH. & INNOVATION FOUND. (Apr. 8, 2019), https://itif.org/publications/2019/04/08/case-against-taxing-robots.

Reserve or anyone else.[26] Advocacy research performed by the Information Technology and Innovation Foundation ("ITIF") has indeed been cited by university scholars as it meets the general litmus test of consistency with the theory of corporate tax incidence.[27] However, the citation to paid research is indeed a rare occurrence, as paid research is generally not accepted as valid without a formal review. Contrary to that approach, in modern science results are checked by other scholars, and if found to be valid, then advanced to further scientific understanding. Accordingly, as summarized here, many technical reasons for skepticism arise largely from the use of modeling designed to reach a desired result, referred to in the terms of psychology as "motivated reasoning," rather than to test causal theories with a multiplicity of competing ideas as would be expected in modern science.[28]

The list of technical errors to be discussed here are as follows:

i. Failure to model simpler or best explanations;
ii. Lack of causal analysis;
iii. Tax technical errors, including omission of wage taxes;
iv. Omission of citations to conflicting theory or results;
v. Errors in accounting methods;
vi. Enhanced degrees of freedom in modeling parameters; and
vii. Reliance on outdated economic theories not reflecting robots as a factor of production.

Failure to model simpler or best explanations. Empirical research may be premised in numbers; however, the numbers' meaningfulness depends foremost on the selection of the hypothesis, which is largely a matter of theory. In the case of advocacy research in particular, the hypothesis selected for empirical review may be suboptimal due to *motivated reasoning*. Consider the basic situation where there are three possible causes: A, B, and C, all of which are supported to some degree by a set of variables and other data. The causal theory or hypothesis is then merely the statement that the variables are related in some manner. Assume here that Cause C is the best explanation of causation supported in the given dataset. Ideally, empirical research comprising regressions or other statistical methods would be undertaken expecting to show Cause C. After empirical research, it would be found that Cause C comprises a very significant relationship between the subject variables, whereas Causes A and B reflect a lesser correlation. The empirical results in respect of Cause C would then be very meaningful, that is a change in one variable is thought to cause a change in another variable. For example, if Cause C was the hypothesis that tax increases on robots as a

26. Anderson & Dewald, *supra* note 12, at 79–80
27. *See supra* note 16 and accompanying text.
28. Popper, *supra* note 8.

type of capital will result directly in more or less economic growth, then empirical information related to the causes would be a very relevant piece of information to policymakers. However, the significance of Cause C could only be discovered or known if that cause was investigated as opposed to Causes A or B.

As explained in the preceding paragraph, if and only if a best cause is investigated by empirical researchers would the resulting evidence be considered very helpful in policy formation. An advocate engaged in motivated reasoning may not wish to find the best explanation of cause. Here, continue to imagine that best explanation is Cause C, and the empirical researcher becomes aware through some initial data mining that the data supports that conclusion. However, since the researcher is engaged in motivated reasoning, they do not want to conclude along the lines of Cause C and prefer Cause A, which is only supported by a correlation that is not significant. There is nothing to force the empirical researcher to look at Cause C even if the data strongly supports it as the primary hypothesis for investigation. For this reason, all empirical research depends in significant degree on the good faith and technical ability of the researcher in selecting the appropriate theory and hypothesis for investigation. As explained in Part III, much of the existing literature on robot taxation draws into severe doubt the good faith of empirical researchers given the number and degree of tax technical errors reflected in such research. In many cases, the errors are severe enough to reverse the results, so the empirical researcher purports to reach one conclusion, but the data actually supports the opposite result, such as the theory that robot taxes are likely to aid, not harm, economic growth.

Another problem may arise insofar as the empirical researcher engaged in motivated reasoning agrees that Cause C is the best avenue for research and would be the proper route for empirical observation, but as a matter of bad faith, affirmatively declines to look at the best avenue. In terms of empirical research, the limitation of a robot tax credit in South Korea is an ideal opportunity to investigate "Cause C," which economic researchers take to be a likely decrease in GDP growth due to a reduction in a robot tax credit.[29] The ability for empirical researchers to isolate that variable is vastly simplified in comparison to attempting to study the hypothetical effects of robot tax on Japan or the United States. It seems obvious that empirical research on robot taxation should begin with South Korea which has varied the terms of its robot tax credit and would be exemplary for empirical study.[30]

Lack of causal analysis. Patterns in datasets are not necessarily causal. All scientific inquiry is intended to relate to causes. The formal statement of

29. *See* Atkinson, *supra* note 25.
30. Kovacev, *supra* note 14, at 202–04.

causation in empirical work is mandatory because it allows researchers to know the difference between causes and random patterns. The formal statement of expected causes is referred to as the hypothesis, and the origins of that hypothesis as an idea are presented in the theory section of an empirical paper. The hypothesis is essentially the researcher stating what they are looking for and expect to find in empirical work. Where empirical work is not preceded by any theory the analysis may become essentially pattern analysis and identification, often referred to as data mining.[31] For example, in the modern-day, a computer can be used to repeatedly run regression analyses on variables within a dataset until a pattern is found. The result can then be published as related to a causal theory, even if the researcher did not know of the pattern prior to running the regression. Such a process constitutes the scientific method in reverse, where the researcher backs into knowledge rather than setting out to discover it. Data mining is essentially cheating in empirical research and may result in a substantive problem, whereby operating the scientific method in reverse may generate confusion around whether the pattern identified is meaningful or causal, as all datasets might or likely will contain such patterns that are the result of random chance.

Although data mining is widespread in empirical work, most academic papers include a theory section which is designed to show that the researcher set out to proceed from theory to hypothesis to pattern identification, even if they did not actually do so. Some journalists have speculated that most empirical researchers are engaged in data mining and do not state the theory or hypothesis in advance of undertaking regressions on datasets.[32] The pre-statement of the hypothesis prior to running tests, such as regressions, largely establishes that when a pattern is found that such pattern is meaningful because the researcher had an idea of what they expected to find and then ultimately found it as a result of empirical work. However, if an academic comes to empirical analysis without a foundation in proper scientific method, the given empirical results can be perverted. For example, relatively weak patterns can be discovered by data mining. The weak patterns can then be presented as related to a causal theory. An example of a weak pattern might be a simple correlation between two variables. The weaker a pattern the less likely it is that the variables are related such that a change to one might change the other. By data mining the researcher may find a pattern which might be the best pattern to be found in the dataset. However, if the researcher did not set out to find that weak pattern, then the correct answer

31. *See* Christie Aschwanden, *Science Isn't Broken*, FIVETHIRTYEIGHT (Aug. 19, 2015), http://fivethirtyeight.com/features/science-isnt-broken/#part1.

32. *See id.*

is that the dataset did not yield any causal result, or in other words, the researcher did not find what they were looking for. The research result is that the dataset did not yield an empirical result. Importantly, if there are a limited number of datasets available to researchers, then it is possible that empirical research would not function at all as a means of inquiry. Of course, the conclusion that a given dataset did not yield any causal result is not publishable and it is accordingly rare that empirical researchers report not finding something because of empirical research. Empirical researchers can thus feel pressure to publish the weak relation as causal to imply the research was meaningful; this is essentially a deer hunter who does not find any deer but does manage to catch a rabbit.

The result of widespread data mining in empirical research is that nearly all research is declared "meaningful" — everybody comes back with at least a rabbit. However, the identification of weak patterns in datasets is close to meaningless in a broad field such as taxation and tax policy. Every dataset can be expected to contain hundreds of weak patterns that can be discovered by data mining, and some of them are likely to relate to a broad or unstated theory of causation, such as the broadly-stated theory of tax incidence within neoclassical economic theory. The weak pattern does not establish causation to that idea however, because it is much too broad and itself premised in motivated reasoning. Yet, to a journalist or any person that receives the report of the empirical finding of a weak pattern, it is nearly impossible to know that the empirical researcher found one weak pattern of many weak patterns, and accordingly, that the result is actually meaningless and relates only to a broad economic concept of tax incidence. Simply put, every empirical researcher can find a weak pattern in a dataset with sufficient time and relate it broadly by motivated reasoning to an idea taken from economic theory. That type of knowledge is meagre, to say the least, even if it is ostensibly based in numbers.

Tax technical errors. A substantial degree of tax technical error has been introduced by scholars in the context of robot taxation. Such errors relate particularly to misstatements of how individual workers pay taxes and how firms calculate tax liability under applicable tax laws and accounting standards. The source of the error can be traced to an omission of references to conflicting scholarship, of which scholars should have been aware, and citation bias,[33] particularly where tax experts have previously explained how the tax system functions in respect to capital investment, which is different in some respects from what economic theory predicts.[34] The differences

33. *See* Christopher J. Ferguson, *Everybody Knows Psychology Is Not a Real Science*, 70 AM. PSYCH. 527, 535 (2015).

34. *See generally* Bret N. Bogenschneider & Benjamin Walker, *A Revised ETR*

between tax practice and economic ideology are most pronounced in respect to the calculation of taxable income by firms, where investments yield immediate tax deductions as a matter of tax practice, but may not yield incremental income that is likely to be subjected to tax. The respective errors are largely in three areas summarized here:

(a) ***Exclusion of Wage Taxes (social insurance taxes)***. When human beings perform work, a variety of different taxes are levied on that activity. They include federal and state income taxes, federal social security taxes, Medicare taxes, the employer portions of these, unemployment taxes, and indirect taxes levied by the states. In Europe, indirect taxes include the value-added tax, or VAT, in lieu of sales taxes. As explained in the next paragraph, generally speaking, none of these taxes are levied either directly on robot workers, or indirectly on firms due to automation or the use of robot workers.[35] A detailed explanation of how human workers and robot workers pay or do not pay each category of existing tax has previously been provided by accounting and law scholars.[36] In the list above, wage taxes are withholding taxes taken out of workers' paychecks such as federal social security taxes, Medicare taxes, and unemployment taxes, plus the employer portions of those. Human workers do not receive an income tax deduction for wage taxes paid even though they never receive the money, and any future benefits received are subject to income taxation. Wage taxes are then the primary illustration of double taxation, which is in effect triple taxation when the same income is taxed as social benefits. In both Europe and the United States, such wage taxes comprise roughly an equivalent portion of the tax base as income taxes, although comparisons are difficult because the United States does not have a federal sales tax.[37]

Severe accounting problems have arisen in respect of how economists set out to measure the wage taxes paid by human workers in the context of robot taxation. Economic theory posits a hypothetical offset that applies against workers and only in the context of wage taxes, where an expectation of possible future social benefits is taken to cancel the cost of wage taxes to

---

Measure for Capital Re-Investment by Profitable Firms, 37 J. TAX'N INV. 33 (2020) (analyzing "how a firm with surplus cash on its balance sheet might be expected to make that of tax-motivated capital re-investment decision"); Bret N. Bogenschneider, *The Tax Paradox of Capital Investment*, 33 J. TAX'N INV. 59 (2015) (arguing that "the amount of actual taxes paid depends not only on the tax rate but also on the tax base (i.e., the legal concept of 'taxable income') against which the rate will be applied").

35. *See* Ryan Abbott & Bret Bogenschneider, *Should Robots Pay Taxes? Tax Policy in the Age of Automation*, 12 HARV. L. & POL'Y REV. 145, 150 (2018).

36. *Id.* at 164–67.

37. *See OECD Tax Database*¸ OECD, https://www.oecd.org/ctp/tax-policy/tax-database/ (last visited Apr. 10, 2022).

workers. Essentially, each worker books an accrual for a future benefit to be received out of a social program that exactly cancels the cost of wage taxes. No other category of taxpayer follows this special accounting method; however, additionally, economic theory does not address the respective details of how to do the calculation. The approach is not methodological in that no evidence exists to show that the amount of future accrual matches the amount of the taxes payable today, or that the benefit should be expected to accrue to the person actually paying the wage tax. Furthermore, many of the social programs are now unfunded mandates, so even if the approach assumed that future benefits would someday become payable to those who paid them into the system, there is no guarantee. Likewise, the special accounting method is not applied to any other groups of taxpayers that also receive transfer payments or other monies directly from the federal or state governments such as multinational firms or the wealthy.

(b) ***Tax Deductibility of Capital Re-Investment for Profitable Firms***. In respect of income taxation, robots as a form of capital investment yield a tax deduction either immediately as an expense or over a short period of time via accelerated depreciation.[38] Prior economic analyses presume the opposite, where robots or automation are taken as a source of income rather than an expense. This is to reverse the entry on the accounting ledger for robot expense to an undefined amount of future income, which economists seem to presume will be a large figure. The flawed idea is essentially that robots as automated workers comprise an incremental revenue stream rather than a depreciable asset. In most business situations, automation is likely to be undertaken by firms that are already profitable in the respective jurisdiction where the robot-type investment is intended either to reduce operating expenses to increase reported earnings, or more likely, to achieve

38. Abbott & Bogenschneider, *supra* note 35, at 164–65 ("The timing of claiming a deduction may have a significant effect on a firm's tax burden. An accelerated tax deduction means that the deduction may be claimed earlier than its actual economic depreciation (the reduction in the value of an asset over time). For example, assume a robot has a total capital cost of $100,000 and seven years of useful life, while an employee has a total wage cost of $100,000 over seven years. If accelerated depreciation for capital is available, the firm may be able to claim a large portion of the $100,000 depreciation as a tax deduction in year one rather than pro[-]rata over seven years. For instance, the firm might claim tax depreciation for an automated worker of $50,000 in year one, $30,000 in year two, $10,000 in year three, and in diminishing amounts to year seven. By contrast, wage taxes must be deducted as paid (i.e., 1/7th in each year). In this case, a present value benefit will accrue from claiming accelerated tax deductions for automated workers relative to the pro-rata tax deductions for employee wages, even where the $100,000 capital outlay is paid up-front. This is possible because the present value of the accelerated tax deduction on capital investment is greater than the discounted value of the return the firm could make by investing the free cash held on its balance sheet.").

after-tax savings by reducing income taxes overall, thereby reducing income tax expenses and increasing reported earnings. The widespread presumption among economists writing on the topic of robot taxation that any multinational firm has or might someday undertake capital investment by automation without considering the favorable tax or revenue effects from that investment seems unlikely.

(c) ***Marginal Tax Rates versus Average Tax Rates****.* A significant error arises within economic theory because firms are presumed to pay taxes on marginal profits, even if the firm pays little to no corporate tax. The problem relates to how abstract modeling is performed within econometrics. To conduct abstract modeling, a necessary variable within any relevant equation is the corporate tax rate. In theory, this means the real or actual rate paid by the firm under the parameters of most economic models. Unfortunately, economists do not know the real or actual tax rate and a solution must be found to proceed with abstract modeling to make tax policy recommendations. Amazingly, nearly all econometrics proceed with the corporate statutory rate as the tax rate variable, even though the statutory rate is nearly always higher than the corporate effective tax rate, assuming the firm can claim any tax deductions, credits, or offsets to reduce tax liability. The distinction simply represents the difference between statutory tax rates, or the tax rate written in the Internal Revenue Code, and the average effective rate, or the rate of tax the firm actually pays after all credits and other deductions, especially in the United States where the tax code provides a litany of potential deductions.

The reason that the corporate statutory rate is considered a plausible modeling parameter is an economic concept referred to as marginal tax rates. Marginal tax rates are generally presumed to be equal to the corporate statutory rate. So, where the corporate statutory is inserted as the tax variable for modeling purposes, economists are actually using the marginal tax rate, which just happens to nearly always be the same as the statutory tax rate. A severe problem is that there really is no way to confirm such a marginal rate, or that even if there was such a marginal rate, that it could be calculated for each firm, or that corporate executives would make decisions based on a marginal tax rate rather than an average tax rate. All of this is merely a figment of economic theory — again, there is no empirical evidence for the modeling assumptions that are used to create what economists claim is empirical evidence. The result of using a higher corporate tax rate based on the marginal tax rate, rather than an average tax rate, is that the negative second-order effects of capital taxes are then measured as relatively larger given the supposed higher tax rates. Of course, many tech firms engaged in automation pay some of the lowest effective tax rates of any firm, so there is a significant difference between the marginal tax rate used in the model and the effective tax rate actually paid by the firm.[39] Other modeling parameters might be to take the average corporate tax rate for tech firms, perhaps five percent or less, and use that in the models.[40] In that case, very little economic effect would likely be registered from robot taxes, either positive or negative large multinationals, in particular, tech firms, simply don't pay much in the way of income taxes.

Omission of Transfer Pricing and other Tax Avoidance Techniques by Multinational Firms. The concern that taxes on capital might cause robots to flee a jurisdiction presumes not only that robots give rise to taxable income, but also that income is taxable in the jurisdiction where the robot is located. But, conditions are neither ideal nor positivist in practice. Every practicing tax lawyer and accountant is aware of this and seeks to undermine the positivist intent of the tax system to the benefit of their clients. The OECD has invested years of effort in attempting to understand the source of non-ideal conditions impacting international tax.[41] Of primary concern, corporate income arises in one jurisdiction and is taxed somewhere else, or not at all.[42] Tax lawyers and accountants call non-optimality in tax matters by various names such as transfer pricing, aggressive tax avoidance planning, and so on.[43] But what that really means is that in terms of tax practice, one cannot presume ideal conditions or matching of taxable income to real events. Economic modeling that does not consider transfer pricing and other means of aggressive tax avoidance by multinational firms is unrealistic and cannot form the basis for viable tax policies.

Omission of citations to conflicting theory or results. The robot tax literature is replete with errors due to the failure to review conflicting theories and results. Examples of the failure to cite to conflicting results: (i) the theory of robot taxation indicates that such a tax may yield efficiency gains by reversal or limitation of an over-investment in robots;[44] (ii) the

---

39. Daron Acemoglu et al., *Does the U.S. Tax Code Favor Automation?*, BROOKINGS INST. (Mar. 18, 2020), https://www.brookings.edu/bpea-articles/does-the-u-s-tax-code-favor-automation/.

40. *See* Stephen Gandel, *Amazon Paid a Tax Rate of Just 1.2% Last Year, Versus 14% for Average Americans*, CBS NEWS (Feb. 6, 2020), https://www.cbsnews.com/news/amazon-taxes-1-2-percent-13-billion-2019/ (noting that "Amazon's 1.2% is low even for corporate America").

41. OECD, *Understanding Tax Avoidance*, YOUTUBE (Jan. 27, 2021), https://www.oecd.org/tax/beps/.

42. *Id.*; *Action 5 Harmful Tax Practices*, OECD, https://www.oecd.org/tax/beps/beps-actions/action5/ (last visited Jan. 11, 2022).

43. *See, e.g.*, *BEPS Action #2 Neutralising the Effects of Hybrid Mismatch Arrangements*, OECD, https://www.oecd.org/tax/beps/beps-actions/action2/ (last visited Jan. 11, 2022).

44. Bogenschneider, *Will Robots Agree to Pay Taxes?*, *supra* note 21, at 19–20

economic theory of tax incidence premised on marginal tax rates has been challenged in the tax literature on the grounds that firms behave as if they do bear the incidence of capital taxation,[45] hence the theory is patently unrealistic due to aggressive tax avoidance by multinational firms; and (iii) one or more of the empirical studies may have cherry-picked results within their own research to suggest that automation is not meaningful to the tax base.[46]

Errors in accounting methods. Nearly all tax policy analysis depends to some degree on accounting methods. Methods in accounting relate to the calculation of tax rates, such as the rate of corporate taxation, which is itself extremely controversial, or to the amount of taxes collected from workers and whether such should include both income and wage taxes. Economists have been very creative in manipulating accounting methods, where the general meaning of terms is reversed from reality. Any failure to disclose an applicable accounting method used within economic modeling leads to a slight-of-hand in discourse over tax policy because manipulating the accounting method yields an intended result which would be reversed under the normal meaning of words. Research in tax policy that does not disclose special accounting methods then proceeds on parallel tracks with other research where it is possible to reach contrary results on the same data simply by manipulating the way in which empirical results are counted or accounted.

Enhanced degrees of freedom in modeling parameters. Any empirical modeling implies a license to make abstractions to render meaningless results meaningful. This is partly what is referred to as degrees of freedom in the tax literature.[47] In the context of robot taxation, the license has been severely expanded where seemingly arbitrary categories are applied to yield results, whereas the results should have been given as the opposite or

(“Productivity gains are thought to occur by reducing tax incentives toward over-investment in robots in situations where a human worker could do the job more efficiently apart from the favorable tax treatment currently granted to robots.”).

45. Clausing, *supra* note 19, at 438–45.

46. *See generally* Kerstin Hötte et al., *Does Automation Erode Governments’ Tax Basis? An Empirical Assessment of Tax Revenues in Europe*, TECHNEQUALITY (Apr. 8, 2021) [hereinafter TECHNEQUALITY], https://technequality-project.eu/files/d52fdautomationandtaxationv30pdf (examining “the effects of taxation that result from robot and ICT adoption in Europe” and concluding that “[a]fter 2008, [there is] an ICT-induced increase in capital income, a rise of services, but no effect on taxation”).

47. *See generally* Daniel N. Shaviro, *On the Relative Generality of Fiscal Language, in* INSTITUTIONAL FOUNDATIONS OF PUBLIC FINANCE: ECONOMIC AND LEGAL PERSPECTIVES 257 (Alan J. Auerbach & Daniel N. Shaviro, eds., 2008) (“Laurence Kotlikoff has played a vital role in demonstrating that prevailing fiscal language terms, such as ‘taxes,’ ‘spending,’ and ‘budget deficits,’ lack fundamental economic content, causing them to be misleading and manipulable.”).

possible inconclusive. A concern over an expansive degree of freedom in empirical work suggests that the researcher has engaged in data mining and used the results to change the analysis criteria to create meaning from non-meaningful data analysis. Illustrations of degrees of freedom include (i) selecting an arbitrary time period for review; (ii) splitting the data sample into meaningful and non-meaningful groups; (iii) positing different types of test data such as automated technology versus industrial robots; (iv) applying arbitrary standards of "strong" versus "weak" results without explaining what those terms mean and then presenting empirical results on such an arbitrary basis; and (v) references to "robot taxation" without defining what type of taxation is contemplated, such as personal taxation of robots versus increased degrees of capital taxation.

Reliance on outdated economic theories not reflecting robots as a fourth factor of production. The economic theories typically applied in the context of robot taxation are that of (i) international tax competition[48] and (ii) tax incidence analysis.[49] However, these are not the exclusive economic theories applicable to robot taxation. In addition, a production function is the basis to understand economic output. Robots comprise, at least ostensibly, a fourth factor of production. Robots and other types of automation (referred to as ICT) currently serve as a complement to human labor, performing some tasks in production that human workers might otherwise do. Robots are also a capital asset, but only for tax and accounting purposes. Capital is expended to purchase the robot which then provides production services. The same is also true of labor where capital is expended to rent humans for some period of time ranging from hours to years, and the human worker then provides production services. Land is also taken to be required for production within the production functions applied in economic modeling. The economic framework is not entirely coherent as human workers might band together to eliminate the need for capital, likewise, land might not be required for all types of production in the 21st century. A project for economic theory then is to revise the base model of the production function for the existence of robots. The implications of a revised model of the production function are likely significant and may change the various tax policy recommendations from economic theory.

48. Michael Keen & Kai Konrad, *The Theory of International Tax Competition and Coordination, in* 5 HANDBOOK OF PUBLIC ECONOMICS (2013).

49. *See supra* note 14.

III. LITERATURE REVIEW: EMPIRICAL EVIDENCE ON ROBOT TAXATION

In Part III, the results of various published works purporting to comprise empirical evidence on robot taxation are summarized and reviewed. In each section, the purpose and results of the research are stated. Extensive citation bias is observed in some cases where the citation is given to responsive works that contain references to the original source materials on robot taxation; however, without citation to the original source because it contained conflicting theory or results. The degrees of freedom are also formally estimated with an indication of whether the amount of freedoms are sufficient to reverse the stated results of the respective empirical analysis.

A. Technequality (Statistical Trends in EU Public Finances Related to Robots)

The authors purport to investigate by empirical methods a potential relation between public finances and automation within the European Union.[50] A methodology section is not provided as the methods are solely pattern analysis and no hypothesis is presented for testing. The discussion section provides an economic literature review presented as three modeling premises of the potential effects of rapid automation processes, including: (i) displacement effects,[51] (ii) reinstatement effects,[52] and (iii) productivity gains from automation.[53] The paper does not address a primary concern with the prior literature, that an over-investment in robots may have occurred due to the heavy tax incentives offered for automation and the displacement of human workers. Much of the analysis is presented as a response to risks to tax collections from rapid automation if taxpaying human workers were displaced with non-taxpaying robot workers, although no citation is given to the prior literature where those concerns were presented. A concern about a risk to the public fisc from the displacement of human taxpayers with non-taxpaying robots formed the basis for much of the initial literature on robot taxation.[54]

50. TECHNEQUALITY, *supra* note 46, at 1–2.

51. *See* Acemoglu & Restrepo, *infra* note 54 ("At the heart of our framework is the idea that automation and thus AI robotics replace workers in tasks that they previously performed, and via this channel, create a powerful *displacement effect*.").

52. *See* Bessen, *supra* note 4 (examining how, under certain circumstances, "productivity-improving technology" can actually increase employment).

53. *See* Graetz & Michaels, *infra* note 130, at 755 (concluding that an increase in the use of robots corresponded with an increase in productivity, a reduction in output prices, and "no significant implications" on total hours worked).

54. Daron Acemoglu & Pascual Restrepo, *Artificial Intelligence, Automation and Work* 1 (Nat'l Bureau of Econ. Rsch., Working Paper No. 24196, 2018) ("At the heart of

A primary motivation of the Technequality paper appears to be an empirically-based response to the thesis that rapid automation could lead to a decrease in tax receipts since human labor comprises much of the tax base.[55] Even having adopted a similar terminology, here "equality" for tech workers as opposed to "neutrality" between the taxation of human and robot workers as was given in the original research paper,[56] which appear to be synonymous, although the authors do not give source citation to the research question's origins, suggesting citation bias.[57] As illustrated, the Technequality authors appear to refer to the initial Abbott and Bogenschneider paper on robot taxation directly although without citation: "Preceding studies argued that policymakers should be concerned about the sustainability of public finances when intelligent machinery replaces labor and undermines the basis of taxation."[58] The Technequality paper on robot taxation is unique among empirical analyses given the quantity and degrees of freedom in the statistical methodology.

Enhanced Degrees of Freedom in Modeling Parameters. The Technequality paper applies at least eight degrees of modeling freedom.[59] Each of these degrees has the potential to vary results or cause results to appear to be meaningful when they are not. The presence of so many unexplained parameters indicates that the results have been engineered toward a particular finding based on the authors' motivated reasoning, to push toward the conclusion that the public finances of European nations may not be at risk from rapid automation. These degrees of freedom are: (1)

---

our framework is the idea that automation and thus AI and robotics replace workers in tasks that they previously performed, and via this channel, create a powerful displacement effect.").

55. *See* TECHNEQUALITY, *supra* note 46, at 1 ("When ATs diffuse and replace labor at a large scale, the tax basis might be significantly undermined. This argument is put forth to support that a robot tax is needed to ensure the sustainability of public finances.").

56. Abbott & Bogenschneider, *supra* note 35, at 152 ("The advantage of tax neutrality as between human and automated workers is that it permits the marketplace to adjust without tax distortions. With a level playing field, firms should only automate if it will be more efficient, without taking taxes into account. Since the current tax system favors automated workers, a move toward a neutral tax system could increase the appeal of human workers. Policy solutions could even be implemented to make human workers more appealing than machines in terms of tax costs and benefits, to the extent policy makers choose to discourage automation.").

57. Ferguson, *supra* note 33, at 535.

58. TECHNEQUALITY, *supra* note 46, at 32.

59. *See infra* notes 60–67.

technology type,[60] (2) stage of diffusion,[61] (3) local conditions,[62] (4) regions of Europe with different stated results,[63] (5) selection of 1995–2006 and 2008–2016 periods,[64] (6) lack of any baseline,[65] (7) different long run versus short run,[66] and (8) strong versus weak results.[67] Each of these parameters is sufficient to *reverse* the stated inferential results. For example, if we were to ignore a difference between "strong" and "weak" results, the conclusion of the paper would be directly reversed, that is, the weak evidence would indicate a decline in overall tax revenues from automation. Likewise, if we applied other time periods, such as any period post-2016 when automation processes were accelerating, the conclusion would apparently be reversed. Further, if we combined robots with ICT, the results would be stronger, and again the conclusion reversed. In the presence of not less than eight conditions sufficient for reversal, it seems plausible to presume that the empirical results were engineered toward one conclusion, and the true results were, under other reasonable assumptions, precisely the opposite of those presented. The authors have engineered the modeling parameters as reflected in a high number of degrees of freedom to achieve the desired empirical result. In lay terms, no reasonable person would apply all eight conditions simultaneously, the inferences presented are not real, and perhaps, even the opposite of those engineered by the authors.

Lack of Citation to Tax Technical Sources, resulting Errors. A lack of source citations appears to have also led to incremental empirical and tax

---

60. TECHNEQUALITY, *supra* note 46, at 2 ("We find that the impact of automation depends on the technology type and the phase of diffusion.").

61. *Id.*

62. *Id.* at 3 ("We find: It depends (a) on the type of technology that is considered, (b) on the stage of diffusion, and (c) on local conditions. We provide structural arguments that enable a better understanding of locally specific conditions, the economic impacts of automation and macro-level effects on taxation.").

63. *Id.* at 20 ("We observe both the share of labor and capital taxation to be positively correlated with factor income shares at the expense of taxes on goods. These observations are robust across different regions and sub-periods . . . .").

64. *Id.* at 22 ("After 2008, we do not observe significant effects on labor market outcomes in automation-intensive industries. We also do not see that automation has any significant impact on capital accumulation and valuation for all periods and sub-periods. [] These relationships are more prevalent before 2007.").

65. The lack of baseline refers to comparisons of tax rates and revenue of a base amount, then modified at a later period in comparison to the base amount. The failure to establish a baseline for comparison renders nearly all the anecdotal analysis presented unviable.

66. TECHNEQUALITY, *supra* note 46, at 32 ("Overall, our findings suggest that there is no strong empirical evidence supporting that tax revenues are negatively affected ATs in the long run.").

67. *Id.*

technical errors in the respective analysis. As an example, the Technequality authors write: "[B]ut there is no clear reason to assume that automation decisions are affected differently from taxation compared to all other forms of capital investments."[68] Strangely, the authors seem to deny any basis for research into robot taxation, which is the topic of their own paper, indicating that the empirical analysis was to deny the implication of the prior research that automation processes are unique because of the non-neutral taxation for labor. Such a "clear reason" for firm decisions as to automation were described extensively in the prior literature on robot taxation, which are to avoid firm level taxes directly or indirectly levied on labor that are not levied on robots as a type of capital investment.[69] As was previously explained in the literature on robot taxation, firms obviously do not pay social insurance taxes for automated workers in either Europe or the United States, let alone VAT or other type of taxes, which is perhaps the clearest explanation possible of tax avoidance by multinational firms via automation of production processes, contrary to the assertion of the Technequality authors.

Omitted years, period 2016 to 2020. Conspicuously, *not* included in the Technequality paper was data for the year 2007, and for the period 2016–2020. Similar data should have been available to the authors, however. The results in later years may have been inconsistent with the stated results for the given periods 1995–2006 and 2008–2016. The selection of the latter periods appears to be the possible omission of years with conflicting data to present inferential results. The error in omitting 2016–2020 is particularly acute given that automation processes appear to have been accelerating in those years. Furthermore, although the Technequality analysis is backward-looking, no limiting discussion was provided relating to the likely effects of increasing degrees of automation in the forward-looking years from 1995 to the present day, such as the potential for self-checkout machines, self-driving trucks, and other types of automation that were not present during some of the years under review.

Lack of Causal Analysis. The Technequality paper further began with an acknowledgment that no attempt to describe causation was attempted in the study. Despite their lack of causal evidence, the authors found "that the

68. *Id.*

69. Abbott & Bogenschneider, *supra* note 35, at 166 ("The indirect tax system also benefits automated workers at the firm level. Indirect taxation refers to taxes levied on goods and services rather than on profits; the primary examples are the Retail Sales Tax (RST) levied by states and municipalities in the United States and the VAT in most other countries. Employers are thought to bear some of the incidence of indirect tax, as worker salaries and retirement benefits must be increased proportionately to offset the indirect tax. In the case of automated workers, however, the burden of indirect taxes is entirely avoided by the firm because it does not need to provide for a machine's consumption.").

impact of automation depends on the technology type and the phase of diffusion," citing the inverse relationship between robots and aggregate tax revenues.[70] However, the paper is replete with causal references, and descriptions are given in causal terms throughout the paper.

Illustrations of causal references are as follows:

> (a) "At the country level, the overall effect on labor income was positive . . . . We also find evidence for a weak increase in aggregate demand. These effects taken together offer an explanation for the shift from capital taxes towards an increasing relative importance of taxes on labor . . . ."[71]
>
> (b) "We find partial support for a robot-induced replacement effect. On the other hand, ICT technologies appear to be labor reinstating . . . ."[72]
>
> (c) "We observe similar differences across time for the impact of ATs on capital valuation, real income and consumption . . . ."[73]

Errors in Identification of Empirical Research Question. The Technequality authors make a noteworthy claim regarding the scope of their own research: "Instead, we are the first who study empirically the relationship between automation and tax revenues taking adoption decisions as given."[74] Here, the idea is that the respective empirical research performed is unique because it excludes taxes from the decision matrix of firms in deciding whether to automate. So, where the original research into robot taxation explained in detail the tax benefits to firms from automation, that is the tax savings resulting from a decision to replace human workers with robot workers, here the idea is that taxes do not have any impact on economic decision making at all — essentially the opposite assumption of all econometric analyses that taxes do affect firm decisions at least at the margin. Unfortunately, in research of this nature, there is typically no way to separate in the empirical datasets decisions made in spite of taxes or as a result of taxes. Therefore, the supposed research question investigated by the Technequality authors simply cannot be answered with the dataset available.

The given results of empirical analysis presented in some sections of the Technequality paper are also confusingly inconsistent with those described in the conclusion section within the same paper. The introduction or summary section of the paper connects declining factor and tax income with that advent of robot labor in the years preceding 2007, a result which is then

70. TECHNEQUALITY, *supra* note 46, at 2.

71. *Id.* at 30.

72. *Id.* at 31.

73. *Id.*

74. *Id.*

denied in the conclusory section of the same paper.[75]

Compare these first two assertions with the third:

- "Until 2007, robot diffusion [led] to decreasing factor and tax income, and a shift from taxes on capital to goods."[76]
- "We also observed a negative relationship with labor taxes, though less significant."[77]

With:

- "Overall, our findings suggest that there is no strong empirical evidence supporting that tax revenues are negatively affected ATs in the long run."[78]

Switching of Research Question in the Conclusory Section to Imply Meaningful Results. The given findings of the Technequality paper do not appear to relate directly to the given research questions. The authors write: "[W]e do not observe any significant relationship between ICT and labor income, but instead [with] capital income [sic] rising."[79] The authors seem to have shifted the inquiry as to whether the aggregate tax base changed, rather than whether the tax base was shifted from one taxpayer to another. However, the shifting of the tax base from capital to labor obviously does not require a change in the aggregate tax base. Government policymakers might be expected to maintain the tax base and could adjust the collections from one tax base to another to maintain a set of fixed expenditures, that is to increase the taxes levied on labor income or goods and services purchased by labor since less tax was collected from capital. Therefore, one would not necessarily expect to observe a change in the aggregate tax base even if automation was directly affecting the composition of the tax base. Furthermore, the Technequality authors identify a strong increase in capital income without a corresponding increase in capital taxes, thus implying a relative shift in taxation, as previously identified in the literature, again neither cited nor discussed in the paper.[80] The findings then of the authors are given as platitudes that do not have research significance nor relate to the dataset which was the subject of analysis.

---

75. *Id.* at abstract; *see id.* at 31 ("We find partial support for a robot-induced replacement effect.").

76. *Id.* at abstract.

77. *Id.* at 30.

78. *Id.* at 32.

79. *Id.* at 31.

80. *See id.* at 31–32 (detailing how the authors recognized an increase in capital income without an increase in taxation after 2008).

B. Tax Foundation (Neoclassical Economics, General Equilibrium Modeling)

The Tax Foundation maintains a simple abstract model of the economy, similar to various government agencies including the Congressional Budget Office, intended to make it possible to render predictions about the effects of a change in tax policy.[81] The Tax Foundation has issued press releases opposed to the taxation of capital, including that of large corporations beyond merely the context of robot taxation.[82] It has updated its modeling for robot taxation and reached the counterintuitive result: *Increasing the tax burden on automation hurts workers*. Here, the details of the modeling processes followed by the Tax Foundation have not been provided so they cannot be comprehensively summarized for purposes of the literature review. The focus of the press release on robot taxation by the Tax Foundation relates primarily to the findings or conclusions of the abstract modeling claimed to have been performed.

The conclusion appears to be based on a simple general equilibrium model where robot taxes are presumed to be shifted to workers — that is, with any type of corporate tax, including an automation tax, the tax is shifted to workers. As one variable is changed within the equilibrium model it is possible to make projections of resulting changes to other variables in the economy, under the given assumptions of the model, especially as capital taxes are taken to relate to GDP. If the corporate tax is shifted to workers, then the conclusion is that robot taxes hurt workers as all corporate taxes would be presumed to be paid by workers anyway. The further implication is that some workers might wish to tax robots because they have lost their job due to automation, which might be counterproductive in economic terms. The Tax Foundation suggests that robots are further alleged to carry a "tax burden."[83] However, automated or robot workers currently do not pay any taxes either directly or indirectly in the United States. By purchasing robots, firms obtain an accelerated tax deduction comprising incremental benefits, not burdens, for both book and income tax accounting purposes. We have then, in the work of such tax organizations, obvious technical errors in misunderstanding how the tax system works in practice. Robots yield a tax

81. *See Who We Are*, TAX FOUND., https://taxfoundation.org/about-us/ (last visited Jan. 12, 2022). *See generally* Milton Friedman, *Essays in Positive Economics* (1953) (theorizing about scientific assumptions, hypotheses, and predictions).

82. *See* Garrett Watson, *Increasing the Tax Burden on Capital Investment and Automation Hurts Workers*, TAX FOUND. (Nov. 12, 2020), https://taxfoundation.org/increasing-the-tax-burden-on-automation-hurts-workers/ (explaining that tax policy does not favor capital investments like robot automation or put workers at a disadvantage).

83. *See id.*

benefit to firms from accelerated tax deductions from capital investment where deductions are taken faster than if wages were paid to human workers for the same work.

The abstract modeling performed by the Tax Foundation differs from that of the Technequality empirical analysis because it does not attempt to find patterns in statistical datasets to show actual facts related to the economy, but instead uses a model with built-in assumptions to predict the directional effects of changes to tax policy. Only neoclassical economic theory is applied in the modeling assumptions and process, however. In respect of robot taxation and policy, the result of abstract modeling of a tax increase on automation is the same as any proposed increase in tax on capital. Accordingly, the model is largely unnecessary to inform the direction of tax policy as the model would always favor tax cuts to capital and shifting as much of the tax burden to labor as possible. The direction of change is always the same, irrespective of the current or future tax rates on each factor of production because the economic theories of tax incidence and international tax competition largely eliminate any need to perform modeling because the directional effect is always the same. In other words, even if labor was taxed at 50% and robot capital taxed at 2%, the model would still call for a reduction of tax to capital from 2% to 0% because of the neoclassical parameters applied within the model. The broader purposes of the model are thus to attempt to quantify economic loss from a tax increase or economic benefits from a tax cut, and to give some pretense of modeling beyond mere theory. A limiting factor of the abstract model is of course that tax increases have at times led to increased economic growth, which the neoclassical model obviously would not be able to predict or explain.

Since the abstract modeling performed by the Tax Foundation is premised entirely on neoclassical economic theory, any review of the model then devolves into a discussion of problems within economic theory. Also, since no statistical or empirical data is used in the abstract modeling, any critique relates predominantly to the tax technical errors rather than to limitations in the data. Thus, there are three tax technical errors within the modeling that limit the viability of the results: (i) tax parity between taxation of human and automated workers; (ii) use of marginal tax rates in abstract modeling; and (iii) positing of productivity gains from automation contrary to or without evidence.

Tax parity between taxation of human and automated workers. The initial paper on robot taxation introduced a new concept of tax neutrality between human workers and robot workers. The idea was that automated workers might be less productive than human workers because the return on investment to firms was evaluated post-tax , and that firms may have been chasing the tax benefits from capital investment in a decision to automate.

The topic was extensively debated and cited by other scholars in various fields reflecting a broad consensus that capital is favored under the current tax system.[84] The Tax Foundation author appears not to have reviewed the tax literature on robot taxation and identified a similar issue, which he referred to as "tax parity" rather than tax neutrality, as was originally proposed.[85] The Tax Foundation generally argues for such tax incentives to capital as a means to encourage tax motivated investment in the economy. The author proposes the same general idea for robot workers as all capital investment, where the idea is that since labor expense is immediately deductible whereas capital investment is not, this appears to favor labor.[86] Error was introduced insofar as the discredited ideas within neoclassical economic theory related to immediate expensing of labor costs in comparison to deductions for capital investment. The Tax Foundation author writes: "Labor costs can already be fully deducted from taxable income when they are incurred. Full expensing for capital investment merely ensures that capital is treated symmetrically in the tax code."[87] For example, research and development costs allow for immediate deduction of some aspects of robot production and development.[88] Likewise, accelerated depreciation allows for faster deductibility of capital expenditures, such as robots.[89]

The conclusion given by the Tax Foundation that current law allows full expensing to labor but not capital is objectively wrong, however. The error occurs because capital investment is incurred up front and on a lump sum basis that is depreciated, or taken into account, over time, whereas workers are paid as services are rendered each year. In other words, the capital asset is durable and lasts for many years. As an example, if a robot worker costs $1 million and lasts for 5 years, whereas a human worker costs $200,000 per year for 5 years, immediate expensing of the $1 million for the robot worker yields a major benefit for the company, as the full $1 million is deductible in year one, which is more valuable due to the time value of money. Even if only one half of the expenditure is deducted in year one, this still yields a

84. *See generally* Orly Mazur, *Taxing the Robots*, 46 PEPP. L. REV. 277, 280 (2019) (noting a concern that "the increase in profits that robots create will primarily benefit the few companies driving the automation, which will further intensify the existing inequality in the distribution of income, wealth, and influence"); Jay Soled & Kathleen Thomas, *Automation and the Income Tax*, 10 COLUM. J. TAX L. 1, 4 (2018) ("[A] significant disparity still exists between the tax treatment of labor and capital . . . .").

85. Watson, *supra* note 82.

86. *See id.*

87. *Id.*

88. I.R.C. § 174.

89. *Id.* § 168.

$500,000 rather than a $200,000 tax deduction which favors capital, not labor.[90] Accordingly, the Tax Foundation has erred in the discussion of robot taxation based on the value of accelerated tax depreciation on an expensive capital asset, such as a robot or other types of ICT.

Use of marginal tax rates in abstract modeling. The Tax Foundation correctly refers to the use of marginal tax rates in economic modeling, as a response to prior critiques of the low effective tax rates on capital. Although not explained in the discussion, it seems likely that the Tax Foundation's general equilibrium model follows the standard approach within econometric modeling, which is to use marginal tax rates as the levies in the model. For example, if the U.S. corporate tax rate is 21% less than applicable deductions that may yield an effective tax rate of 5% or less, the econometric modeling still inserts the 21% statutory rate because that is considered the marginal rate. The idea is that firms only undertake capital investment to yield a marginal return and that any extra return is taxed at the marginal rate only. However, that reflects error since firms do apply the average (or effective) tax rate in the modeling for capital investment. To its credit, the Tax Foundation discusses the potential for use of effective tax rates in econometric modeling; however, since that was not done in their model the given results are not reliable.

Positing productivity gains from automation contrary to or without evidence. Numerous economists referred to the presumption of efficiency gains from automated workers in comparison to human workers. The idea appears to be that robotic arms on a vehicle assembly line must be more efficient than human workers. But that idea is not so obvious. As has been previously explained, because the tax system heavily favors robots or automated workers it may be that human workers were more efficient in production than some automated workers, and that firms placed automated workers into service because of the tax advantages therefrom. The issue of whether productivity gains result from automation is accordingly unclear. Productivity losses may result from tax-motivated investment in automated workers. Likewise, efficiency gains could result from the reversal of tax incentives for capital that lead to an overinvestment in automation. The preference for capital investment is extreme under the current tax system which presents strong anecdotal evidence of the latter.

C. Information Technology and Innovation Foundation (The Case Against Taxing Robots)

The ITIF's paid advocacy analysis was presented as: *The Case Against*

90. *See* Abbott & Bogenschneider *supra* note 35, at 164–66.

Taxing Robots.[91] Although the paper does not present any original empirical data on robot taxation, it has been cited by other empirical scholars and at once constituted the first result on any Google search for "robot taxation," thus meriting further discussion.[92] The review is based on the original paper's organization which was presented as a series of empirically-based claims. Each of which is connected to the summary and deemed causal to comprise the case against a robot tax. Here, there is no empirical analysis performed so the literature review is presented as limitations on results interpreting the same or similar data as presented by the ITIF author.

Robots and Automation Do Not Reduce Employment. The empirical literature does not fully support the paper's assertion or causal claim, although some economists have published theoretical papers suggesting that might be the case.[93] Economic scholars broadly agree that robots and automation do displace workers, especially "routine workers,"[94] but disagree on whether what has been referred to as a reinstatement effect that may be large enough to mitigate the displacement effect.[95] Some empirical studies

91. Robert D. Atkinson, The Case Against Taxing Robots 10 (May 29, 2019) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3382824.

92. Google search for "robot taxation" performed July 7, 2011, 4:51 P.M. yielded a result for *The Case Against Taxing Robots.*

93. Sotiris Blanas et al., *Afraid of Machines*, ECON. POLICY 628, 628 (2019) ("The results suggest that software and robots reduced the demand for low- and medium-skill workers, the young and women, especially in manufacturing industries; but raised the demand for high-skill workers, older workers and men, especially in service industries. These findings are consistent with the hypothesis that automation technologies, contrary to other types of capital, replace humans performing routine tasks."); Graetz & Michaels, *infra* note 130, at 766–67 ("We find no significant relationship between the increased use of industrial robots and overall employment, although we find that robots may be reducing the employment of low-skilled workers."); Terry Gregory et al., *Racing With or Against the Machine? Evidence from Europe* 3 (CESinfo Working Paper No. 7247, 2018) ("Firstly, RRTC reduces labor demand through *substitution effects*, as declining capital costs incentivize firms in the high-tech tradable sector to substitute capital for routine labor inputs, and to restructure production processes towards routine tasks. Secondly, RRTC induces additional labor demand by increasing product demand, as declining capital costs reduce the prices of tradables — we call this the *product demand effect*. Thirdly, *product demand spillovers* also create additional labor demand: the increase in product demand raises incomes, which is partially spent on low-tech non-tradables, raising local labor demand.").

94. Blanas, et al. *supra* note 93, at 633 (citing David H. Autor et al., *The Skill Content of Recent Technological Change: An Empirical Exploration*, 118 QUART. J. ECON. 1279 (2003)) ("Recent task-based approaches have found that the employment shares and wages of workers in routine occupations, who happen to fall in the middle of the wage distribution, have declined.").

95. Acemoglu and Restrepo, *supra* note 54, at 2 ("We argue that there is a more powerful countervailing force that increases the demand for labor as well as the share of labor in national income: *the creation of new tasks*, functions and activities in which

have catalogued a displacement effect larger than any reinstatement effect at various times and in various regions.[96] The so-called "reinstatement effect" is also misleading because it implies that the same workers that lose jobs due to automation may be reinstated in new jobs later, a view which is not at all supported by the empirical literature. If there is a reinstatement effect, all empirical scholars seem to agree that it would involve a few highly skilled workers earning high salaries substituting for perhaps many lower skilled workers subject to replacement by automation.

Firms That Adopt Robots Still Pay Taxes. Three Pinocchios should be assigned to the ITIF on this false assertion. Firms do not pay wage taxes or indirect taxes for robots or automated workers that are indeed otherwise payable on human workers. The prior literature has cataloged the categories or types of taxes avoided by using robot or automated workers.[97] By automation, firms also reduce their relative income taxation by the acceleration of deductions from capital investment generally without reduction to reported earnings for the purposes of generally accepted accounting principles ("GAAP").[98] If there were a reduction in GAAP earnings, even with cash tax savings, most multinational firms would probably not be as interested in automation. Accordingly, cash tax savings, albeit *without* a reduction in reported earnings, are necessary to foster capital investment in automation through the tax code. Notably, each of these necessary conditions are present under current tax and accounting standards. Although many high technology companies pay little, if any, income taxes, it is possible that some firms might after automating to some degree. However, these firms pay very low effective tax rates, especially after the Tax Cuts and Jobs Act, which reduced the statutory corporate tax rate to twenty-one percent.[99] Any taxes paid by capital are magnitudes less than the effective tax rates paid by human workers in comparison. By analogy, the argument that robots still pay taxes is akin to saying that lettuce still has calories in comparison to donuts. The claim is technically true but is

---

labor has a comparative advantage relative to machines.").

96. *Id.*

97. *See* Abbott & Bogenschneider, *supra* note 35, at 164–67.

98. *Id.* at 166 ("Where tax depreciation is accelerated relative to *book* depreciation (the amount reported on financial statements), a firm may generally claim a profit (or earnings benefit) to reported earnings from the tax benefit. Thus, a large corporation enjoys a book benefit to reported financial earnings from the differential in depreciation periods. Any firm seeking to accelerate reported earnings could use automation to achieve such a timing benefit. This increase to reported earnings may be an even more significant motivation for large firms to automate than a cash tax savings.").

99. Tax Cuts and Jobs Act of 2017, Pub. L. No. 1197, 131 Stat 2054 (codified as amended in scattered sections of the I.R.C.).

misleading to readers that are not tax experts and unable to gauge the very low rates of tax paid by large multinationals in the present day.

Tax Incentives for Investing in Robots Spur National Economic Competitiveness. Although this assertion may seem intuitively correct to persons who have taken an introductory course in economic theory, the tax technical literature has drawn that claim into significant doubt. This is because tax deductions are worth more to multinational firms within higher tax jurisdictions than elsewhere. Firms that are profitable around the world, including most U.S. multinationals, may choose to make capital investment in higher tax jurisdictions to claim the tax deductions from capital investment. Therefore, capital investment for automation should be expected to flow into higher tax jurisdictions and not away, which is ironically, exactly what we observe in empirical terms but has not been identified by empirical researchers.[100] Most automation investment seems to flow into and not away from higher tax rates. Aggressive tax avoidance planning, including transfer pricing techniques, can then be used to remove any taxable income arising from the automation to other jurisdictions to avoid any residual tax. In any case, the gross income of firms is also taken to be simply maintained, and not increased, from a transition of human workers to robot workers with the primary benefit being cost savings. For example, where a profitable multinational firm has a production facility in both Japan, which levies taxes at very high rates, and the United States, which levies taxes at moderate rates, the tax accountants at that firm may maximize the value of tax deductions by channeling the investment into Japan whilst simply ignoring the potential for future income from the capital investment. The availability of aggressive tax avoidance planning and transfer pricing to multinational firms enables them to avoid any ultimate tax anyway. However, these techniques are ignored within neoclassical economic theory because firms are thought not to bear the incidence of wage taxation. However, the very existence of aggressive tax avoidance indicates that firms behave as if they do bear the incidence of both capital and wage taxation at least to some significant degree.

Taxing Robots would Slow GDP Growth. An empirical assertion about the potential for slowing GDP growth by taxation is really the core economic claim that concerns capital investors with any robot tax proposal. Note, however, that the policy matter involves shifting of the tax base further from capital to labor. As firms substitute automated workers, the tax base is proportionately reduced and less funds are paid into social security and other programs. So, the assertion is not whether any taxes reduce GDP growth;

100. *See supra* Figure 1.

rather, assuming that taxes are to be payable by persons with a given society, the appropriate question is really whether robot taxes reduce GDP growth more than taxes levied directly on workers. This is not necessarily to posit taxes as a zero-sum game, but to simply acknowledge the potential for differing efficiency results under relatively higher taxation of labor. Neoclassical economic theory suggests that any capital taxes may reduce economic growth, but there are strong technical reasons to doubt this claim. Furthermore, little or no reliable empirical evidence has ever been presented by economists that capital taxes reduce economic growth. As illustrated in Figure 1, higher taxes are associated with faster economic growth in most nations. This is also true within lower tax nations over time, including the United States. Lower tax nations experience slower economic or GDP growth than higher tax nations, with a lesser association in the United States. The broad mobility of capital around the world over the past seventy years strongly indicates that if capital migrated away from taxes, the opposite empirical data should have been observed where higher tax nations experienced diminished rates of economic growth. The key tenant of neoclassical economic theory, that GDP growth might be negatively affected by higher tax rates on capital as such increases, seems unlikely. Rather, robot taxes may serve as a boon for capital re-investment for firms seeking to reduce taxes by obtaining tax deductions for capital investment.

Governments Need to Tax Robots Because There Will Be Little Else Left to Tax. The origins of this claim by the ITIF are unclear and, since they are not cited, may comprise a straw man fallacy. The primary concern of tax scholars is not that there will be nothing left to tax, but instead, that in lieu of a robot tax more of the tax base will be shifted to labor as large corporations automate and thereby fail to pay much or any taxes. Many tax experts in the United States have discussed a potential for implementation of a VAT or possibly a wealth tax as opposed to a robot tax, which in comparison is a relatively new tax policy proposal.[101] In the future, if revenue needs from taxation increase or become more desirable, as opposed to incremental borrowing, it seems entirely possible that a debate will ensue on whether a VAT, wealth tax, or robot tax is most advantageous. In empirical terms, however, there is no limitation on implementing only one, or all of these together, or possibly even simply taxing only human labor and exempting the wealthy and large corporations from any taxation at all, as many economists would prefer. For example, if we follow the reasoning of neoclassical economic theory, one might simply increase levies against

101. *See, e.g.*, Reuven S. Avi-Yonah, Designing a Federal VAT: Summary and Recommendations (June 2009) (unpublished manuscript) (on file with the University of Michigan Law School's Law & Economics Working Papers Archive: 2003–2009).

workers from the current rates of roughly 50% to 60%, to perhaps a 90% effective rate, and thereby eliminate all other forms of taxation entirely, such as a robot tax or even the corporate tax. As the tax rates on human workers trend toward full taxation of 100%, however, this would again ironically seem to be a type of socialism. In this neo-socialism of full tax exemption for large corporations, people would be required to perform work, except all the profits from work would be transferred to either the government or their employers and persons could live only by government-transferred payments. Essentially, workers would receive very little or possibly even no money from performing work on behalf of their employers. From this perspective, some taxation of capital is actually required to avoid a type of feudal-style socialism, which inspired many of the libertarian theorists in 19th century Britain during the Industrial Revolution when automation was also a major policy issue. The discussion seems to have come full circle as to whether human workers are entitled to much or any of the fruits of their own labor given the extremely high rates of wage taxation and the refusal by unwilling governments to levy tax on the wealthy or large corporations.

Ad hominem attacks. In the ITIF paper, each section of the paper begins with personal attacks directed at scholars that have written on robot taxation by calling them bad names or implying they are liberals, and so on.[102] Reference was also made to news reporting in the New York Times, except without any credit to the existence of the scholarly research underlying the news reporting, implying that the news reporter had simply made up all of the tax technical analysis related to robot taxation rather than reported on legitimate scholarly research.[103] The ITIF also does not provide a funding disclosure of the organization and appears to function as a tech lobbying organization as it relates to robot taxation.

D. Tyers & Zhou (Robot Tax for Redistribution Model)

The Tyers and Zhou paper described automation as a governmental policy decision with international rivalry largely between the European Union, China, and the United States.[104] Tax effects are described not as a result of

102. *See*, *e.g.*, Atkinson, *supra* note 25, at 7 ("Many on the tax robots bandwagon have argued for taxing robots because otherwise inequality will grow, particularly because the share of total income going to labor will fall.").

103. *See* Eduardo Porter, *Don't Fight the Robots. Tax Them.*, N.Y. TIMES (Feb. 23, 2019), https://www.nytimes.com/2019/02/23/sunday-review/tax-artificial-intelligence.html.

104. Rod Tyers & Yixiao Zhou, *Automation, Taxes and Transfers with International Rivalry* 8–9 (Ctr. for Applied Macroeconomic Analysis, Working Paper No. 44/2018, 2018), https://cama.crawford.anu.edu.au/sites/default/files/publication/cama_crawford_anu_edu_au/2018-09/44_2018_tyers_zhou.pdf.

automation, but as a governmental design potentially to offset displacement of lower-skilled workers due to automation. In tax terms, this modeling approach reflects an earmarking of special taxes to particular projects related to automation. The premise is that either capital or consumption taxes could be implemented with the funds targeted specifically to offset the harms caused to particular persons by rapid automation. Specific reference to China was given from the command description policy decisions reflected in the modeling, which might be considered most relevant to that nation as it is not clear whether the United States has the policy flexibility to implement such a command framework even if policymakers wanted to do so.[105] The effects of the tax increase intended to offset the effects of automation were then modeled and described in Rawlsian and utilitarian terms. The Rawlsian goals of the incremental tax were ultimately found to be met in Europe, but not in other jurisdictions. However, other economic results were found to be negative due to the taxation of mobile capital.[106]

Potential Diminishment of Tax Base. Tyers and Zhou gave some indication that they are aware of the differences in the design of the tax system between China and the United States.[107] However, it is possible that these differences were not investigated in the draft version of the initial paper on robot taxation which explained the potential for diminishment in the tax base, especially in the United States, due to its heavy reliance on the taxation

105. *Id.* at 18–19 ("Next consider the financing of the policy by increases in the tax rates on capital income. Under a Rawlsian criterion all regions would implement the policy as before, though by a small margin the low-skilled would prefer collective rather than unilateral implementation. By the other criteria the US would not, the EU might on total welfare grounds and the Chinese would not. Stabili[z]ing the Gini by this means would require capital income tax rates to rise by about 15 percentage points for the three regions. This would be politically difficult, though more affordable in the case of China than the consumption tax option. If, by some means, the three large economies were forced to implement the policy, a total welfare criterion would have them preferring to finance it by capital income taxation, while a real GDP criterion would see governments preferring the consumption tax.").

106. *Id.* at 19–20 ("In our modelling we first examine whether there is a national, economic, first-mover advantage in implementing automation by individual countries, finding no evidence for this due to positive economic spill-overs that act through capital earnings and financing costs. Indeed, unless Rawlsian policy criteria are ubiquitous, in which case governments would resist implementation, the technology twist is a dominant strategy for all regions. We then turn to balance-preserving fiscal interventions to inhibit changes in income inequality, focusing on the earned income tax credit system and the stabili[z]ation of the Gini coefficient. With the preservation of fiscal balance we find only weak spillover effects, even where financing is via taxes on income from internationally mobile capital. [] [I]nternational spillovers from interventions that retain fiscal balance appear too small for there to be a more egalitarian global equilibrium.").

107. *See id.* at 17.

of labor.[108] In any case, the results of the paper are limited by the lack of empirical modeling of a potential diminishment of the tax base from automation processes that displace human workers and replace them with robots or automated workers.

Earmarking Tax to Worker Displacement Due to Automation. The tax technical literature differs broadly from the public policy literature of other social scholars writing about potential changes to tax policy as it relates to the *earmarking* of tax proceeds from a particular policy proposal. Tax lawyers and accountants usually do not earmark tax proposals to particular projects. If a tax levy is proposed, it is typically presumed by tax experts that any proceeds would be paid to the general fund. Social science scholars often do propose earmarking, as was famously recommended in respect of the taxation of sugar sweetened beverages.[109] Here, the social idea is that taxes are a means to influence a social outcome, both by economic means of deterrence of an undesirable social behavior through taxation (i.e., "If you want less of something, tax it"), and also, the spending of the tax revenue on social programs related to the social issue. Regarding the sugar beverage taxation, the social program proposed was a re-education program for social classes that chose to consume sugar beverages.[110]

In the context of robot taxation, the social program often proposed is referred to as Universal Basic Income ("UBI").[111] The idea is that displaced workers would receive a minimum government stipend as their jobs are eliminated by automation. If someday, all human jobs were eliminated by automation, as a few futurists have proposed, then all persons would presumably receive such a UBI stipend. However, any discussion of social programs to be purchased with tax revenue from robot taxation undermines one of the key aspects of tax policy relevant to the discussion, which is that human workers pay taxes at nosebleed rates. If it is true that "*if you want less of something, tax it*," then, in the United States at least, the activity subject to tax is productive work. A skeptic might presume that U.S. policymakers have done everything possible to discourage productive work by human workers, as opposed to robots or automated workers. Although the disincentive effects to lower-income persons from high wage taxes are not considered within economic theory, reliable empirical data to support

108. Abbott & Bogenschneider, *supra* note 35.

109. *See* Kelly Brownell et. al., *The Public Health and Economic Benefits of Taxing Sugar-Sweetened Beverages*, 361 NEW ENG. J. MED. 1599 (2009).

110. *See* Kelly Brownell & Nicole L. Novak, *Taxation as Prevention as a Treatment for Obesity: The Case of Sugar Sweetened Beverages*, 17 CURRENT PHARM. DESIGN 1218 (2011).

111. *See* Cynthia Estlund, *What Should We Do After Work? Automation and Employment Law*, 128 YALE L.J. 254, 323 (2018).

that modeling parameter does not yet exist, and there are strong anecdotal reasons to think that the reduction of the high taxes levied on workers would have positive and salient social effects. An offset or slowing of the rapid shifting of the tax base from capital to labor is a key benefit of robot tax proposals and the discussion of a UBI earmark to be paid to non-working adults from the proceeds of robot taxes is really a separate policy objective which might be debated based on its own merits.

E. Guerreiro, Rebelo & Teles, Automation and Income Inequality Modeling (Should Robots be Taxed?)

The Guerreiro et al., paper compares potential efficiency results and relative inequality under several modeling parameters related to automation and effects on labor demand.[112] The modeling proposals are broadly that of Mirrless' optimal taxation and a modification of the Heathcote, Storesletten, and Violante model for lump sum tax rebates to taxpayers.[113] The paper relates in significant part to the design of optimal taxation systems, which are largely hypothetical inquiries within doctrinal econometrics so research inquiry along these lines is then how robot taxes may fit within economic ideas about optimal taxation. Since robot taxes are a type of capital, where capital taxes are universally disfavored as a matter of optimal taxation, the line of inquiry of Guerreiro et al., seems to be whether inequality considerations may change that result and to model various tax re-configuration scenarios based on projected changes to the demand for labor.

Economic Modeling relates to Unrealistic Tax Proposals. The Mirrless and other modeling proposals given by Guerreiro et al., are widely debated based on the technical grounds of econometrics and economic theory. However, it is unclear whether or how such optimal tax proposals could be implemented in practice and would require significant changes or "re-

112. Joao Guerreiro et al., *Should Robots Be Taxed?* (Nat'l Bureau of Econ. Rsch., Working Paper No. 23806, 2020).

113. *See* Emanuel Gasteiger & Klaus Prettner, *A Note on Automation, Stagnation, and the Implications of a Robot Tax 2* (Sch. of Bus. & Econ. Discussion Paper 2017/17, 2017) ("While the standard neoclassical growth models of Solow (1956), Cass (1965), Koopmans (1965), and Diamond (1965) lead to remarkably similar predictions with regards to the growth effects of household's savings behavior and investment decisions, they lead to diametrically opposed predictions with regards to the growth effects of automation. Models of automation based on Solow (1956), Cass (1965), and Koopmans (1965), in which households save a part of their wage income and a part of their asset income, imply that automation could lead to perpetual long-run growth even without (exogenous or endogenous) technological progress. However, models of automation based on the canonical overlapping generations (OLG) framework of Diamond (1965), in which households save *exclusively* out of wage income, imply economic stagnation in the face of automation.") (citations omitted).

configurations" of the tax system in the United States, which appear to be politically infeasible. As the authors wrote: "Mirrleesian tax systems are known to be complex and potentially difficult to implement in practice."[114] The discussion of the robot tax in relation to sweeping policy changes is only broadly helpful to tax policy discourse. A tax rebate proposal along the lines of Heathcote et al., appears to be similar but not identical to a UBI funded by robot taxes, as modeled by other economists. A potential difference between a tax rebate and UBI would be that a non-refundable rebate would only be payable to individual persons working and thereby potentially paying income taxes. The Earned Income Tax Credit ("EITC") is partly a refundable credit where income tax liability is not required. Notably, the issue of income tax refundability and the EITC is often confused because the EITC is similar in quantum to wage withholding taxes as opposed to income taxes.

Other Means to Reduce Inequality. A policy objective of the Guerreiro et al., paper is the reduction of inequality in the United States by or through the tax system, particularly as it relates to routine workers.[115] Presumably, routine workers are lower-income wage workers. Guerreiro et al., reasonably investigate under what modeling conditions a robot tax levied on capital might reduce inequality.[116] However, a simpler and more direct means to reduce inequality would be simply to reduce wage taxes on lower income workers, either using the proceeds of any robot tax or perhaps not. As at least one philosopher has identified, the goal of reducing the taxes paid by routine workers may be a difficult objective in policy terms.[117] A more realistic policy objective may be to slow down the increasing acceleration toward the heavy taxation of workers, particularly in the United States. In simple terms, if the goal is to reduce inequality in the United States, the most direct means to do so would be tax cuts for lower-income persons, who often are subjected to average tax rates over fifty percent, or at least not to increase those taxes any further.

Tax Rebates (or UBI) with Sources of Revenue other than Robot Taxation. The premise of the Guerreiro et al., paper is the potential for robot taxes to reduce inequality.[118] The modeling is then performed based on a re-

114. See Guerreiro, et al., *supra* note 112.

115. *Id.* at 1 ("Our model has two types of occupations, which we call routine and non-routine.").

116. *See id.* at 1–2 (considering the effect lump-sum taxes can have if the government starts to observe worker types).

117. *See, e.g.*, Tom Parr, *Automation, Unemployment, and Taxation*, 48 SOCIAL THEORY & PRAC. 357 (2022).

118. *See* Guerreiro et al., *supra* note 112, at 3 ("[I]t is optimal for the planner to tax robots to help redistribute income toward routine workers of the initial older generations

configuration of the tax system. A simple response to that approach is that other sources of revenue could be identified as intended to reduce inequality besides robot taxes. Although automation processes may be taken as a source of inequality, both executive pay[119] and the effective non-taxation of wealthy individuals,[120] are also sources of inequality. Furthermore, a robot tax could be levied in several of the eleven forms proposed in the literature,[121] several of which would not require a full re-configuration of the tax system, which is undesirable in policy terms.

IV. CONCLUSION

Econometric modeling has been presented as a type of empirical evidence to suggest that higher taxes on capital, including robot taxation, would diminish economic productivity in several ways. A few scholars have suggested that robot taxes might represent a tax on the most innovative segment of the economy, which would then be doubly misguided, or perhaps even illogical. The issue in respect of robot taxation is how to interpret these conflicting results, especially those purporting to be empirical evidence. Shall we consider the empirical evidence a purer form of knowledge that might yield true and reliable knowledge? Or, shall we consider it as a form of "black magic" to be viewed with skepticism?

The flawed idea often applied in the context of robot taxation is that empirics comprise bedrock. Empirics, which denies any role for theory, may serve as a means to conceal an underlying theory and allow motivated reasoning to be presented in objective terms. In the context of robot taxation, a causal theory for empirical testing has in some cases not been presented at all, and the supposed empirical results are presented as the rawest form of data-mining.[122] Such results are simply not in the nature of science or

---

who are still in the labor force.").

119. *See* Thomas Piketty & Immanuel Saez, *Income Inequality in the United States, 1913-1998*, 118 QUART. J. ECON. 1 (2003); THOMAS PIKETTY, CAPITAL IN THE TWENTY-FIRST CENTURY (2014).

120. *See* Jesse Eisinger et al., *The Secret IRS Files: Trove of Never-Before-Seen Records Reveal How the Wealthiest Avoid Income Tax*, PROPUBLICA (June 8, 2021, 5:00 AM), https://www.propublica.org/article/the-secret-irs-files-trove-of-never-before-seen-records-reveal-how-the-wealthiest-avoid-income-tax (detailing how ProPublica has obtained a vast cache of IRS information showing how billionaires like Jeff Bezos, Elon Musk, and Warren Buffett pay little in income tax compared to their massive wealth — sometimes, even nothing).

121. *See* Bogenschneider, *Will Robots Agree to Pay Taxes?*, *supra* note 21, at 11–13.

122. *See* J. Doyne Farmer, *Hypotheses Non Fingo: Problems with the Scientific Method in Economics*, 20 J. ECON. METH. 377 (2013); Cornelis A. Los, *A Scientific View of Economic Data Analysis*, 17 E. ECON. J. 61, 61 (1991) ("The results of the alternative, or reverse, regressions are ignored. That is regrettable from a scientific point of view,

scientific inquiry.[123] In many cases within robot taxation, motivated reasoning is obvious.[124] As a prime example, consider conclusions from an economist based on OECD data from the year 2016, that forward-looking predictions by the author occurring in the year 2018 about the risk of automation to the tax base to occur prospectively in the future are empirically unfounded based on abstract modeling of historical data.[125] Such data suggests that in a model with 'routine' workers, who are at risk of being replaced by robots, and 'non-routine' workers, who are not, a fall in the price of robots will raise tax revenue. While this conclusion may be entirely plausible, except for the possibility that the future has not happened yet, backward looking econometric modeling based on arbitrary categories of routine and non-routine workers, may not predict future events very well. As Keuzenkamp & Magnus stated in regards to such econometric analyses: "It must be admitted that it is hard (but perhaps not impossible) to find a convincing example of a meaningful economic proposition, that has been rejected (or definitively supported) by econometric tests."[126]

A causal mechanism or link is also missing from the empirical analysis relating to how lower-priced robots might be expected to raise any tax revenue.[127] Since robots are not subject to wage taxes (such as social security and Medicare), indirect taxes (such as property and sales taxes), or much in the way of income taxes, and often serve to directly reduce the income taxes of firms that engage in automation, failure to tax them actually exacerbates the displacement of human workers by the non-neutrality of a tax system where robots as a type of capital are heavily favored in comparison to human labor. It should be viewed as at least possible that an over-investment in robots and other automation technology may have already occurred in the broader economy as firms set out to claim the disproportionate tax benefits offered to capital, of which robots are one part. Reversal of the tax

since the results of the reverse regressions often conflict disturbingly with the results of regressions selected on the basis of a *priori* theory.")

123. *See* David F. Hendry, *Econometrics — Alchemy or Science?,* 47 ECONOMICA 387, 401 (1980).

124. For a description of motivated reasoning, see Nathan Walter & Nikita A. Salovich, *Unchecked vs. Uncheckable: How Opinion-Based Claims Can Impede Corrections of Misinformation*, 24 MASS COMMC'N & SOC'Y 500 (2021).

125. OECD, ECONOMIC SURVEYS: UNITED STATES JUNE 2018 52 (2018), http://www.oecd.org/economy/surveys/Overview-United-States2018-OECD.pdf.

126. Keuzenkamp & Magnus, *supra* note 18, at 6.

127. *See* David H. Autor, *Why Are There Still So Many Jobs? The History and Future of Workplace Automation*, 29 J. ECON. PERSPECTIVES 3, 7 (2015) ("First, workers are more likely to benefit directly from automation if they supply tasks that are complemented by automation, but not if they primarily (or exclusively) supply tasks that are substituted.").

exemptions to robots may yield an efficiency *gain* as human workers performed work in lieu of robots. That is of course, since humans were more efficient than robots in some aspects of production. Only by using an outdated economic model, which does not take robots as a fourth factor of production, is it then possible to think that robots are always more efficient in production than human workers based on production functions without that fourth factor of production with special characteristics, such as tax benefits. In the real economy, *less efficient* robots appear to have in some cases been placed in service partly to obtain the overwhelming tax incentives offered for using robots rather than human workers. Although economic theory does not cognize any deadweight loss from worker taxes, as it does for taxes on the wealthy or large corporations, it seems reasonable to think that further efficiency gains could result from a zero-sum reduction of the taxes levied on workers if robots took on a larger or meaningful share of the tax base.[128]

Flaws in the methods applied by researchers including a failure to disclose the methods applied in the respective empirical work, strongly implies that further empirical research is necessary. Since the ITIF organization has purchased priority Google search results for the term "robot taxation," it draws into question whether conflicting theory and evidence was properly taken into consideration to reach the desired policy conclusion, and whether that work is reliable enough to be cited by university scholars. Likewise, the Tax Foundation has not disclosed any of the parameters or modeling of their work on robot taxes, so there is no way to check whether any work was actually done, done well, or to replicate the results, a required condition of modern science. The stated results were consistent with standard neoclassical economic theory that capital should never be taxed on efficiency grounds based on the premise that no efficiency gains are includable for possible reductions on the taxation of human workers by the payment of some taxes by robots.

As a prime illustration of the risks of automation to the labor force, economists readily admit that self-driving vehicles comprise a severe risk to some routine workers which they refer to as: "[D]rivers with few recognized qualifications, including many immigrants from less developed countries."[129]

128. For an explanation of the term "deadweight loss," see Martin Feldstein, *Tax Avoidance and the Deadweight Loss of the Income Tax*, 81 REV. ECON. & STAT. 674, 674 (1999).

129. Georg Graetz & Guy Michaels, *Robots at Work*, 5 REV. ECON. & STAT. 753, 767 (2018) ("Another area where autonomous machines hold both promise and threat to jobs is self-driving vehicles. If and when they become commercially viable, self-driving cars offer a more convenient, more flexible, and safer mode of transportation. At the same time, they pose a threat to the employment of drivers with few recognized qualifications,

However, the Teamsters Union currently numbers 1.4 million members in the United States alone, and the total number of non-unionized drivers may be as many as 3 or 4 times that amount. Assuming that the only profession at risk of obsolesce by automation was "drivers," that one profession comprises between 2% and 5% of the total labor force in the United States, comprising conservatively (depending on the relative salary levels of drivers) as much as 4% to 8% of aggregate tax collections. The assertion that automation does not comprise a risk to tax collections reflects an attempt to use deductive reasoning to substitute for actual data. As Lawrence Summers, now an outspoken critic of robot taxes,[130] once wrote: "Reliance on deductive reasoning rather than theory based on empirical evidence is particularly pernicious when economists insist that the only meaningful questions are the ones their most recent models are designed to address."[131] Empirical research accordingly may be helpful at times and could form the basis of policymaking, such as in cases where empirical results might strongly support one view and not another. But the policy issues associated with robot taxation are not such a simple case. Policymakers have a duty to consider the possibility that many other professions, beyond just "drivers," may also be at risk due to rapid automation. Since labor bears the vast majority of the tax base in most OECD countries the risk to government finances is severe notwithstanding base empirical models that may suggest to the contrary.

The empirical evidence on robot taxation is not the type of evidence that would be considered reliable empirical evidence with significant results as in the social sciences; rather, the given conclusions are merely statistical reviews and raw modeling reliant on neoclassical economic theory. The results are not significant in statistical terms, nor any more reliable than any other normative applications of theory. In respect of the Technequality paper in particular, no causal analysis was presented and accordingly, no testing was performed from which significant results might be derived. The motivation for a full tax exemption for robots as a type of capital is of course a tenant of standard neoclassical economic theory. However, such results may not hold any significance beyond theory, and have no significance at all if the given theory does not explain causation and serve to predict future events. Because robots and other ICT comprise a fourth factor of production

---

including many immigrants from less developed countries.").

130. *See* Sarah Kessler, *Lawrence Summers Says Bill Gates' Idea for a Robot Tax is "Profoundly Misguided"*, QUARTZ (Mar. 6, 2017), https://qz.com/925412/lawrence-summers-says-billgates-idea-for-a-robot-tax-is-profoundly-misguided/.

131. Lawrence H Summers, *The Scientific Illusion in Empirical Macroeconomics*, 93 SCANDINAVIAN J. ECON. 129, 145 (1991).

not cognized within the present version of economics, it seems reasonable to think that an outdated economic theory premised on land, capital, and labor as the three exclusive factors of production is unlikely to comprise a causal theory accurate enough to be used to formulate tax policy. Future empirical studies on robot taxation should also consider the strong association between tax share and per capita GDP where nations that levy tax including on capital seem to grow faster than those that do not. The causal mechanism reflected in the empirical data not cognized by neoclassical economic theory is that capital investment for robots is tax deductible for profitable firms yielding an income tax benefit as opposed to burden, and accordingly, firms may be likely to undertake robot investment in nations with higher tax rates.[132] The empirical data is consistent with this view and indicates that nearly all capital investment in robots takes place in higher tax nations, and almost none in tax havens or lower tax nations. Broadly speaking, nearly all capital re-investment occurs in higher tax nations. Robot density is positively associated with very high corporate tax rates, such as in Germany, Japan, South Korea, and the Nordic states, and almost no automation occurs in tax havens or nations with lower corporate tax rates where the value tax deductions for capital investment is zero.[133]

Table 2. Robot Density* and Corporate Tax Rates^

	Robot Density	Corporate Tax Rate
Top		
South Korea	631	25%
Singapore	488	17%
Germany	309	30%
Japan	303	26.1%
Sweden	223	21.4%
Denmark	211	22%
USA	189	21%, 35% (2018)
	Robot Density	Corporate Tax Rate
Bottom		
Panama	<1 est.	0%
Cayman Islands	<1 est.	0%
Ireland	<1 est.	15%-
Russia	3	15%
Phillipines	3	25%
India	3	25%+
Indonesia	5	25%

*Robot Density Data per IFR (Interational Federation of Robotics) Press Release https://ifr.org/ifr-press-releases/news/robot-density-rises-globally

^ Tax rates public sources

132. *See supra* Figure 1.

133. *See infra* Table 2.