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Robot taxation: The scrapping of automated checkout machines

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This paper examines the recent trend among major retailers to scrap self-checkout machines in favor of returning to human cashiers, exploring the underlying reasons beyond customer dissatisfaction and inventory shrinkage. Through quantitative analysis of tax incentive reversals and their impact on capital investment decisions, we investigate the role of tax policy changes, specifically the expiration of accelerated depreciation benefits, in prompting this shift. The findings reveal a strategic alignment with big-bath accounting write-offs, allowing companies to consolidate expenses and minimize book depreciation impacts. The paper contributes to the robot taxation literature by using a multidisciplinary approach of accounting methodology and tax technical analysis to highlight the financial accounting implications of de-automation and suggesting an understanding of tax policy's influence on technological adoption in the retail sector.

Key words: Automation, robot tax, tax policy.

INTRODUCTION

Automated or self-checkout machines are now a ubiquitous part of modern daily life (Mosteller, 2023). Over the past decade, many major retailers, including Wal-Mart stores, have invested heavily in such automation (Garcia, 2021). Amazon has further developed “just walk out” stores in airports and other locations, with fully automated checkout machines (Meyersohn, 2022). Chipotle has likewise announced its intent to develop nearly automated restaurants (Stebbins, 2022). Other startups have developed fully automated grocery fulfillment for online orders and delivery (Wells, 2021). Each of these represents a harbinger of a future shopping experience more reliant on automation (Debter, 2022). Yet, cracks have recently appeared in the growth of autonomous or self-checkouts, including with the announcement that several major retailers, including Wal-Mart, Costco, Target, Wegmans, and Dollar General, are moving to scale back self-checkout and return to a focus on human cashiers (Crumley, 2023; Stempler, 2023; Reinhard, 2023).

As self-checkouts represent a quintessential illustration of automation, the return to an emphasis on human cashiers by major retailers might even be referred to as a type of “de-automation.” The reasons given by retailers for de-automation in self-checkout machines relate to customer dissatisfaction with the process and inconvenience of self-checkout devices (Meyersohn, 2022), changes in the expected range of retail cashier tasks, and inventory shrinkage at self-checkout kiosks either by theft or inadvertent mistake in scanning items

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(Chun, 2018). Although customer convenience and inventory control are plausible retailer concerns, another explanation for these recent developments lies with the origins of robotics and other forms of automation in business processes, in particular, reductions in the tax savings thought to arise from automation (Abbott and Bogenschneider, 2017; Oberson, 2017).

Tax savings arise from automation by several channels, including accelerated depreciation for tax purposes, avoidance of indirect taxes, such as retail sales taxes levied by the states (or VAT in foreign jurisdictions), and tax reporting benefits of reporting relatively higher profits in the early years after placing the automation equipment into service (Oberson, 2018; Bogenschneider, 2022). These tax factors appear potentially relevant to the recent "de-automation" announcements and may relate also to changes in the tax code including after the year 2017, including: (i) tax depreciation of automated machines in comparison to salary expense for human workers; (ii) reductions in the corporate tax rate itself reducing the value of tax savings from automation; (iii) the financial accounting for income taxes used to calculate reportable earnings for publicly traded firms; and (iv) the use of accounting write-off techniques to mitigate the negative effects of accelerated tax depreciation for automated equipment in later years.

The basic assumptions as set forth in Table 1 reflect an automation machine of initial cost $480,000 with an annual maintenance cost of $5,000. The tax rate is given in the base case only as 35%, where capital investment may have occurred prior to the implementation of the Tax Cuts and Jobs Act of 2017. The salary expense corresponding to the automation is taken as $100 per year, totaling $500, or the same as the automation device up-front cost-plus repairs in nominal terms. The company uses the straight-line method for accounting and the double-decline-balance method for tax purposes.

TAX FACTORS IN DE-AUTOMATION

The tax factors potentially relevant to the initial decision to automate, as described in prior literature (Oberson, 2018; Soled and Thomas, 2018; Mazur, 2019), are multidisciplinary in nature and reflect tax technical and legal analysis along with accounting methods, which when taken in conjunction, potentially explain taxpayer behavior. Factors such as tax avoidance are also potentially relevant to corporate decisions to de-automate, where taxpayers are thought to engage in behaviors to minimize tax (Bogenschneider, 2022). In particular, the depreciable period on automation equipment for tax is relevant to several factors applicable to corporate decision-making, including (i) cash taxes payable (that is, the amount of taxes actually paid by the firm), (ii) book-tax differences where the tax period of depreciation differs from the book accounting period, and (iii) effective tax rates for the respective firm (Gosh, 2013; French and Price, 2018). The use of robots may lead to a reduction in human labor costs (Oberson, 2018). By proposing tax policies that equate the use of a robot with employment, the aim is to preserve the labor tax base and ensure that automation does not erode public revenues (Soled and Thomas, 2018). The results of the combined tax technical and accounting analysis are presented in Tables 1 to 3.

First, in respect of tax depreciation, the accelerated "depreciable period" of automated equipment for tax purposes may explain the recent shift away from automated or self-checkout machines. For tax purposes, the period for recovery of capital expense for equipment is relatively short, 5 to 7 years, depending on the specific classification of the equipment. Self-scanning equipment, money or change counters, computers, and printers have a period of 5 years, whereas appliances and equipment not otherwise categorizable have a period of 7 years. Additional factors such as Bonus Depreciation, where special tax advantages are available for capital investment, may also change the recovery period and allow the depreciation to be taken even sooner for tax purposes (Hulse and Livingstone, 2010). Since automated or self-checkout machines are complex devices and possibly a combination of these categories, and since the historic availability of Bonus Depreciation depends on the date the equipment is placed into service, it is not necessarily knowable how the machines are classified for accounting purposes by the respective retailers which have announced intent to de-automate.[1] The recovery for tax purposes of the investment in capital for automation equipment is therefore highly accelerated where a full tax deduction may be achieved even though the equipment itself has a much longer useful life (Kommunuri, 2022).

As modified by the Tax Cuts and Jobs Act of 2017, the current rate for Bonus Depreciation in the year 2023-2024 is 100%, which would add further to the tax savings from automation. However, regardless of the rate of Bonus Depreciation, once the depreciation period expires, no further tax benefit arises from depreciation on the equipment. Such tax treatment of equipment is distinguishable from the tax deduction for salary expense, where the tax deduction for salary accrues in each year where the worker, namely a cashier, is paid wages for work at the retail location. Accordingly, for some retailers, it may be that the tax benefit from depreciation that served as an advantage to automate and may have driven the decision to place the automated checkout devices in stores has fully expired.

Second, the reduction in corporate tax rates reflected in the Tax Cuts and Jobs Act of 2017 may also be relevant to the recent "de-automation" announcements by retail firms. The TCJA reduced the corporate tax rate from 35

[1] Self-checkout devices appear to have been placed in many retail locations for a period exceeding 5 to 7 years concurrent or after the year of major corporate tax reform, 2017.

Table 1. Illustration of Tax Savings by Automation.

Alternative 1 - Automated checkout							
Cashflow item	**Column 1**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Cost of Automated Checkout Machine	(1)	480					**480**
Maintenance Expenses	(2)		5	5	5	5	**20**
Depreciation - Tax (Double-decline-balance method)	(3)	192	115	69	52	52	**480**
Tax deductible expenses	(4) = (2)+(3)	192	120	74	57	57	**500**
Tax rate	**35%**						
Tax shield	(5) = (4) × 35%	67.2	42.1	25.9	19.9	19.9	**175**
Net cash outflow	(6) = (1) + (2) -(5)	412.8	(37.1)	(20.9)	(14.9)	(14.9)	**325**
Alternative 2 - Human-operated checkout							
Cashflow	**Notes**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Salary Expense	(7)	100	100	100	100	100	**500**
Tax shield	(8)	35.0	35.0	35.0	35.0	35.0	**175**
Net cash outflow	(9) = (7) - (8)	65.0	65.0	65.0	65.0	65.0	**325**
Discount factor		0.9434	0.8900	0.8396	0.7921	0.7473	
Difference in Tax Savings from Automation	(5) - (8)	32.2	7.1	(9.1)	(15.1)	(15.1)	**-**
NPV of tax savings		30.38	6.29	(7.61)	(11.97)	(11.29)	**6**
Difference in cash outflow/(inflow)	(6) - (9)	**347.8**	**(102.1)**	**(85.9)**	**(79.9)**	**(79.9)**	**-**
NPV of difference in cash outflow		328.1	(90.8)	(72.2)	(63.3)	(59.7)	**42**

Notes: Excludes Bonus Depreciation. Double-decline-balance method applied.

Period	**Beginning Book Value**	**Curr. Depr.**	**Acc. Depr.**	**Ending Book value**
1	480	192	(192)	288
2	288	115	(307)	173
3	173	69	(376)	104
4	104	52	(428)	52
5	52	52	(480)	-

to 21%. If tax benefits are indeed associated with automation and robot workers, a reduction in the tax rate paradoxically reduces the incentive for firms to invest in equipment in that location. This is because the value of a tax deduction, such as for depreciation of an automated checkout machine, is the deductible amount times the tax rate, which results in mathematical terms in less value as the tax rate declines. Such a disincentive effect toward capital investment from a reduction in corporate tax rates is well-known to tax practitioners but may come as a surprise to some economists who often suppose that lower tax rates might be expected to increase capital investment, including in robots (Hemel, 2020). Economists often describe the benefit of lower tax rates as encouraging future investment by increasing the after-tax rate of return (Gentry and Hubbard, 2004). Here, in the context of automated or self-checkout devices, it appears that many or all devices are placed in existing store locations. If these stores are thought to be profitable, the automation of checkout services at the store results foremost in incremental tax deductions that would serve to offset some of the taxable income from the ongoing operations of the store. As the corporate tax rate has been reduced in recent years, the value of accelerated tax deductions has accordingly declined and may not have been offset by increasing foot traffic, such as where customers would choose to spend more or come into the retail location in order to engage in self-checkout. If true, that would mean that the self-checkout devices do not entail an incremental revenue stream, as presumed in neoclassical economic theory. The accelerated tax deductions may then be the predominant factor in decisions regarding capital investment (Bogenschneider and Walker, 2020). If tax deductions are the predominant factor in corporate decision-making on capital investment rather than marginal income, then a reduction in the corporate tax rate would reduce the tax savings arising from automation.

Table 2 illustrates the effects of a reduction in the tax rate on the financial outcomes of using automated checkout machines. Initially, the cost of the automated checkout machine is $480,000 with yearly maintenance

Table 2. Effects of reduction in the tax rate

Alternative 1 - Automated checkout	Column 1	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Cost of Automated Checkout Machine	(1)	480					**480**
maintenance Expenses	(2)		5	5	5	5	**20**
Depreciation - Tax (Double-decline-balance method)	(3)	192	115	69	52	52	**480**
Tax deductible expenses	(4) = (2)+(3)	192	120	74	57	57	**500**
Tax rate	**21%**						
Tax shield	(5) = (4) *21%	40.3	25.2	15.6	11.9	11.9	**105**
Net cash outflow	(6) = (1) + (2) -(5)	439.7	(20.2)	(10.6)	(6.9)	(6.9)	**395**

expenses of $5,000. Using the double-decline-balance method for tax depreciation, the total tax-deductible expenses over five years amount to $500,000. When the tax rate is reduced from 35 to 21%, the total tax shield (that is, the tax savings from deductible expenses) decreases from $175,000 to 105,000. This reduction significantly increases the net cash outflow from $325,000 to $395,000, indicating that the lower tax rate reduces the financial benefit of investing in automated checkout technology due to a diminished tax shield.

Third, the financial accounting for income taxes may also be relevant to the shift away from automated or self-checkout by some retailers. Depreciation of capital assets creates what is referred to as a “book-tax difference” that may itself be relevant to corporate decision-making on whether to use expensive equipment to automate in check-out lines. A book-tax difference commonly occurs where the depreciation permitted on a capital asset, such as a self-checkout machine, is relatively faster for tax purposes than for book accounting purposes. Reported profits are correspondingly higher in earlier periods with lower amounts of depreciation. A tracking entry must then be recorded in the books of the company that says essentially that the tax code presumes that equipment wears out faster than the financial accounting rules presume in respect to the same equipment. Current and future financial or book accounting entries then do not match those recorded on the tax returns. Such differences are thought to be relevant to investment decisions and are reported in financial statements for public companies. Book-tax differences are further thought to be relevant to corporate decision-making because longer depreciation periods for book are advantageous for book as opposed to tax. As the accelerated deductions for tax purposes expire, the firm is then left with a book deduction that reduces corporate profits in future years without a corresponding tax deduction, which may be seen as undesirable.

Table 3 presents an illustration of the book-tax differences arising from automation, specifically focusing on the depreciation of automated checkout machines over a ten-year period. It compares the tax savings achieved through depreciation under accounting practices (straight-line method) and tax reporting (double-decline-balance method) at a 35% tax rate. Initially, accelerated tax depreciation allows for significant tax savings, but as the tax benefits are front-loaded, the savings diminish over time. The table shows a growing divergence between the book depreciation and tax depreciation values over the years, leading to a cumulative book-tax difference. This difference represents the disparity in perceived equipment value between financial accounting and tax reporting, initially providing a tax advantage that declines over time. The net present value (NPV) of the book-tax difference highlights the financial impact of these diverging depreciation methods on the company's finances, underscoring the complexity and strategic considerations involved in asset management and tax planning in the context of automation.

Fourth, if financial accounting is relevant to the decision to automate, where the tax deductions for automated equipment have expired, then it may be that firms engage in accounting strategies to mitigate the ongoing effect of book depreciation without tax savings in later years. An illustration of such accounting strategies may be to write-off the automation equipment for book. The accounting strategy related to the write-off is referred to as the “big bath” method (Walsh et al., 1991). The problem sought to be addressed is that the period of book depreciation is longer than the respective tax period of 5 to 7 years or even much less in the case of Bonus Depreciation. The effect of the “big bath” accounting strategy is to pull the book expense for future depreciation on automation equipment into the current year in order to continue to accrue depreciation in future periods that reduce reported earnings (Francis et al., 1996). In simple terms, as the accelerated period for tax depreciation expires after the 5 to 7 years, book depreciation continues onward for the period of the useful life of the equipment taken here to be at least 10 years, where book earnings are reduced but without a corresponding cash tax savings. The recent announcements by the respective firms may then be thought to reflect an accounting strategy to write-off equipment for book purposes that has already been fully depreciated for tax.

Table 4 illustrates the financial implications of writing off self-checkout machines in the sixth year of their use, considering both accounting and tax perspectives under

Table 3. Book-Tax Difference arising from

Automation Accounting	Column 1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Cost of Automated Checkout Machine												
Depreciation - Accounting (Straight-line method)		48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00	**480.00**
Tax rate	35%											
Tax savings	(a)	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	**168.00**
Tax		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Total**
Depreciation - Tax		192.00	115.20	69.12	51.84	51.84						**480.00**
Tax rate	35%											
Tax savings	(b)	67.20	40.32	24.19	18.14	18.14	-	-	-	-	-	**168.00**
Book-Tax Difference	(b) - (a)	50.40	23.52	7.39	1.34	1.34	(16.80)	(16.80)	(16.80)	(16.80)	(16.80)	**-**
Discount factor		0.9434	0.8900	0.8396	0.7921	0.7473	0.7050	0.6651	0.6274	0.5919	0.5584	
NPV of Book-Tax Difference		47.55	20.93	6.21	1.06	1.00	(11.84)	(11.17)	(10.54)	(9.94)	(9.38)	**24**

Table 4. Illustration of Write-Off of Self-Checkout

Machines in Year 6 Accounting	Column 1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Cost of Automated Checkout Machine												
Depreciation - Accounting (Straight-line method)		48.00	48.00	48.00	48.00	48.00	240.00					**480.00**
Salary expenses								100.00	100.00	100.00	100.00	**400.00**
Total accounting expenses		48.00	48.00	48.00	48.00	48.00	240.00	100.00	100.00	100.00	100.00	**880.00**
Tax rate	21%											
Tax savings	(c)	10.08	10.08	10.08	10.08	10.08	50.40	21.00	21.00	21.00	21.00	**184.80**
Tax		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Total**
Depreciation - Tax		192.00	115.20	69.12	51.84	51.84						**480.00**
Salary expenses								100.00	100.00	100.00	100.00	**400.00**
Total tax expenses		192.00	115.20	69.12	51.84	51.84	-	100.00	100.00	100.00	100.00	**880.00**
Tax rate	21%											
Tax savings	(d)	40.32	24.19	14.52	10.89	10.89	-	21.00	21.00	21.00	21.00	**184.80**
Book-Tax Difference	(c) - (d)	30.24	14.11	4.44	0.81	0.81	(50.40)	-	-	-	-	**0**
Discount factor		0.9434	0.8900	0.8396	0.7921	0.7473	0.7050	0.6651	0.6274	0.5919	0.5584	
NPV of Book-Tax Difference		28.53	12.56	3.72	0.64	0.60	(35.53)	-	-	-	-	**11**

a reduced tax rate of 21%. Initially, the cost of the automated checkout machine is accounted for through straight-line depreciation over five years, totaling $480,000. In year 6, an accelerated write-off of $240,000 is applied, representing the remaining book value. This maneuver significantly impacts the accounting expenses, spiking in year 6 before normalizing due to the elimination of depreciation expenses thereafter.

On the tax side, depreciation follows the double-decline-balance method, concluding after year 5, which aligns with the period before the write-off. Salary expenses for human-operated checkouts, assumed as an alternative, are consistently $100,000 annually, influencing both accounting and tax calculations. The key takeaway is the strategic use of a "big bath" write-off in year 6 to manage financial reporting and tax obligations. This write-off results in a substantial increase in reported accounting expenses for that year but provides tax savings under the new lower rate. The book-tax difference, particularly notable in year 6 due to the write-off, reflects the strategic financial accounting maneuvers companies may undertake to optimize their financial reporting and tax positions in response to changes in tax legislation.

PRIOR RESEARCH

Prior research in the area of what is referred to as "Robot Taxation" has focused on tax incentives for automation, comprising capital investment in lieu of direct salary payments to human workers (Mazur, 2019; Oberson, 2018). In this context, the term "robot" is understood to refer to automated devices that have the potential to replace a human worker in the workplace. At least one scholar has also interpreted the term "robot" as synonymous with an android or human-like robot and proposed levying taxes on androids, which would constitute a more literal interpretation of the term "Robot Taxation" (Oberson, 2017). Yet, for the most part, scholars have identified a threat to the overall tax base from higher degrees of automation in the workplace, as many taxes are levied directly on human workers that may be reduced if automation supplants the need for some human labor (Bogenschneider, 2022). A significant degree of debate exists in the literature on the issue of the likelihood of a net dilution in the aggregate human workforce resulting from automation, where some scholars have proposed that automation could be net accretive to the aggregate human workforce (Atkinson, 2019). Nonetheless, many more scholars argue that automation will be net dilutive of the aggregate human workforce and have proposed robot taxes as a means to fund transfer payments to fully or partially offset the social effects of rapid automation resulting from such dilution (Oberson, 2017; Bendel, 2019). A potential trend of "de-automation" or transition away from automation in some contexts, as reflected in the recent announcements on self-checkout devices, is potentially significant to the prior literature as the net dilution in the aggregate human workforce due to automation may be more limited than initially anticipated.

CONCLUSION

The significance of taxes and tax rates to corporate decision-making on capital investment is a major part of economic theory (Ionescu, 2019; Ooi and Goh, 2018). The nascent field of "Robot Taxation" expands some aspects of neoclassical economic theory by applying a multidisciplinary approach of tax technical and accounting methods, focusing on the significance of tax deductions to corporate decisions rather than the tax rate on incremental income streams arising from capital investment, including automation equipment. Numerous scholars and paid researchers have challenged the theoretical bases for Robot Taxation (Atkinson, 2019; Englisch, 2018). As such, the analysis is likely to be relevant only under certain conditions where the subject firm is: (i) Already profitable in the given jurisdiction and can use the tax deductions to offset other income; (ii) Able to use transfer pricing or other means of income shifting to move revenue streams resulting from automation, if any, into lower or zero-tax jurisdictions (Clausing, 2012); and (iii) Sensitive to either cash taxes payable or the effect of book-tax adjustments on reported earnings over time. Of course, the overall effective tax rate of the firm may also be lowered by reinvestment of profits into capital investment of any sort, including by automation equipment.

A significant implication of the research is that a process of "de-automation" or shift away from automation in favor of human workers may result from the faster depreciation periods for tax in comparison to book or financial depreciation. Once the accelerated tax depreciation expires, the early benefits are offset by later depreciation deductions for book that continue forward for the useful life of the equipment. In the case of high levels of bonus depreciation as under current law, thus resulting in nearly 100% deduction in the first year, the book depreciation would generate an expense in later years for nearly the full useful life of the automation equipment. Corporate decision-makers may not wish to continue to book depreciation expenses for these years for many reasons and may instead elect a big-bath entry to write off the value of the automation equipment for book purposes in one year. The near simultaneous announcements by many large retailers of a shift away from automation equipment in favor of human workers may reflect the efforts of large accounting firms to implement or justify the big-bath accounting treatment with their clients on a national scale where the announcements are intended to show a general trend or

shift by firms away from self-checkout machines in favor of human cashiers and the resulting diminishment in value of the existing equipment.

This study contributes to the broader discourse on Robot Taxation and the economic ramifications of automation, providing insights into how tax policy can influence corporate strategies and labor market dynamics. The findings underscore the sensitivity of capital investment decisions to changes in tax policy, specifically how the expiration of accelerated depreciation benefits can disincentivize the continued use of automated technologies. This partly aligns with economic theories that posit tax policy as a critical lever for influencing corporate behavior, but also challenges the doctrinal neoclassical view that tax incentives uniformly encourage investment. Instead, the study illustrates a more nuanced and multi-interaction between tax policy and investment in automation, where the benefits of tax deductions diminish over time, leading to a reevaluation of investment strategies.

The shift back to human cashiers, driven in part by tax policy changes, has broader implications for the labor market and automation debates. While the immediate impact may be seen as positive for employment in the retail sector, it also signals the contingent nature of jobs replaced or supplemented by technology. This underscores the importance of considering labor implications in tax policy design, particularly as automation continues to advance in various sectors. The results of the paper highlight the need for a multidisciplinary approach to address the challenges and opportunities presented by technological advancements, suggesting avenues for future research that spans economics, tax law, and labor studies and suggest further exploration into the intersection of tax policy, labor markets, and the evolving landscape of automation is needed.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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