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Is the Fourth Industrial Revolution (IR4.0) Adoption Able to Save Tax?

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Abstract
Purpose: This study aims to analyze the relationship between the adoption of IR4.0 and the effective tax rate for listed companies in Malaysia, where firms adopt the Fourth Industrial Revolution (IR4.0) technologies to reduce corporate taxes.
Design/methodology/approach: Panel data analysis was used to examine the adoption of IR4.0 and the effective tax rate relationship in a balanced panel of 954 firms listed in Bursa Malaysia from the years 2015 to 2019. Adoption of IR4.0 is identified by at least one of the three conditions: (1) Keywords representing the 17 pillars of IR4.0 technologies, (2) Acquirer of the IR4.0 technologies or (3) Appointment of Chief Information Officer (CIO).
Findings: Adoption of IR4.0 has a negative and significant effect on the effective tax rate as measured by both ratios of tax expense on net profit before tax and tax paid on net profit before tax.
Research limitations/implications: This study uses the approach of content analysis to identify firms that are related to 17 pillars of the IR4.0 technologies. The limitation is insufficient analysis of the other factors related to the adoption of IR4.0. It is suggested that future studies can adopt the survey approach to identify the degree of IR4.0 adoption, which would be a better indication of tax avoidance where high adoption companies are expected to have a better tax planning strategy compared to low adoption firms.
Practical implications: The results suggest that the adoption of IR4.0 is an effective tax planning tool. The findings will shed light on National Industry 4WRD Policy, encouraging firms to embrace IR4.0 through various tax incentives from the Malaysian government and tax authority. However, diligent caution should be exercised in evaluating such technologies, given the opportunity for international income shifting.
Originality/value:
While most articles on corporate taxes focus on tax aggressiveness and tax avoidance on firm financial performance, this study attempts to measure the adoption of IR4.0 and its effect on tax avoidance for listed firms in Bursa Malaysia.

Keywords: IR4.0, effective tax rate, board size

Introduction

COVID-19 pandemic severely hit businesses and changed the way the business operates. Before the pandemic, firms that deployed IR4.0 tools were more efficient in monitoring business activities than others. The pandemic aggravated the requirement of utilizing IR4.0

when people are required to work remotely. According to The Edge Financial Daily (2019), Malaysia faces challenges in adopting IR4.0 owing to incompetency and insufficient resources. Only 7.4% of companies in Malaysia use autonomous robots and intelligent manufacturing. Lack of usage is mainly due to cyber security and data protection risks. Some areas of concern include finding the right technology partners and getting top management's support. Various companies make an effort to raise productivity and boost profitability levels by deploying the so-called disruptive technologies such as the Internet of Things (IoT), robotic automation, artificial intelligence (AI), machine learning (ML), cloud and others. To survive the age of disruption, producers have to adopt an effective business strategy that can react swiftly to consumer needs and market changes and remain cost-effective.

How does IR4.0 adoption contribute to tax savings? The adoption of IR4.0 automates the process and increases the speed and accuracy of data. Accounts are better classified and linked to tax purposes, thus enabling astute decision-making, improving tax audit and investigation support and documentation, and further enhancing tax compliance and reporting accuracy, particularly in performing repetitive, structured data. The essential duty of AI and ML is to increase the accuracy of prediction and forecasting by using regression, rolling averages, and exponential smoothing approaches. The more advanced methods can detect trends within tax filing periods, either decreasing or increasing tax cash payments and changes in accruals and prepayments. AI's predictive functionality enables a more exact estimation for tax computation that includes effective tax rates for interim financial reporting. With AI, companies will be better prepared in cash flow position to meet their short-term obligation, including tax instalments to the tax authority. Hence, tax planning strategy can be achieved with improved quality data, accuracy, and greater efficiency.

In addition to the forecasting function, AI can identify those tax-sensitive accounts to ensure proper income tax return compliance and IFRS reporting requirement. For instance, some aspects of research and development (R&D) qualify for the double deduction, and some are just for single deduction. AI can cluster and classify the features according to the needs of users.

As tax is based on a territorial basis, different jurisdictions have different tax systems. Therefore, it is crucial for tax experts to input the correct program in the AI systems to perform accordingly. In programming, decision rules are encoded and then queried for accurate responses. Data sets can be created to capture accurate general ledger account details with rules applied to calculate taxable amounts. An easy illustration is the treatment of entertainment expenses, the Inland Revenue Board of Malaysia (IRBM) allows 50% deductibility on entertainment for existing customers and non-deductibility for potential customers. AI will be able to segregate between existing and potential customers. For companies taxed on a world scope basis, particularly banking, insurance, shipping and airlines, a similar treatment can be applied to foreign tax credits, either unilateral or bilateral credits where relevant data are spread across various accounts and jurisdictions subject to specific tax rules and calculations. Today, robots are no longer restricted to the manufacturing industry, R&D, and any other "high-tech" firms. In finance and tax, AI and ML are capable of producing "bots" that simulate human behaviours. With suitable and applicable rules applied, it can execute routine, repetitive jobs, releasing humans from low-end activities to higher value-added activities. Also, robots nowadays can execute automated data entry, integrate data from various systems and multiple locations, repeat tedious, monotonous tasks, and reconcile and validate or control checks related to direct or indirect tax tasks. As a consequence, human error can be mitigated.

Corporate taxes are a vital source of revenue for the Malaysian government. IRBM empowers taxpayers to self-assess, determine, file tax returns and pay their tax liability in accordance with Income Tax Act 1967 (Faizal et al., 2017).

Literature Review and Hypothesis Development

Tax Planning and Effective Tax Rate

Investors are looking for a higher return if the corporate tax is high, which erodes their dividend income. Domar and Musgrave (1944) conducted a study of taxation and risk-taking by examining how investors allocated their portfolios between risk-free and risky assets (e.g, between cash and stock) in the existence of an income tax.

Tax planning aims to reduce costs (Klassen, Lisowsky & Mescall, 2016). There are few proxies used to measure tax planning. Some authors use Book-Tax Differences (BTD) by calculating the difference between profit from an accounting perspective and profit from a tax perspective (Frank, Lynch & Rego, 2009). However, BTD as a measure of tax aggressiveness is prejudiced because the propensity can also define its behaviour to earnings management (Ferreira, Martinez, Costa & Passamani, 2012). Thus, it is crucial to control this aspect before it can be inferred whether the entity is being aggressive in fiscal terms.

The most usual aggressiveness measures are linked to the effective tax rate (ETR). Hanlon and Heitzman (2010) proposed that the effective tax rate on the accounting profit is calculated as tax expense divided by profit before tax (GAAP ETR). Thus, a low ETR infers that a company operates tax planning more assertively than companies with higher ETR rates. As variations of this measure taking consideration of deferred tax where the total effective rate (ETRt) and the current effective rates (ETRc) are calculated (Guimarães, Macedo, & Cruz, 2016). It is worth highlighting that Malaysia does not practice GAAP, but we use IFRS. Nonetheless, ETR is a good proxy for tax planning.

Other studies focus on actual tax paid rather than tax expense by using the effective tax rate on cash which can be defined as the tax paid divided by profit before tax. Da Silva & Martinez (2017) argued that a company's cash ETR is the most explicit indicator of a company's tax liability in cash. Any tax planning that diminishes the cash tax burden will directly affect the cash ETR. The short-term cash ETR serves to capture timely reactions to existing financial constraints, as there is a series of potential tax planning strategies companies can implement over a relatively short period, such as, for example: making expenses more aggressively than capitalizing them; obtaining advantages from tax incentive programs and engaging in timely strategies that accelerate deductions and postpone the recognition of earnings.

IR4.0 Adoption

Companies use big data analytics to optimize bottom lines. Management accountants can use big data analytic tools to predict timely maintenance, optimize production schedules, reduce machine downtime, and fulfil manufacturing needs to reduce cost, reduce idle time and maximize profit. On the financial management side, companies can achieve better customer satisfaction, be more competitive, and provide after-sale support. Therefore, through IR4.0, cost savings, and efficiency, companies can attain operational excellence.

Robotic process automation (RPA) empowers prompt end-to-end business process automation that incorporates automation of front and back-office business processes and then orchestrating work across collaborative human-robot teams. Companies use RPA to optimize cash conversion, prevent delays in account payables and receivables, and reduce inventory turnover. RPA can target the gap and weakness in the current financial and accounting systems.

Due to COVID-19, in which physical inspection and audit are impossible, remote auditing can be conducted without delay by using robotics, AI, machine learning and drones to capture inventories. Adoption of IR4.0 witnesses a significant momentum towards automation as a guiding principle to navigate and address processes that traditionally required manual intervention and physical presence.

Earlier studies used the proportion of personal computers to total employees to measure information technology adoption (Forman 2005; Bloom et al. 2012; Hershbein and Kahn 2018). However, with the rapid development of technology and digital over the last decade, this indicator appears insufficient to measure the degree of digitalization. Swift change in technology has brought down the costs of computers. To take advantage of the leading edge of digitalization, companies must link information, connect every process, and systemize workflows after gathering the data. Sophisticated software solutions are essential to perform complicated tasks. Latest studies in the CiTDB survey capture the dimension of digitalization by using different types of software as a proxy for the level of a firm's degree of digitalization (Bloom et al., 2014; Candel Haug et al., 2016).

Klein et al. (2020) create a unique internal digitalization index by capturing companies' access to crucial software solutions such as enterprise resource planning (ERP) system, a database management system (DBMS) and groupware software. These software solutions support internal digitalization from many dimensions and fit well in a comprehensive index.

Information technology implementation affects the performance of fundamental business operations. Among others, Hitt et al. (2002) discovered a positive correlation between adopting an enterprise resource planning (ERP) system and the firm's earning management such as profit margins, return on assets, and other key performance indicators. Using an ERP system is crucial for informed and improved decision making in the operational unit (Aral et al., 2012; McAfee, 2002). Furthermore, past literature (Fayyad et al. 1996; Grover et al. 2018) showed that big data analytics boost businesses' efficiency, effectiveness, and productivity. Thereby, a firm's competencies to integrate big data analytics into its existing process, with highly skilled and motivated employees who handle the data and technical systems to store and process the data, contributed to quality decision making (Janssen et al., 2017).

Technology platforms reciprocate our trust by ensuring a high level of reliability, efficiency, and security. Companies must have metrics in place to track the progress or success of AI-enabled automation initiatives as there are significant risks involved, such as data security, privacy concerns, failure of AI-enabled automation for mission-critical tasks, regulatory non-compliance for specific functions, underperforming return on investment, the inability of infrastructure to support automation, biases of algorithms, limited budget for investment in AI-enabled automation technologies, the decline in customer trust or bad experience.

AI is poised to reshape the financial services industry by reshaping new value-added roles requiring creativity and judgement skills, supplanting mundane routine tasks, and managing vast volumes of data. AI could revolutionize accounting practices and prepares accountants for disruption and adoption. However, AI adoption involves money and the readiness of the workforce in a firm. Management must consider the risk of adopting and not adopting IR4.0 in this competitive world. According to Hoffman's tax planning theory (1961), corporations need to understand the prevailing tax laws to minimize tax payments. For those companies that adopt IR4.0, they must apprehend the Malaysian tax laws on the criteria for a further deduction, accelerate capital allowance or pioneer status, reinvestment allowance, and investment tax allowance.

Firm Characteristics and Tax Avoidance

Previous studies on tax avoidance of China firms include firm characteristics that encompassed gearing, firm size, and firm ownership (Adhikari et al 2006; Liansheng et al 2012). Firm size does play a role in tax-saving strategies. Economists argue that large corporations tend to have a higher degree of tax compliance because the cost of collusive tax cheating is higher. Kleven et al. (2016) studied that threat of whistleblowing effectively improves tax compliance at large firms. Pomeranz (2015) concluded that tax compliance increases with firm size. Large firms

are more organized and enjoy more tax incentives, thus having a negative effective tax rate relationship. On the other hand, small firms may use excessive tax planning tools and thus have a negative effective tax rate. We are unsure about the direction of the signal.
A highly leveraged firm will enjoy higher tax deductibility on its interest incurred and, consequently, have lower ETR. Leveraged firms are prone to manipulate interest payments and loan tax deductibility. They tend to transfer debt among variably taxed jurisdictions (Hines & Rice, 1994; Newberry & Dhaliwal, 2001; Rego, 2003; Taylor, Richardson, & Lanis, 2015; Taylor, Richardson, & Taplin, 2015). Highly geared companies are inclined to be more tax aggressive than those with high equity (Bernard, Jensen, & Schott, 2006; Dyreng et al., 2008; Gupta & Newberry, 1997). Therefore, companies must weigh the cost and advantage of deploying a gearing policy.
Companies frequently use capital expenditure as a tax-saving tool where a capital allowance is claimable on adjusted income. Capital expenditures differ subject to the size of the company and the industry in which the company is. Beyond expectation, Gala & Julio (2016) confirmed that small firms have significantly higher investment rates than large firms.

Corporate Governance and Tax Avoidance
Managers are responsible for tax planning to reduce income tax expenses because corporate taxes constitute a high cost to a firm (Chen et al., 2010). Managerial characteristics influence corporate tax avoidance, while risk incentives of CEOs are highly connected with more aggressive tax avoidance strategies (Rego & Wilson, 2012). The board of directors is responsible for the internal control mechanism of the company to monitor tax aggressiveness. In 2003, the Australian Tax Office (ATO) placed tax planning and compliance centre of good corporate governance strategies (ATO, 2005).
Non-executive directors should enthusiastically support greater corporate responsiveness to society's needs compared to executive directors. Rather than focusing on financial performance, non-executive directors tend to be more responsive to society's needs and not contribute to tax planning (Ibrahim et al., 2003).

IR4.0 Adoption and Tax Avoidance
Mukherjee et al., (2017) highlighted that the higher corporate taxes reduced innovator incentives and discouraging risk-taking. In business taxation, after-tax profit maximization is the essential element in decision making (Robinson et al. 2010; Scholes et al. 2016). Klein et al. (2020) conclude that European companies deployed I.T. to exploit income shifting incentives by shuffling income to lower tax jurisdiction and therefore maximizing companies' after-tax profits. Their empirical analysis validated the prediction that digitalized firms react more effectively to income shifting incentives than non-digitalized firms.
Based on the above literature review, there is evidence that the adoption of IR4.0 technologies will increase the opportunities for tax avoidance; hence we hypothesized our study as follow:

H1: A firm's adoption of IR4.0 has a significant negative impact on the effective tax rate

We also include firm characteristics and corporate governance mechanisms as control variables in our regression models. These variables are market to book value, firm size, leverage, the board size, board independence and capital expenditure.

Methodology

Sample Selection

The sample consists of 943 public listed companies in Bursa Malaysia. The sample data are collected for five years, from 2015 to 2019.

Identify IR4.0 Adoption

We employ three conditions to identify IR4.0 adoption. (1) Identify IR4.0 keywords representing 17 pillars of the IR4.0 technologies in the profiles of key executives from the S&P Capital database. The IR4.0 keywords include 3D printing, 5G, AI, augmented reality, automated guided vehicles, blockchain, cloud, robots, cybersecurity, digital twin, drones, edge computing, IoT, IoT platforms, machine vision, quantum computing, virtual reality, and any other related terms in the respective pillars. (2) Identify firms that have suppliers who provide the IR4.0 technologies. (3) Identify the Chief Information Officer (CIO) appointment. The dummy variable of IR4.0 equals one when at least one of the above conditions is made, zero otherwise.

Empirical Model and Variable Definitions

The empirical analysis in this study uses the following general multivariate model to examine the impact of IR4.0 adoption on ETR.

$$ETR = \beta_o + \beta_1 IR4.0 + \beta_2 MTBV + \beta_3 Size + \beta_4 Leverage + \beta_5 Board\ Size + \beta_6 Board\ Independence + \beta_7 CAPEX + Year + Sector + \varepsilon$$

ETR refers to the effective tax rate. We use two different measures for ETR. ETR1 is measured by tax expense divided by net profit before tax, while ETR2 is measured by tax paid divided by net profit before tax. IR4.0 is a dummy variable representing the adoption of IR4.0 by the firm. MTVB is measured by market capitalization divided by total equity. Size is the company size, and it is the log of market capitalization. Leverage is the total assets divided by total liabilities. Board Size is the number of members on the board of directors. Board Independence is measured by the number of independent directors divided by board size. CAPEX is the capital expenditure measured by the log of total capital expenditure in the year.

Findings

Descriptive Statistics

Table 1 presents the sample's descriptive statistics for the main variables used in the empirical analysis. The IR4.0 adoption rate is pretty low at merely 14%. MTBV is 27%, the firm's leverage ratio is 37%, and the number of directors on the board is 7.15. Effective tax rate (ETR1) measured by tax expense divided by profit before tax is 15% on average. On the other hand, considering tax paid (cash basis) represented by ETR2 is much lower, only 9%.

Table 1. Descriptive statistics

Variable	n	Mean	S.D.	Min	0.25	Mdn	0.75	Max
IR4.0	4771	0.14	0.35	0	0	0	0	1
MTBV	4606	0.27	0.69	-0.8	0.01	0.08	0.24	4.39
Firm size	4295	5.59	1.72	1.03	4.3	5.29	6.48	11.59
Firm leverage	4770	0.37	0.22	0	0.2	0.36	0.52	0.92
Board size	4770	7.15	2.22	1	6	7	8	20
Board independence	4770	0.49	0.15	0	0.4	0.5	0.6	1
CAPEX	4483	1.61	2.47	-7.18	0.06	1.58	3.21	9.33
ETR1	4705	0.15	5.01	-186.33	0	0.13	0.29	166.67
ETR2	4705	0.09	7.5	-290.95	-0.01	0.11	0.28	196.33

Baseline Model Analysis

Table 2 is the baseline model of this study using the random-effects model (REM). We discovered that IR4.0 was negatively related to ETR1 and ETR2, with a significance level of 10%, meaning that IR4.0 adoption contributed to tax savings. These results reflect those of Argilés-Bosch et al. (2020), who also found that digital businesses are significantly more tax avoidant than traditional firms. Moreover, the technology-based companies have greater opportunities to incorporate in another country and transfer high-value business operations to tax havens for lower statutory corporate tax rates (Huizinga & Laeven, 2008). Consequently, tax enforcement is difficult for the territorial-based taxation system to detect tax evasion in the digital economy when technology-based companies create more off-shore locations (Cockfield, 2001). Besides, firms deploying IR4.0 are more efficient with data accuracy and account classifications for tax purposes, enabling astute decision-making, improved tax audit, tax compliance and reporting accuracy. IR4.0 is superb in performing repetitive tasks on primarily structured data.

Table 2. Baseline Model of ETR1 and ETR2

	ETR1	**ETR2**
IR4.0	**-0.1923***	**-0.1972***
	(0.1105)	(0.1134)
MTBV	0.0155	-0.0825
	(0.0419)	(0.0881)
Firm size	0.0303	0.0717
	(0.0290)	(0.0489)
Firm leverage	-0.0509	0.7728
	(0.7961)	(0.7992)
Board size	**0.1161***	0.1300
	(0.0612)	(0.0803)
Board independence	2.2959	1.8854
	(1.6943)	(1.3225)
CAPEX	-0.0519	-0.0525
	(0.0464)	(0.0542)
Constant	-2.2942*	-2.7599
	(1.3787)	(1.9213)
Firm cluster	Yes	Yes
Year dummy	Yes	Yes
N	4,158	4,158
Overall R2	0.0055	0.0033

The result reveals that the board size is positively associated with the effective tax rate measured by tax expense divided by profit before tax (ETR1). It indicates that more members on the board of directors can reduce excessive tax aggressive strategy by the managers, therefore supporting the agency cost theory. The role of the board of directors is to monitor the actions of top management in a firm (Fama & Jensen, 1983). The larger capacity of board of directors enables effective monitoring tasks, and hence the addition of members directors to a board increases its ability to monitor top management (Fama & Jensen, 1983).

Discussion and Conclusion

This paper examines the tax aggressiveness of firms that have adopted IR 4.0 technologies relative to non-IR 4.0 firms. We use two measures, i.e. the ratios of tax expense and tax paid on net profit before tax, to capture the degree of tax aggressiveness. The finding is consistent with the notion that technology firms would exhibit a higher level of tax aggressiveness due to more opportunities for these firms to avoid taxes by transferring high value operations to the host country with lower tax rates (Salihu et al., 2015).

The adoption of IR4.0 enhances more efficient tax support decisions, thus making tax compliance possible and at ease. The findings will shed light on the National Industry 4WRD Policy, encouraging firms to embrace IR4.0 through various tax incentives. However, an important insight from these findings for policymakers is that while the adoption of IR4.0 is generally encouraged by the government to increase productivity, diligent caution should be exercised in evaluating such technologies, given the opportunity for international income shifting. Our findings support Hoffman's theory that firms are taking advantage of the Malaysian tax law by legally claiming capital allowances, further deduction, and other tax incentives by investing in IR4.0 tools for tax saving purposes.

Besides, the result highlights the importance of a good corporate governance mechanism to alleviate agency costs. Our findings support more members on the board of directors to effectively monitor managers from aggressive tax planning, mitigate the potential penalty imposed by the tax authority, and the potential damage to the firm reputation.

This study uses the approach of content analysis to identify firms related to 17 pillars of the IR4.0 technologies. The limitation is insufficient analysis of the other factors related to the adoption of IR4.0. It is suggested that future studies can adopt the survey approach to identify the degree of IR4.0 adoption, which would be a better indication of tax savings where high adoption companies are expected to have a better tax planning strategy compared to low adoption firms.

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