Customer-Supplier Relationships and Corporate Tax Avoidance*

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ABSTRACT

We find that close customer-supplier relationships facilitate tax avoidance by both principal customers and their dependent suppliers. Further analysis suggests that principal customer firms engage in a tax strategy involving centralized procurement by tax haven subsidiaries. Moreover, tax benefits appear to explain principal customer firms’ supply chain organization decisions. Finally, we show that close customer-supplier relationships promote the diffusion of tax avoidance knowledge from principal customers, who tend to be relatively large and sophisticated, to their dependent suppliers, who tend to be smaller and less sophisticated. Overall, our study provides evidence of the importance of tax avoidance as a source of gains from these relationships.

JEL Classification: H25, H26, L14

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1. Introduction

A fundamental principle of tax avoidance is that it can rarely be done in isolation (Scholes, Wolfson, Erickson, Hanlon, Maydew, and Shevlin, 2014). Tax avoidance almost invariably affects or is affected by relationships with other parties (Shackelford and Shevlin, 2001; Hanlon and Heitzman, 2010). Researchers have examined the influence of several important relationships on tax avoidance, including relationships with owners (Chen, Chen, Cheng, and Shevlin, 2010), employees (Chyz, Leung, Li, and Rui, 2013), joint-venture partners (Shevlin, 1987), potential acquirers (Erickson, 1998), and other firms via board interlocks (Brown, 2011). Understanding the influence of these relationships is important for explaining why such a large variation in tax avoidance exists across firms (Dyreng, Hanlon, and Maydew, 2008).

In the recent finance and accounting literature, researchers have come to stress the importance of customer-supplier relationships (e.g., Hertzel, Li, Officer, and Rodgers, 2008). However, the role of customer-supplier relationships in tax avoidance is for the most part unknown. This gap in the literature is surprising given that most prominent tax advisors, including the Big Four accounting firms (i.e., Ernst & Young, Deloitte Touche Tohmatsu, KPMG and PricewaterhouseCoopers), provide consulting services on tax efficient supply chain management, such as procurement center strategies (Gilson, Wells, Feinberg, and Newman, 2014). The strategies generally result in the shifting of income into low tax jurisdictions, an area of growing interest among researchers (Dyreng and Lindsey, 2009; Dyreng, Lindsey, and Thornock, 2013b). Indeed, tax avoidance via the supply chain has captured the attention of policy-makers, as evidenced by recent Senate hearings involving Caterpillar (U.S. Senate, 2014). According to the Senate report, Caterpillar was able to reduce its U.S. taxes by $2.4 billion by
tax planning related to its supply chain.\textsuperscript{1} The Caterpillar case received extensive coverage in the popular press such as the \textit{Wall Street Journal}, \textit{Financial Times}, and \textit{Reuters}.\textsuperscript{2} However, not every firm is able to engage in tax strategies such as the one used by Caterpillar. We posit that close customer-supplier relationships create opportunities for tax avoidance, particularly supply chain-related tax avoidance, and also facilitate the diffusion of tax avoidance knowledge across firms.\textsuperscript{3}

In the United States, firms are required to disclose the existence of their principal customers, defined as those that account for at least 10\% of a firm’s total sales. Taking advantage of this disclosure, we classify all Compustat firms into three categories: principal customer firms, dependent supplier firms, and other Compustat firms. Specifically, we define a firm as a principal customer firm if the firm is reported as a principal customer by at least one firm and a firm as a dependent supplier firm if the firm reports at least one principal customer in a specific year. All other firms that are neither principal customers nor dependent suppliers are defined as “other Compustat firms.”\textsuperscript{4} In a multiple regression framework, we examine whether firms in significant customer-supplier relationships (i.e., principal customer firms or dependent supplier firms) have a different degree of tax avoidance relative to other Compustat firms.

Besides the advantage of data availability, we focus on the \textit{principal customer-dependent supplier} relationship in our tax avoidance setting for the following reasons. First, the loss of a principal customer usually leads to a significant decline of the dependent supplier’s performance

\textsuperscript{1} See Section 3.1 for a detailed discussion of Caterpillar’s Swiss tax strategy.
\textsuperscript{3} Following prior research, we use the term “tax avoidance” to refer to the reduction of a firm’s taxes relative to its pre-tax income, with no connotation of anything improper, whereas the term “aggressive tax avoidance” refers to strategies that may fall into the grey area of the law.
\textsuperscript{4} We provide a detailed discussion of these three types of firms in Section 4. On average, 12\%, 34\%, and 57\% of Compustat firms are classified as principal customer firms, dependent supplier firms, and other Compustat firms, respectively. In addition, the overlap of principal customers and dependent suppliers is small: Only 3\% of firm-year observations are simultaneously classified as principal customer and dependent supplier firms.
given that the average sales to principal customers represent more than 35% of a dependent supplier’s total sales (Hertzel et al. 2008; Cen, Dasgupta, and Sen, 2014). On the other hand, a typical principal customer usually has many dependent suppliers and the input from each individual dependent supplier, on average, accounts for less than 1% of a principal customer’s cost of goods sold. Therefore, the loss of one particular supplier may not pose a critical threat to the principal customer. This asymmetry in mutual influence and bargaining position implies that, to avoid potential relationship disruption and termination, dependent suppliers have a strong economic incentive to cater to their big customers’ requests. For example, a dependent supplier might be less likely to question a particular transaction with a tax haven affiliate of the principal customer than would another third party firm. In the case of Caterpillar, the dependent suppliers are more likely to cooperate with its change in procurement arrangements: The suppliers have to work with CSARL (a subsidiary of Caterpillar located in Switzerland) in the financial transaction (i.e., contracts and invoicing are with CSARL) and with Caterpillar in the product transaction after the implementation of the Swiss tax strategy.

Second, the repeated interactions with important customers or suppliers requires and cultivates mutual trust and confidentiality in information sharing, which is an essential element for efficient communication and coordination (Li and Zhang, 2008). Cannon and Homburg (2001) find that better communication and coordination between customers and suppliers is associated with lower customer operating costs. We argue that the efficient communication and coordination between principal customers and dependent suppliers can also facilitate tax planning activities of these firms. Finally, the close customer-supplier relationship can facilitate the transfer of tax planning knowledge from the principal customers, who are relatively large and sophisticated, to the dependent suppliers, who tend to be smaller and less sophisticated.
The discussions above suggest that firms in close customer-supplier relationships have more opportunities to avoid taxes. Firms in these relationships, however, may have disincentives for tax avoidance. Graham, Hanlon, Shevlin, and Shroff (2014) provide survey evidence that reputation concerns affect executives’ incentives to pursue tax planning strategies. Prior archival research also finds that the public revelation of tax avoidance can damage a firm’s reputation among consumers, resulting in sales declines (e.g., Austin and Wilson, 2013; Hanlon and Slemrod, 2009). Moreover, aggressive tax planning can also increase a firm’s distress risk (e.g., Kim, Li, and Zhang, 2011). In our setting, dependent suppliers often have to make investments specific to principal customers because a large proportion of their sales depend on these large customers and the products demanded by these customers are often uniquely designed. As a result, dependent suppliers have a warranted concern over their principal customers’ reputation or distress risk because they will have difficulty in redeploying their customer-specific assets should the customers fail or their demand shrink (e.g., Hertzel et al., 2008; Kolay, Lemmon, and Tashjian, 2013). Therefore, to encourage dependent suppliers to make relationship-specific investments, principal customers can have disincentives for tax planning.

Our empirical results show that principal customer firms have significantly lower cash effective tax rates (CASH ETRs) than other Compustat firms, consistent with the prediction that principal customer firms are better able to take advantage of tax planning opportunities involving their supply chains.\textsuperscript{5} We then examine whether the result is attributable to principal customer firms’ superior bargain position over their dependent suppliers or their effective communication with these suppliers. First, we find that the number of dependent suppliers for a principal customer firm is negatively and significantly associated with the principal customer firm’s

\textsuperscript{5} All the main results are robust to the use of alternative measures of tax avoidance, including GAAP effective tax rates, long-run cash effective tax rates, simulated marginal tax rates, and the ratio of cash taxes paid to pre-tax operating cash flows.
CASH ETRs. This finding supports the bargaining power effect because principal customer firms with more dependent suppliers have relatively higher bargaining power over each individual dependent supplier. Second, we show that principal customer firms with long-term dependent suppliers have significantly lower CASH ETRs than principal customer firms without long-term dependent suppliers. This result supports the effective communication effect because repeated interactions between parties in long-term relationships reduce information asymmetry and enhance the efficiency of communication. Taken together, it appears that both the superior bargaining power effect and efficient communication effect contribute to principal customer firms’ effective tax planning.

According to the Senate investigation of Caterpillar (U.S. Senate, 2014) and articles in the tax practitioner literature (e.g., Gilson et al., 2014), customer firms can avoid taxes by shifting income to procurement subsidiaries in low-tax jurisdictions. Consistent with the argument that principal customers are better able to implement tax planning strategies involving their supply chains, we find that principal customer firms with tax haven subsidiaries and principal customer firms that mention the word “procurement” or variations thereof in their 10-K filings have lower CASH ETRs. The lowest CASH ETRs are for principal customer firms that have a tax haven subsidiary and that mention procurement in their 10-Ks: The average CASH ETR for this group of principal customers is five percentage points (20% of the mean CASH ETR) lower than other Compustat firms in our sample.

Our primary findings indicate that close customer-supplier relationships facilitate tax avoidance strategies involving supply chains. A natural follow-up question is whether tax incentives have an effect on customer-supplier relationships or supply chain organizations. A large body of corporate finance literature suggests that tax benefits explain the choice of leverage,
dividend policy, or organization form (Graham, 2003; 2006; 2013). For example, using the U.S. Bureau of Economic Analysis’ firm-level data, Desai, Foley, and Hines (2005) show that multinational firms respond opportunistically to cross-country differences in taxes and the net internal debt infusion into foreign subsidiaries increases with foreign tax rates. Extending this literature, we next offer some analysis on whether tax incentives explain the supply chain choices. Using marginal tax rate as a proxy for tax incentives, we find no evidence that firms with higher marginal tax rates in year t are more likely to become principal customer firms in year t+1.\(^6\) We find, however, that principal customer firms with higher marginal tax rates in year t are more likely to establish procurement subsidiaries in tax haven countries than principal customer firms with lower marginal tax rates. Moreover, principal customer firms with higher marginal tax rates increase the amount of purchases from dependent suppliers around the establishment of procurement subsidiaries in tax havens. Overall, although tax incentives are unlikely to be the first order determinant of close customer-supplier relationships, tax incentives appear to motivate firms in these relationships to re-structure part of their supply chains. Finally, we find that close customer-supplier relationships appear to enhance firm value through the tax channel. In particular, we show that principal customer firms with tax haven subsidiaries or centralized procurement have higher (industry-adjusted) Tobin’s Q than other Compustat firms. Principal customer firms with both tax haven subsidiaries and centralized procurement have the highest Q, a pattern consistent with the findings on tax avoidance.

We next turn to the dependent supplier firms, which are typically much smaller and less sophisticated than their principal customers. Prior research shows that tax planning ideas spread through business networks, such as board of director interlocks (Brown, 2011; Brown and Drake, \(^6\) The relationship status variable in our data is very stable and the results can be driven by the endogenous nature of marginal tax rates. Unlike the capital structure literature, an ex-ante measure of marginal tax rate (i.e., the tax rate excluding the effect of supply chain relationship on taxes) is unavailable to us.

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2014). The close ties between dependent suppliers and their principal customers can provide an avenue for the spread of information about tax avoidance activities. For example, principal customers can share their tax planning expertise (e.g., in-house tax experts or recommending external advisors) with their dependent suppliers. Consistent with dependent suppliers avoiding more taxes, we find that dependent supplier firms have significantly lower CASH ETRs than other Compustat firms. Moreover, there is a significantly negative association between a dependent supplier firm’s CASH ETRs and the proportion of total sales to its principal customers, suggesting that suppliers with stronger relationships with principal customers can avoid more taxes. In addition, dependent supplier firms with long-term principal customers have significantly lower CASH ETRs than other dependent supplier firms, suggesting that repeated communications facilitate the diffusion of tax avoidance ideas.

In further analyses, we find that dependent supplier firms’ CASH ETRs are positively associated with the CASH ETRs of their principal customers and the association is stronger when the headquarters of the dependent supplier firms are closer in geographical distance to their principal customers’ headquarters, consistent with tax information/knowledge transfer (Brown, 2011; Brown and Drake, 2014). Moreover, we show a significant reduction in supplier firms’ CASH ETRs after the relationship establishment with principal customers, relative to a sample of control firms with similar size, similar ex-ante CASH ETRs, the same industry, but without principal customers. This effect is particularly strong when the principal customers have very low ex-ante CASH ETRs, which is again consistent with the diffusion of tax avoidance knowledge from principal customers to dependent suppliers. Finally, we show that dependent supplier firms are more likely to set up foreign subsidiaries in a country if their principal customers have subsidiaries in the same country. More importantly, the colocation effect is more
pronounced if foreign subsidiaries are located in tax havens. This result provides indirect evidence that supplier firms, learning from their principal customers, avoid taxes using strategies involving tax haven subsidiaries.7

In the next section, we discuss how this study relates and contributes to the finance and tax literature. Section 3 presents the Caterpillar case and develops the hypothesis. Section 4 presents the data and measurement of key variables. Section 5 conducts main empirical analysis and several robustness checks. Section 6 examines potential mechanisms and explores several extensions. The final section concludes.

2. Related literature

Tax planning has become an increasingly important source of cash flows for U.S. corporations (Dyreng, Hanlon, Maydew, and Thornock, 2014; Mills, Erickson, and Maydew, 1998). Some researchers view tax avoidance as a financing arrangement with tax authorities that generates funds for operating and investment activities (Armstrong et al., 2012; Edwards, Schwab, and Shevlin, 2014). Our study contributes to the emerging literature on the determinants of corporate tax avoidance (Hanlon and Heitzman, 2010). Recent studies have focused on the manager-shareholder relationship by examining the effects of managerial compensation contracts, ownership structure, and corporate governance on tax avoidance (e.g., Armstrong, Blouin, and Larcker, 2012, 2013; Chen et al., 2010; Desai and Dharmapala, 2006; Phillips 2003; Rego and Wilson, 2012). We advance this literature by examining how customer-supplier relationships affect the extent of tax avoidance. Our research is also related to the findings of Rego (2003), Lisowsky (2010), and Dyreng et al. (2013b) that firms with foreign operations and subsidiaries in tax havens have more opportunities to avoid taxes. Our results suggest that firms with tax haven

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7 While our main argument is that dependent suppliers learn from principal customers, another possibility is that principal customers offer tax guidance and cooperation to attract dependent suppliers. We argue, however, this possibility is also a mechanism of tax avoidance diffusion in a broader sense.
subsidiaries and with extensive dependent-supplier networks (or firms with large corporate customers) are better able to generate tax savings than other firms with subsidiaries in tax havens.

Our research also adds to the literature of the stakeholder theory of corporate finance and accounting. One stream of research in this literature examines how information diffusion along the supply chain affects the operating and financial performance of customers and suppliers (e.g., Hertzel et al., 2008; Cohen and Frazzini, 2008). Another stream of research investigates how customer-supplier relationships affect various aspects of corporate policy or strategy, such as capital structure (Kale and Shahrur, 2007; Banerjee, Dasgupta, and Kim, 2008), corporate disclosure (Hui, Klasa, and Yeung., 2012; Cen et al., 2014), contract design (Costello, 2013), dividend policy (Wang, 2012), mergers and acquisitions (Fee and Thomas, 2004; Cen et al., 2013), and ownership structure (Fee, Hadlock, and Thomas, 2006). We extend this literature by showing that customer-supplier relationships also have a significant effect on corporate tax planning. In addition, we provide some initial evidence that close customer-supplier relationships enhance overall firm value, partially through the mechanism of effective tax planning.8

Our study is closely related to that of Banerjee et al. (2008), who show that firms in close customer-supplier relationships use less debt in their capital structure. The authors interpret their findings as evidence that firms in close customer-supplier relationships minimize distress risk to encourage relationship-specific investments. The findings of our study offer another potential explanation. Specifically, Graham and Tucker (2006) find that companies using tax shelters have less debt because shelter deductions serve as a nondebt tax shield that is substituted for debt. Thus, given the main results of our research, an explanation for the findings of Banerjee et al. (2008) is that firms in close customer-supplier relationships have more opportunities to reduce

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8 Patatoukas (2012) examines the impact of customer concentration on a supplier firm’s performance. We are the first to examine the impact of supply chain relationships on firm value from the customer side.
tax payments through other, and perhaps cheaper, mechanisms than debt tax shield, and thus have lower before-financing corporate marginal tax rates. Lower before-financing marginal tax rates, in turn, reduce the demand for debt (Graham, Lemmon, and Schallheim, 1998). However, it is important to note that our explanation does not invalidate that of Banerjee et al. (2008), and the two explanations for the lower leverage of customer/supplier firms can co-exist.

The findings of this study are also relevant for policy-makers, who have expressed concerns about such strategies but lack broad empirical evidence about them. For example, the Organisation for Economic Co-operation and Development (OECD) has recently undertaken a major initiative aimed at what it terms “base erosion” in which multinational firms are able to shift large amounts of their income into tax haven affiliates (OECD, 2013). Policy-makers in the U.S. are equally concerned, as illustrated by the U.S. Senate hearings scrutinizing individual companies (e.g., U.S. Senate, 2014). By providing rigorous empirical evidence of the influence of customer-supplier relationships on tax avoidance, we contribute to a more complete and in-depth understanding of how tax avoidance takes place and the conditions that give rise to it, both of which are necessary precursors to informed policy-making.

3. **Hypothesis development**

3.1. **Caterpillar’s tax strategy**

Before turning to our formal hypothesis, it is useful to explore actual tax strategies that firms in customer-supplier relationships have a unique advantage in structuring. In this section, we discuss the case of Caterpillar Inc. (Caterpillar), drawing mainly on the U.S. Senate report of

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9 We find that principal customer and dependent supplier firms have lower before-financing marginal tax rates than other Compustat firms.

10 In our data, we find that customer/supplier firms have lower leverage than other Compustat firms after controlling for the set of control variables as in Banerjee et al. (2008). We add before-financing marginal tax rates as an additional control variable in the regression, and find a positive and statistically significant relation between before-financing marginal tax rates and leverage. The coefficients on customer/supplier firm status, however, remain negative and statistically significant.
“Caterpillar’s Offshore Tax Strategy.” Caterpillar, a multinational corporation headquartered in the United States, is the world’s leading manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines, and diesel-electric locomotives. According to Caterpillar’s documents, while the company typically earns a small profit margin from the initial sales of its machines, its replacement parts business has a high profit margin and generates steady earnings for Caterpillar. The replacement parts, also known as “purchased finished replacement parts (PFRPs),” are produced primarily by third party suppliers. The PFRPs carry the Caterpillar brand and are packaged as Caterpillar products. While Caterpillar does not own most of its suppliers, it exercises oversight of them to maintain product quality and protect its brand. At times, Caterpillar stations its own personnel on site at supplier plants to oversee operations and promote Six Sigma compliance. Currently, approximately half of Caterpillar’s third-party PFRPs suppliers are located in the United States.

Around 1998, Caterpillar began to implement a supply chain tax strategy designed by PricewaterhouseCoopers, building on Caterpillar’s already relatively centralized procurement. As part of the strategy, Caterpillar consolidated several purchasing entities into a single Swiss subsidiary, known as Caterpillar SARL (CSARL). CSARL was to act as the global purchaser of Caterpillar replacement parts. After the implementation of the supply chain tax strategy, Caterpillar’s third party suppliers sold Caterpillar brand replacement parts directly to CSARL, which then sold them to Caterpillar or Caterpillar’s non-U.S. dealers (Figure 1). For the sales of replacement parts to non-U.S. dealers, the strategy resulted in much of the income being attributed to CSARL, and thus subject to tax in Switzerland at much lower rates than in the

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12 PricewaterhouseCoopers was paid $55 million for developing and implementing the supply chain tax strategy for Caterpillar.
United States. There are many variations on this strategy in existence, but the general idea is to make the subsidiary in the low-tax jurisdiction be responsible for high-value activities (e.g., procurement expertise) and be the residual claimant within the firm. In most cases, the goods do not physically travel through the tax haven. The key is that the high-value aspects of the procurement are centralized into the tax haven subsidiary.

The third party suppliers played an important and subtle role in Caterpillar’s supply chain tax strategy: They have to work with CSARL in the financial transaction (i.e., contracts and invoicing are with CSARL) and with Caterpillar in the product transaction (i.e., the product quality and physical inventory delivery are monitored by Caterpillar under a service license agreement between CSARL and Caterpillar). Therefore, the implementation of this strategy required a high level of coordination and trust between Caterpillar and its suppliers.

According to the Senate report, the supply chain tax strategy helps Caterpillar shift 85% or more profits of the replacement parts from the United States to Switzerland, where Caterpillar had negotiated an effective corporate tax rate of 4% to 6%. The Senate report estimated that over the period 2000 to 2012, the supply chain strategy reduced Caterpillar’s U.S. taxes by $2.4 billion. In the next section, we discuss how close customer-supplier relationships facilitate the implementation of supply chain tax strategies similar to that used by Caterpillar.

3.2. Hypothesis

In this paper, we focus on the bilateral relationship between principal customers and their dependent suppliers (e.g., Banerjee et al., 2008). For the customer side, we argue that principal

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13 Strictly speaking this is a deferral strategy. Since the ultimate parent in Caterpillar’s legal structure is a U.S. corporation, presumably at some point the income in the Swiss entity will be repatriated to the U.S. parent and subject to U.S. taxation.

14 CSARL paid Caterpillar a fee (costs plus 5%) in exchange of Caterpillar’s management and sales of replacement parts, including monitoring the third-party suppliers.

15 It took Caterpillar five years to fully implement this strategy.
customer firms can potentially avoid more income taxes because they have more opportunities and lower implementation costs in tax planning involving suppliers. Many tax strategies, such as the one used by Caterpillar, require the involvement of a third party (e.g., dependent suppliers). Principal customers have a natural advantage in implementing such tax planning transactions because of two important characteristics of the supply chain relationship. First, given that sales to principal customers always constitute a significant part of a dependent supplier’s total sales (on average 39.6% in our sample), the exit of principal customers has a devastating impact on the dependent supplier’s operating and financial performance. As a result, dependent suppliers have a strong economic incentive to cater to their big customers’ requests to avoid potential relationship disruption and termination, leading to better coordination in tax planning activities of principal customers involving their suppliers (Gallemore and Labro, 2013).

Second, a significant customer-supplier relationship with repeated transactions cultivates, and in fact requires, a high level of mutual trust between the principal customers and their dependent suppliers. One important reason is that relationship-specific investments often involve the transferring of sensitive information and technology between the two parties (e.g., Li and Zhang, 2008). For example, in training its suppliers to produce parts for a new generation of iPad or iPhone, Apple needs to have trust in its suppliers not to leak the information and technology to its competitors. In a sense, principal customers’ trust in their dependent suppliers is also grounded on their credible threat of exit: Principal customers have the confidence that their dependent suppliers will cooperate because these suppliers cannot afford the economic consequence of relationship termination. In the case of Caterpillar, the dependent suppliers were more likely to cooperate with its change in procurement arrangements (i.e., requiring Caterpillar’s suppliers of replacement parts, which are mostly U.S. suppliers, to sell to its Swiss
affiliate instead of Caterpillar U.S.). In addition, for a customer firm engaging in tax planning at the aggressive end of the tax avoidance continuum, its dependent suppliers are less likely to challenge or whistle-blow an aggressive strategy.¹⁶

The close relationship between principal customers and dependent suppliers can also benefit the supplier firms, although the supplier firms are unlikely to engage in sophisticated tax planning transactions by themselves. Because of better communication and coordination, firms in a close customer-supplier relationship can organize their bilateral trading activities in optimal tax saving ways. For example, principal customers can help their dependent suppliers to minimize taxes by arranging title transfers in zero or low tax locations where the principal customers have warehouses or subsidiaries. Moreover, the dependent suppliers can also learn from their principal customers regarding tax avoidance strategies. Because of their small size and limited resources, dependent suppliers are unlikely to be able to develop their own tax avoidance strategies. Their principal customers can be effective in sharing information and referring them to their network of tax advisors (Brown, 2011; Brown and Drake, 2014). Based on the above discussions, we predict that firms in close customer-supplier relationships can avoid more taxes.

**Hypothesis:** Principal customer firms/dependent supplier firms have lower effective tax rates than other Compustat firms, ceteris paribus.

4. Data and variable measurement

4.1. Sample and data sources

The initial sample includes all firm–year observations in the Compustat Databases over

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¹⁶The threat of whistle-blowing is very real (Bowen et al., 2010; Dyck et al., 2010). This is true even for tax strategies that have been vetted by outside tax advisors. The strategy employed by Caterpillar reportedly caught the attention of the U.S. Senate after it was disclosed in a lawsuit involving a former Caterpillar employee (U.S. Senate, 2014). Apart from the costs of attracting the scrutiny of policy-makers and tax authorities, firms appear to be wary of reputational consequences of adverse press coverage, although empirical evidence of lasting reputational effects is mixed (Gallemore et al., 2013).
the period 1994 to 2009. We start our sample from 1994 because two regulatory events likely affect the consistent measurement of our tax avoidance variables. First, FAS 109, Accounting for Income Taxes, was enacted in 1993, which changed the accounting for income taxes. Second, the U.S. statutory corporate income tax rate increased from 34% to 35% in 1994. Following prior research (e.g., Chen et al., 2010; Dyreng, Hanlon, and Maydew, 2014; Hanlon, Maydew, and Saavedra, 2013), we remove firm-year observations with negative pre-tax income or book value, with non-positive sales, or with total assets of less than $1 million.\textsuperscript{17} Firms from the financial services and utilities industries are also excluded. We then drop observations with unavailable information from Compustat in calculating our key tax avoidance variable and other control variables. These screening criteria yield a final full sample of 42,565 firm–years. Table 1 provides the sample distribution across time and industry. On average, 12%, 34%, and 57% of Compustat firms are classified as principal customer firms, dependent supplier firms, and other Compustat firms, respectively. In addition, the overlap of principal customers and dependent suppliers is small: Only 3% of firm-year observations are simultaneously classified as principal customer and dependent supplier firms.

4.2. Principal customers and dependent suppliers

Information on customer-supplier relationships is based on the Compustat Segments database. This information is publicly available, as SFAS No. 14 (before 1997) and SFAS No. 131 (after 1997) require firms (regardless of the number of segments operated) to disclose the existence and sales to principal customers representing more than 10% of total firm revenues.\textsuperscript{18}

\textsuperscript{17} We do not include firm-year observations with negative pre-tax income in our main sample because of the need for an interpretable effective tax rate. In robustness tests, we explore alternative definitions of effective tax rates that are available for observations with negative pre-tax income.

\textsuperscript{18} Some firms temporarily stopped reporting principal customers in 1998 and 1999 since it took time for them to adjust their financial reporting after the regulation had changed. However, all our results are robust to dropping observations for these two years from our sample.
We define a firm as a dependent supplier firm if it reports at least one principal customer in that year.\textsuperscript{19}

However, the database reports only the name of the principal customers without identifiers. In many cases, only the abbreviated versions of the names are reported (e.g., “GM” instead of “General Motors”), and sometimes the same customer is reported in a different form in different years and by different suppliers. Using manual search procedures, we identify and match customers to their Compustat identifier (i.e., GVKEY) whenever possible. Using the matched customer ID data, we define a firm as a principal customer firm if the firm is reported as a principal customer by at least one other firm.\textsuperscript{20}

Given our definition of principal customers, it is not surprising that most principal customers are large and mature firms with industry leadership, such as Walmart, AT&T, and Caterpillar. The median market capitalization of principal customers in our sample is $4.6 billion and their average age in Compustat is 19 years.\textsuperscript{21} The dependent supplier firms are usually much smaller and younger than their principal customers. The median market capitalization of dependent suppliers in our sample is $112.3 million and their median age in Compustat is ten years. As an example, we provide a list of dependent suppliers for Caterpillar in Appendix II. It is worth mentioning that dependent supplier firms are also smaller and younger than firms without important customer-supplier relationships (i.e., “other Compustat firms” in our sample), which have a median market capitalization of $170.3 million and a median age of 11 years.

In addition to firm size and age, the most important difference between principal

\textsuperscript{19} Our results are qualitatively unchanged if we use 15% or 20% of total sales as the threshold in defining principal customers/dependent suppliers.

\textsuperscript{20} Due to data limitations, we are not able to identify principal supplier firms in the Compustat universe. Similar to principal customers, principal suppliers can also have significant control over the supply chain and thus can avoid more taxes. However, the data limitation likely works against us finding significant results because our “other Compustat firms” may include principal suppliers.

\textsuperscript{21} Firm age is measured as the number of years since a firm was initially covered by Compustat.
customers and dependent suppliers is the strength of their bargaining powers in the customer-supplier relationships. A dependent supplier usually has only one or two principal customers whereas a principal customer, such as Walmart and AT&T, can have more than 50 dependent suppliers. \(^{22}\) Further, for a dependent supplier, the average percentage purchase from principal customers in its total sales is higher than 35%. On the other hand, for a principal customer, the average percentage of inputs from each individual dependent supplier is lower than 1% of cost of goods sold. Because of the asymmetry in the mutual importance and the difference in replaceability, it is not surprising that principal customers enjoy a much stronger bargaining position than dependent suppliers. Put differently, dependent suppliers have a much stronger incentive to retain principal customers by catering to the corporate strategies of principal customers than vice versa.

It is useful to point out that it is relatively rare for a principal customer firm to take a partial/full equity stake in its dependent suppliers. Based on the same dataset from 1988 to 2001, Fee et al. (2006) find that significant cross-holding equity stakes are present in only 3.31% of all sample relationships. In explaining this pattern, they argue that the customer-supplier relationships can be effectively governed by explicit and implicit contracts without the involvement of ownership. We argue that this pattern is also consistent with our argument above that the principal customer—dependent supplier relationship itself is a strong governing mechanism.

4.3. Key tax variable and control variables

Following prior research, we use CASH ETRs (variable name: CETR), as our main

\(^{22}\) Note that the data structure is akin to a separate “hub-and-spoke” network topology, where each principal customer firm represents a hub and its dependent suppliers represent spokes. There are generally minimal intertwinements between different networks (centered on each customer firm) because a dependent supplier usually has only one or two principal customers and the overlap of principal customers and dependent suppliers is quite small.
measure of tax avoidance. It is defined as cash taxes paid divided by pre-tax book income less special items. CASH ETR uses cash tax paid in the numerator and thus can capture tax deferral strategies that are not captured in the traditional GAAP effective tax rate (Dyreng et al., 2008). Following prior research (e.g., Dyreng et al., 2008), we winsorize CASH ETR at zero and one. We identify control variables following prior literature (e.g., Chen et al., 2010; Dyreng et al., 2008; Rego, 2003). The set of control variables include ROA, financial leverage, loss carry forward, change in loss carry forward, foreign assets, new investments, property, plant, and equipment, intangible assets, equity income in earnings, firm size, market-to-book ratio, abnormal accruals, cash holdings, and Delaware indicator. Appendix I provides detailed definitions for all the variables. All variables are measured in the same year when the tax avoidance variable is measured. Following Chen et al. (2010), we measure size and book-to-market at the beginning of the year. We include ROA, loss carry forward, and change in loss carry forward to capture firm profitability, which can affect the incentives and needs to avoid taxes. We include financial leverage to capture the effect of the tax shield of debt. Higher debt tax shields can reduce marginal tax rates and the incentives for incremental tax planning (Graham, 1996a; Graham, 1996b; Graham, 2000). We include foreign assets as a control because Rego (2003) finds that multinational firms with more extensive foreign operations have more opportunities for tax planning. We use new investments, property, plant, and equipment, intangible assets, and equity income in earnings to control for the effect of a firm’s investment activities on book-tax differences because tax and accounting rules are often different for these investments (e.g., Chen et al. 2010). We control for firm size and book-to-market ratio to capture fundamental firm characteristics following most tax avoidance research. Abnormal accruals are included to control the potential effect of earnings management on book-tax differences (e.g.,
Frank, Lynch, and Rego 2009). We also control for cash holdings to capture the incentives of tax planning. Firms with more cash can have less need to defer taxes. On the other hand, tax aggressive firms may hold more cash as a precautionary measure for future settlements with the IRS (e.g., Hanlon et al. 2013). Finally, we include a Delaware incorporation indicator because prior research argues that Delaware is a domestic tax haven (Dyreng et al., 2013b).

4.4. Descriptive statistics

Table 2 provides the descriptive statistics for our main regression variables. Column (1) of Table 2 reports the means of all variables for the full sample. Columns (2) to (4) report the means for the principal customers, dependent suppliers, and other Compustat firms, respectively. As expected, principal customer firms are generally large firms and dependent supplier firms are generally small firms, relative to other Compustat firms. An interesting pattern from the descriptive data is that dependent suppliers tend to have higher levels of foreign operations and are more likely to be incorporated in Delaware than other Compustat firms. This pattern can suggest that suppliers with foreign operations and suppliers in Delaware are more likely to be chosen by principal customers, possibly because these types of suppliers can bring more tax planning opportunities to the principal customers, among other considerations. The mean CASH ETR for the principal-customer sample is slightly lower than that for other-firm sample ($CETR = 25.6\%$ versus $CETR = 25.8\%$). On the other hand, the mean CASH ETR of dependent suppliers is discernibly lower than that of other Compustat firms ($CETR = 23.1\%$ versus $CETR = 25.8\%$). While these univariate comparisons can give us some indication of differences across firms, we rely on multiple regression analysis for more rigorous evidence.
5. Principal customers, dependent suppliers, and tax avoidance

5.1. Main results

To examine the effect of customer-supplier relationships on corporate tax avoidance, we estimate the following regression model:

\[
CETR = \alpha + \beta_1 \text{Customer Firm} + \beta_2 \text{Supplier Firm} + \Gamma X + \text{Industry FE} + \text{Year FE} + \varepsilon, \tag{1}
\]

where \(CETR\) is our (inverse) measure of tax avoidance; \(\text{Customer Firm}\) is an indicator that takes the value of one if the firm is a principal customer firm; \(\text{Supplier Firm}\) is an indicator that takes the value of one if the firm is a dependent supplier firm; The vector \(X\) represents the set of control variables as discussed in Section 4. In all regressions, we control for year and industry fixed effects.\(^{23}\) We predict \(\beta_1 (\beta_2)\) to be significantly negative, i.e., principal customer (dependent supplier) firms avoid more taxes than other Compustat firms.

Column (1) of Table 3 presents the main regression results. The \(t\)-statistics are based on standard errors adjusted for clustering on both firm and year levels. Column (1) shows that principal customer firms have lower CASH ETRs (2.4 percentage points) than other Compustat firms. For an average principal customer firm in our sample, a 2.4% lower cash tax rate translates into about $31.6 million cash tax savings annually. This statistically and economically significant result suggests that principal customer firms avoid significantly more taxes relative to other Compustat firms. As seen from Column (1), dependent supplier firms also have significantly lower cash effective tax rates than other Compustat firms. Specifically, the average CASH ETR of dependent supplier firms is 1.3 percentage points lower than that of other Compustat firms, which is also economically significant (representing 5.2% of the mean CASH ETR of the full sample).

\(^{23}\) The limited within-firm variations in our independent variables of interest prevent us from including firm fixed effects in the regression.
Turning to control variables, ROA is positively related to CASH ETRs (though statistically insignificant) and loss carry forward is negatively related to CASH ETRs, consistent with Chen et al. (2010). Leverage is negatively related to the CASH ETR measure. Firms with more foreign assets have lower CASH ETRs, albeit insignificantly. Firms with more new investments have higher CASH ETRs. Firms with more PPE, intangible assets, and equity income in earnings generally have lower CASH ETRs. Firm size is positively related to CASH ETRs and market-to-book ratio is negatively related to CASH ETRs. The relation between abnormal accruals and CASH ETRs is negative and significant. Finally, Delaware incorporation is negatively related to CASH ETRs, suggesting that firms incorporated in Delaware generally pay less cash taxes.24

5.2. Asymmetric bargaining position and communication

Principal customer firms can better implement tax avoidance strategies involving their supply chains because of their superior bargaining position and/or efficient communication with their dependent suppliers. In this section, we examine whether the main findings are attributable to the bargaining position effect or the communication effect. Toward this end, we construct two measures of the characteristics of the supply chain relationship for principal customers. The first measure is the total number of dependent suppliers for a principal customer firm, which captures the replaceability of each dependent supplier. Principal customer firms with more dependent suppliers should have greater bargaining power over each individual dependent supplier. On average, a principal customer firm has 4.5 dependent suppliers. The second measure is an indicator variable that takes the value of one if a principal customer firm has at least one long-term dependent supplier. We define a supplier to be a long-term supplier if it has been in the

24 We also estimate the regression with only a minimal set of controls (i.e., Firm Size) and find very similar results (untabulated).
customer-supplier relationship with the customer firm for at least three years. Repeated interactions between parties in long-term relationships should reduce information asymmetry and enhance the efficiency of communication. In our sample, 50.5% of principal customer firms have at least one long-term dependent supplier.

Columns (2) and (3) of Table 3 report the results. Column (2) shows a significantly negative association between CASH ETRs and the number of dependent suppliers for a principal customer firm, and column (3) shows that principal customer firms with long-term dependent suppliers avoid more taxes than principal customer firms without long-term dependent suppliers. Thus, it appears that both the asymmetric bargaining power effect and enhanced communication effect contribute to principal customer firms’ effective tax planning.

Similar to the case of customer firms, we also construct two measures of supply chain characteristics for dependent supplier firms. First, to capture the importance of principal customers to dependent supplier firms, we calculate the percentage of total sales to their principal customers. Second, we construct an indicator variable that takes the value of one if a dependent supplier firm has at least one long-term principal customer. Column (2) of Table 3 shows a significantly negative association between CASH ETRs and the proportion of total sales to principal customers, suggesting that suppliers with stronger relationships with principal customers can avoid more taxes. Column (3) of Table 3 shows that dependent supplier firms with long-term principal customers have lower CASH ETRs than supplier firms without long-term principal customers, which may indicate that repeated interactions enhance the transferring of tax avoidance knowledge. Overall, principal customer (dependent supplier) firms can avoid more taxes than other Compustat firms and the results are likely to be driven by both the asymmetric bargaining power effect and the enhanced communication effect.
5.3 Robustness checks and additional tests

5.3.1. Alternative proxies of tax avoidance

Following prior research, we use several alternative effective tax rates to measure the overall level of tax avoidance. Our first alternative effective tax rate measure is GAAP ETR (denoted by GETR), defined as total income tax expense divided by pre-tax book income less special items. GAAP ETR captures tax avoidance activities that result in permanent tax savings. However, GAAP ETR generally does not capture tax avoidance strategies that defer cash taxes because the reduction in current tax expense is offset by an increase in deferred tax expense (Hanlon and Heitzman, 2010; McGill and Outslay, 2004). Our main measure, CASH ETR, does not suffer from these problems. However, Dyreng et al. (2008) point out that the annual CASH ETR measure can suffer from a so-called mismatch problem. That is, the numerator in the CASH ETR formula can include tax paid on earnings in a different period. To alleviate this problem, Dyreng et al. (2008) develop a long-run CASH ETR measure. Following Dyreng et al. (2008), we define a long-run CASH ETR (denoted by CETR3 or CETR5) as the sum of cash tax paid over three or five years ($t$ to $t+2$ or $t$ to $t+4$) divided by the sum of pre-tax income adjusted for special items over the same accumulation period.\(^{25}\)

Both GAAP ETR and CASH ETR measures capture non-conforming tax avoidance but not conforming avoidance. Conforming tax avoidance occurs when a firm lowers its taxes by reducing both taxable income and pretax accounting income. It is possible that firms in a close customer-supplier relationship have relatively lower pressure to deliver accounting earnings than other Compustat firms, and thus, these firms can also use conforming tax avoidance strategies. As a result, GAAP ETR or CASH ETR measures can have a limitation in capturing the overall

\(^{25}\) In calculating tax rates in this section, we do not require firm-year observations to have positive pre-tax income at individual year level, except for GAAP ETR.
level of tax avoidance of these firms. To address this concern, we use a cash effective tax rate measure (denoted by $CASH\_RATIO$) that uses operating cash flows as the denominator. Specifically, the $CASH\_RATIO$ measure is defined as cash tax paid divided by pre-tax operating cash flows adjusted for extraordinary items and discontinued operations. We winsorize all effective tax rate measures at zero and one. The results in columns (1) to (4) of Table 4 show that our main findings are robust to all these alternative effective tax rate measures.

Our $CETR$ measure requires the denominator (i.e., pre-tax income) to be positive and we thus remove firm-year observations with negative pre-tax income in constructing our main sample, which may lead to sample selection bias. The long-run $CASH\_ETR$ measures suffer less from this problem since negative earnings are less common over longer periods of time. The long-run measures, however, require multiple years of data for each firm, reducing sample size. To further test the robustness of our results, we use several additional measures of tax rates that are available for firms with negative earnings. First, we use simulated marginal tax rates as additional measures of tax avoidance (Graham and Mills, 2008). Hanlon and Heitzman (2010) suggest that marginal tax rates (MTR) can be used as a comprehensive proxy of overall tax avoidance, reflecting both conforming and non-conforming tax avoidance, as well as tax deferral strategies. We use both the before and after interest expense MTRs. Second, we use a cash tax differential ($CTD$) measure developed by Henry and Sansing (2014), which is estimated as the difference between cash taxes paid and the product of statutory tax rate and pre-tax income, scaled by lagged total assets. Columns (5) to (7) of Table 4 show that all of our main results continue to hold.

5.3.2. Endogeneity

Our main empirical results show that there is a strong association between principal
customer or dependent supplier status and corporate tax avoidance. However, our results may be biased if principal customer firms or dependent supplier firms have some other firm-specific characteristics unaccounted for in our empirical model that affect both the degree of tax avoidance and a firm’s status in a customer-supplier relationship. In addition, the ability of tax avoidance may contribute to a firm’s status as a principal customer or a dependent supplier. To partially address these endogeneity issues, we use an instrumental variable approach to examine the robustness of our main results. We note, however, that it is extremely hard to find valid instruments for our endogenous variables and thus the results in this section (as well as the main results) should be interpreted with caution.

We use three instrumental variables for our two endogenous variables (i.e., Customer Firm, Supplier Firm). The first and second instrumental variables are the percentage of principal customer firms and dependent supplier firms, respectively, within a firm’s industry (Fama-French 48-industry classifications). By construction and in theory, these two variables (i.e., the industry mean of the variable Customer Firm and Supplier Firm) should have a strong positive relation with our variables of interest, and we have no clear reason to believe that these two variables have any direct impact on firm-level tax avoidance other than through the effect of firm-level status as a principal customer or a dependent supplier. Our third instrumental variable is an indicator variable that takes the value of one for firms in durable goods industries and zero for firms in other industries. We argue that firms in durable goods industries are more likely to develop close customer-supplier relationships because the products are more unique and the levels of relationship-specific investments are higher in these industries (i.e., higher required commitment). Again, in theory, we do not expect any direct relation between durable goods industry membership and firm-level tax avoidance other than through the effect of customer-
supplier relationships. Moreover, we control for industry indicators in our regression model, which can make the instruments more safely excluded from the second stage.

We conduct the two-stage least squares (2SLS) regressions using the percentage of principal customers in a firm’s industry, the percentage of dependent suppliers in a firm’s industry, and an indicator of durable goods industry membership as instruments. Our results are robust to the instrumental variable approach. We also check the validity of our instruments. The large magnitudes of $F$-statistics (much greater than the rule of thumb critical value of ten) reject the hypothesis that our instruments are jointly weak. Moreover, our over-identification tests show that the hypothesis that the instruments are jointly exogenous cannot be rejected.

In our main tests we use all other Compustat firms as the control sample. To further examine the robustness of our main results, we also use a propensity score matched control sample to re-examine our hypothesis and find that all the main results remain qualitatively unchanged. Overall, we conclude that our main results are unlikely to be simply driven by omitted variables or reverse causality.

6. Potential mechanisms and extensions

In this section, we examine the mechanisms by which firms in close customer-supplier relationships avoid taxes. In addition, we explore an interesting follow-up question of whether potential tax benefits explain firms’ supply chain organizations. Finally, we examine whether close customer-supplier relationships enhance firm value through the tax channel.

6.1. Customer firms

6.1.1. Tax avoidance mechanisms: The procurement strategy

While there are many structured tax planning transactions that firms can use to reduce their effective tax rates, we empirically test a potential mechanism in this section that is likely to
be attractive to principal customers – establishing centralized procurement companies that are incorporated in tax haven countries. Principal customer firms are more likely to centralize procurement because they are better able to leverage economies of scale and take advantage of bulk discounts (American Productivity and Quality Center, 2014). In addition, by shifting part of their corporate profits to offshore procurement centers incorporated in tax haven countries, as in the case of Caterpillar, companies can substantially reduce their U.S. tax burdens. Although our case study focuses on external transactions of Caterpillar with their dependent suppliers, the strategy also involves coordination of internal transactions (transfer pricing). For example, to transfer profits, the procurement subsidiary sells replacement parts at a profit to Caterpillar’s other subsidiaries. This transaction requires internal coordination between the procurement subsidiary and the firm’s other subsidiaries. However, as discussed, implementing the strategy also requires coordination with external parties (i.e., external suppliers have to deal with the new centralized procurement entity from a tax haven).

To empirically identify firms with procurement centers in tax havens, we rely on textual analysis on firms’ annual reports to define two variables, *Procurement* and *Tax Haven Subs*. *Procurement* is an indicator that takes the value of one if the annual report (i.e., 10-K) of a firm mentions the words “procure” or “procurement” in a specific year. We use this variable to proxy for the likelihood that a firm has a procurement center in a specific year. According to this proxy, 40.1% of principal customers, 34.8% of dependent suppliers, and 27.5% of other firms belong to the group with a high likelihood of operating a procurement center. As a confirmation, in the case of Caterpillar, procurement-related words were mentioned in its financial report starting

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26 The existence of measurement errors in the variable *Procurement* is somewhat obvious. However, we do not have a better way to identify procurement centers for a firm. One can expect that the noise in the procurement variable works against us finding any significant results. Note also that the regression specification with only the more accurate variable, *Tax Haven Subs* (i.e., Column (2) of Table 5), can provide partial evidence supporting the procurement through tax haven subsidiaries strategy.
from 1998, which is about the time when Caterpillar started its procurement center tax strategy. *Tax Haven Subs* is an indicator variable that takes the value of one if a firm has at least one subsidiary in a tax haven country, as defined by Dyreng and Lindsey (2009). 46.6% of principal customer firms, 27.0% of dependent supplier firms, and 22.6% of other firms have at least one tax haven subsidiary.

Table 5 reports the results when we classify customer firms into different types based on *Procurement* and *Tax Haven Subs*. Column (1) reports the results when we classify customer firms into two types, *PC with Procurement* and *PC with No Procurement*. It shows that both types of customer firms have lower CASH ETRs than other Compustat firms; and *PC with Procurement* has lower CASH ETRs than *PC without Procurement* (the difference is 2.3 percentage points and statistically significant at the five percent level). Column (2) reports the results when we classify customer firms into another two types, *PC with Tax Haven Subs* and *PC with No Tax Haven Subs*. It shows that both types of firms have lower CASH ETRs than other Compustat firms (though the coefficient is only statistically significant for *PC with Tax Haven Subs*). In addition, *PC with Tax Haven Subs* has lower CASH ETRs than *PC without Tax Haven Subs* (the difference is 3.2 percentage points and statistically significant at the one percent level).

Column (3) reports the result when we classify customer firms into four types, *PC with Procurement & Tax Haven Subs* (21.8% of customer firms), *PC with Procurement & No Tax Haven Subs* (15.5% of customer firms), *PC with No Procurement & Tax Haven Subs* (21.6% of customer firms), and *PC with No Procurement & No Tax Haven Subs* (41.1% of customer firms). It shows that *PC with Procurement & Tax Haven Subs* has the lowest cash effective tax rate among the four types of customer firms. Specifically, average CASH ETR of principal customers *with Procurement & Tax Haven Subs* is 4.4 percentage points lower than that for firms with no
customer-supplier relationships, which translates to a 17.6% reduction of CASH ETR based on its mean level in the full sample. The coefficient of $\text{Procurement} \times \text{Tax Haven Subs}$ is -0.016 and statistically significant at the one percent level, consistent with the notion that firms generally require some centralized transfer pricing scheme (as opposed to a decentralized, negotiated transfer prices) to exploit tax savings opportunities with internal transactions. However, the coefficient of $PC \times \text{Procurement & Tax Haven Subs}$ (-0.044) suggests that due to better control and communication along the supply chain, principal customer firms are better able to utilize centralized procurement centers in tax havens to avoid taxes than other firms. Overall, with some caveats of the measurement error in $\text{Procurement}$, the results in Table 5 are consistent with the conjecture that offshore procurement in tax haven countries is one of the potential mechanisms through which customer firms reduce their corporate taxes.27

Finally, in an untabulated test, we repeat our tests in Table 5 by partitioning the sample based on whether a customer firm purchases from manufacturing industries (i.e., SIC 4-digit from 2000 to 3999) or not. Because offshore procurement usually involves the procurement of goods rather than services, its effect on customer firms’ tax avoidance is limited when suppliers are from non-manufacturing industries. Consistent with this prediction, we find that the results in Table 5 are mainly driven by the subsample of customer firms with suppliers from manufacturing industries.

6.1.2. Tax incentives and supply chain organizations

Our primary findings indicate that close customer-supplier relationships facilitate tax avoidance. A natural follow-up question is whether the potential tax benefits affect how firms organize their supply chains. In this sub-section, we examine several aspects of how taxes can

27 All the results are qualitatively unchanged if we use the alternative tax avoidance measures discussed in Section 5.2.
affect the organization of the supply chain. We begin with the basic decision of whether to enter into a principal customer-dependent supplier relationship. Note that this test does not focus on how the firm organizes its affairs to take advantage of the relationship, just whether it enters into a relationship. We actually do not expect tax avoidance to have a first-order effect in this test. For example, a firm’s decision to become a dependent supplier to Walmart is more likely to be driven by fundamental business issues than tax avoidance. Consistent with our prediction, we find that the likelihood of a firm entering into a customer-supplier relationship is not significantly influenced by its marginal tax rate (untabulated).

We next examine whether tax benefits can explain how the supply chain is organized, conditional on being in a customer-supplier relationship. Here is where we expect tax benefits to play an important role. In particular, we examine a firm’s decisions to centralize its procurement function and do so via a tax haven, as well as the concentration of the firm’s procurement in dependent suppliers.

In Tables 6 and 7 we examine whether tax avoidance incentives affect how firms organize their supply chains, conditional on being in a customer-supplier relationship. Table 6 examines centralization of the procurement function via a tax haven subsidiary. It reports the estimates from linear probability models on how the marginal tax rate (as a proxy for tax incentives) and the status of customer-supplier relationship interactively affect a firm’s decision of taking tax-haven procurement strategy. The dependent variable in columns (1) and (2), $Tax\ Haven\ Subs_{t+1}$, is a dummy variable that is equal to one if a firm has at least one subsidiary in tax haven countries/regions in year $t+1$; the dependent variable in columns (3) and (4), $Procurement_{t+1}$, is a dummy variable that is equal to one if the annual report (i.e., 10-K) of a firm mentions the words “procure” or “procurement” in year $t+1$; the dependent variable in columns
(5) and (6), *Procurement & Tax Haven Subs*, is a dummy variable that equals one if both *Procurement* and *Tax Haven Subs* are equal to one for year $t+1$. To ensure that our results reflect initiations of procurement and tax haven strategies in year $t+1$, in each specification we exclude observations where the dependent variable corresponding to year $t$ is equal to one. All independent variables, as defined in Appendix I, reflect information in year $t$. We control for industry and the year fixed effects in all specifications.

Columns (1) and (2) of Table 6 show that principal customer firms with stronger tax incentives (i.e., higher marginal tax rates) in year $t$ are more likely to establish subsidiaries in tax haven countries in year $t+1$ than principal customer firms with weaker tax incentives (i.e., lower marginal tax rates). Columns (3) and (4) show that centralized procurement is more likely among principal customer firms facing a high marginal tax rate than for principal customer firms facing a low marginal tax rate. Finally, columns (5) and (6) show that principal customer firms with stronger tax incentives in year $t$ are more likely to establish procurement subsidiaries in tax haven countries in year $t+1$ than principal customer firms with weaker tax incentives.

Table 7 examines whether the adoption of tax-haven procurement strategy affects the strength of customer-supplier relationships. We measure the strength of customer-supplier relationships by the percentage of inputs purchased from dependent suppliers to total cost of goods sold. The dependent variable in columns (1) and (2), $\Delta \text{Purchase from All Suppliers}$, is the change in the percentage of inputs purchased from all dependent suppliers to total cost of goods sold (COGS) between year $t$ and year $t+1$. The dependent variable in columns (3) and (4), $\Delta \text{Purchase from Existing Suppliers}$, is the change in the percentage of inputs purchased from existing dependent suppliers (i.e., excluding new suppliers in year $t+1$) to cost of goods sold (COGS) between year $t$ and year $t+1$. We define year $S$ as the first year when a firm adopts the strategy.

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28 This requirement results in different numbers of observations across the three different dependent variables.
tax-haven procurement strategy (here, we require that Procurement & Tax Haven Subs must equal to 0 from year S-3 to year S-1 and equal to 1 in at least two years from year S to year S+2). Pre_Adoption(S-3,S-1) is a dummy variable that is equal to one if a firm will adopt tax-haven procurement strategy in the following three years and zero otherwise; Post_Adoption(S,S+2) is a dummy variable that is equal to 1 if a firm adopted the tax-haven procurement strategy within the last three years and zero otherwise. All other independent variables, as defined in Appendix I, reflect information in year t. We partition the entire sample into two equal sub-groups according to the level of marginal tax rates and run regressions in two sub-groups. We compare the coefficients of Pre_Adoption(S-3,S-1) and Post_Adoption(S,S+2) estimated from two sub-groups with statistical tests.

The results in Table 7 show that the coefficients of Pre_Adoption(S-3,S-1) and Post_Adoption(S,S+2) are both positive and statistically significant for the sub-group with higher marginal tax rates, and the difference in coefficients between the two sub-groups is positive and statistically significant. These results suggest that adoption of centralized tax-haven procurement by high marginal tax rate firms leads to increased concentration of purchases from dependent suppliers. Taken together, tax incentives appear to motivate firms in customer-supplier relationships to re-structure part of their supply chains.

6.1.3. Customer-supplier relationships and firm valuation

We next examine the effect of tax avoidance from customer-supplier relationships on firm value, as reflected in Tobin’s Q. Table 8 presents the estimates of OLS regressions of firm value on the status in customer-supplier relationships and offshore procurement in tax-haven countries/regions. The dependent variable in columns (1) to (3) is a firm’s Tobin’s Q. The dependent variable in columns (4) to (6) is the adjusted Tobin’s Q, defined as Tobin’s Q minus its
industry median of that year. Detailed definitions of all independent variables are provided in Appendix I. We find that close customer-supplier relationships enhance firm value, and the effect appears to be partially driven by the tax channel. In particular, we show that principal customer firms with tax haven subsidiaries or centralized procurement have higher (industry-adjusted) \( Tobin's \ Q \) than other Compustat firms. Principal customer firms with both tax haven subsidiaries and centralized procurement have the highest \( Tobin's \ Q \), a pattern consistent with the findings on tax avoidance.

6.2. Supplier firms

6.2.1. Tax avoidance diffusion along the supply chain

In this section, we empirically test a potential explanation of the lower cash effective tax rates for supplier firms – tax avoidance knowledge diffusion along the supply chain. If dependent suppliers obtain tax avoidance knowledge from their principal customers, the effective tax rates of the customer-supplier pair should be positively correlated. In addition, such a positive correlation should be stronger when the cost of knowledge diffusion is lower. We use the distance between the customer firm and the supplier firm to measure the cost of diffusion because prior literature argues that proximity to trade partners facilitates the communication of soft information (e.g., Costello, 2013; Cannon and Homburg, 2001).\(^{29}\) For this test, the dataset is at the relationship-year level instead of the firm level. The specification is:

\[
\text{Supplier's CETR} = \alpha + \beta_1 \text{Customer's CETR} + \beta_2 (\text{Customer's CETR} \times \text{Distance}) + \beta_3 \text{Distance} + \Gamma X + \text{Industry FE} + \text{State FE} + \text{Year FE} + \epsilon, \tag{2}
\]

where \( \text{Supplier's CETR} \) is the CASH ETR for the dependent supplier firm; \( \text{Customer's CETR} \) is the CASH ETR for the corresponding principal customer firm; \( \text{Distance} \) is the geographical

\(^{29}\) As an example, many of Caterpillar’s suppliers are located in the United States in close proximity to the Caterpillar manufacturing plants that produce its machines.
distance between the supplier firm and its customer firm based on the Zip codes of the headquarters. The vector $X$ represents the set of control variables related to the supplier firm’s characteristics. In all regressions, we control for suppliers’ industry, state, and time fixed effects. We include the state fixed effects to ensure that the positive association between the effective tax rates of the customer-supplier pair is not driven by common state tax rates. We predict $\beta_1$ to be significantly positive and $\beta_2$ to be significantly negative.

Table 9 presents the results. Consistent with the diffusion story, we find a positive association between a supplier’s CASH ETR and its principal customer’s CASH ETR. In addition, the positive association is stronger when the geographical distance between the customer firm and the supplier firm is shorter. The positive association of tax avoidance between dependent supplier firms and their principal customers is consistent with the conjecture that tax avoidance knowledge diffuses along the supply chain. However, this result can suffer from the following concerns. First, it is not clear whether the positive association of tax avoidance between customer firms and supplier firms suggests a uni-directional diffusion of tax avoidance knowledge from customers to suppliers, instead of vice versa. Second, the positive correlation of CASH ETRs between customers and suppliers can also be consistent with the principal customers picking dependent suppliers with similar tax avoidance levels. Third, the geographic proximity results can be caused by unobserved correlation in tax circumstances not controlled for by the fixed effects.

We address the above concerns using a difference-in-differences approach around the establishment of customer-supplier relationships.\textsuperscript{30} Relationship establishment is defined as the event year $t$ in which a firm reports a principal customer for the first time. Since the diffusion of

\textsuperscript{30} In spirit, one can do a similar test around relationship terminations. However, relationship terminations usually lead to a devastating effect on suppliers’ operating performance (see Cen et al., 2014), which can make tax avoidance less relevant.
tax avoidance in the supply chain involves a gradual learning process, we require that the relationship lasts for at least 2 years (i.e., year \( t+1 \) and year \( t+2 \)) in this test. Accordingly, the pre-establishment period is year \( t-2 \) (i.e., 2 years before the principal customer is first reported) and the post-establishment period is year \( t+2 \) (i.e., 2 years after the principal customer is first reported). We combine the observation at year \( t-2 \) for the pre-establishment period and that at year \( t+2 \) for the post-establishment period for each relationship establishment into one pair.

Table 10 presents the diff-in-diff tests. The dependent variable in Columns (1)-(3) of Table 10 is CASH ETR, the cash effective tax rate of dependent suppliers; the dependent variable in Columns (4)-(6) of Table 10 is Adj. CETR, the adjusted cash effective tax rate of dependent suppliers. The Adj. CETR is the difference between CETR and the average CETR of benchmark firms that are neither principal customers nor dependent suppliers between year \( t-2 \) and \( t+2 \). We require that, in year \( t-2 \), the incumbent supplier and the benchmark firms must belong to the same size and CASH ETR quintiles in the same industry. This adjustment allows us to isolate the changes of CASH ETR from those driven by industry trend. The key independent variable, After Relationship Establishment, is a dummy variable that equals zero for the pre-establishment period and one for the post-establishment period. In addition, we also include all time-varying control variables in our main specification (i.e., Table 3) in this test.\(^{31}\)

We require that all information for the dependent and independent variables be available, resulting in 543 relationship establishments (i.e., 1086 observations with 2 observations for each relationship establishment) in this test. To control for unknown common factors for each relationship establishment, we add the pair fixed effects for each relationship establishment in all specifications reported in Table 10.

\(^{31}\) In fact, the only control variable we dropped here is Delaware, since the state of incorporation usually does not change after the relationship establishment.
The results in Column (1) of Table 10 suggest that, after relationship establishment with principal customers, the CASH ETRs of dependent suppliers decrease by 2.5 percentage points on average. After incorporating the differences between our treatment firms (i.e., incumbent suppliers experiencing relationship establishment in year $t$) and benchmark firms (i.e., firms of similar size and CASH ETR ex ante in the same industry but with no principal customers in the period from $t-2$ to $t+2$), the results in Column (4) confirm that the reduction in CASH ETRs is not driven by common industry trends or common factors that affect firms with similar size or similar tax rates before the relationship establishment.

We further partition our relationship establishment sample into two groups based on the CASH ETRs of principal customers. Specifically, when a customer’s CASH ETR is lower than the 25th percentile in the distribution for the industry in a specific year, we define this customer as a low tax firm. According to this definition, 206 relationship establishments (i.e., 412 observations) are classified into the low tax group and others are classified into the normal and high tax group. Our results in Columns (2) and (3) suggest that the reduction in a supplier’s CASH ETRs around the relationship establishment is conditional on whether the principal customer has a low tax rate. For example, suppliers establishing relationships with principal customers in the low tax group have a CASH ETR reduction of 4.5 percentage points, which is statistically significant at the 5% level. On the other hand, supplier firms establishing relationships with principal customers in the normal and high tax group have a reduction in CASH ETR of only one percentage point, which is insignificant statistically. Again, results in Columns (5) and (6) confirm that this result is not driven by industry trends or common characteristic-related factors associated with size or tax rate before the relationship establishment.

Using a similar approach (untabulated), we find that the change in CASH ETRs of
principal customers around the relationship establishments is not conditional on the tax rates of incumbent suppliers before the relationship establishment. Taken together, the results suggest that tax planning knowledge is more likely to diffuse from principal customers to dependent suppliers, but not vice versa.

6.2.2. Tax incentives and colocation choices of foreign subsidiaries in the supply chain

A natural question arising from the above analysis is how supplier firms are able to avoid tax in a cost effective manner. To shed light on this question, we test one channel that is related to the procurement strategy of customer firms. Specifically, we test whether supplier firms are more likely to set up foreign subsidiaries in the country where their principal customers have subsidiaries, especially for tax havens. By doing so, supplier firms can potentially book sales to their principal customers in those tax havens and justify the business purpose of such transactions by referring to the “location” of their principal customers.

For each year $t$ between 1994 and 2009, we match all supplier firms with all possible foreign countries/regions identified in Dyreng and Lindsey (2009). We estimate the following linear probability model (LPM) of supplier firms’ location choices of foreign subsidiaries:

$$\text{Supplier Subsidiary} = \alpha + \beta_1 \text{Customer Subsidiary} + \beta_2 (\text{Customer Subsidiary} \times \text{Tax Haven})$$

$$+ \beta_3 \text{Tax Haven} + \Gamma X + \text{Firm FE} + \text{Year FE} + \epsilon.$$  

(3)

where $\text{Supplier Subsidiary}$ is a dummy variable that is equal to one if a supplier operates a subsidiary in this country in year $t$, and zero otherwise; $\text{Customer Subsidiary}$ is a dummy variable that is equal to one if at least one of the principal customers of this supplier operates a subsidiary in this country in year $t$, and zero otherwise; $\text{Tax Haven}$ is a dummy variable that is equal to one if this country/region is defined as a tax haven in Dyreng and Lindsey (2009). The

---

32 Thus, the total number of observations in the model roughly equals the number of supplier firms times the number of foreign countries/regions identified in Dyreng and Lindsey (2009).
vector $X$ represents the set of control variables related to country characteristics that attract foreign investment from U.S. firms, including the distance between the U.S. and this country ($\log(\text{Distance to USA})$), local English literacy ($\log(\text{GDP Per Capita})$), GDP per capita ($\log(\text{GDP Per Capita})$), GDP growth rate ($\log(\text{GDP Growth Rate})$), import growth rate ($\log(\text{Import Growth Rate})$), inflation rate ($\log(\text{Inflation Rate})$) and labor force ($\log(\text{Labor Population})$). We include firm and year fixed effects. We predict both $\beta_1$ and $\beta_2$ to be significantly positive.

Table 11 presents the results. In this test, we require that the supplier does not have a subsidiary in this country/region in year $t-1$. This sample selection rule ensures that our results are not driven by existing subsidiaries in tax haven countries/regions. Specifically, if $\text{Supplier Subsidiary}$ is equal to one in year $t$, it must be driven by a new establishment of subsidiary in the country in year $t$. In all specifications, both the coefficient of $\text{Customer Subsidiary}$ and that of $\text{Customer Subsidiary} \times \text{Tax Haven}$ are positive and statistically significant at the one percent level. The results suggest that dependent supplier firms are more likely to set up foreign subsidiaries in a country if their principal customers have subsidiaries in the same country, and that the colocation effect is more pronounced if foreign subsidiaries are located in tax havens. While this result is consistent with the conjecture that dependent suppliers learn from principal customers, it does not rule out the possibility that principal customers offer tax guidance and cooperation (as part of implicit or explicit contracts) to attract or support dependent suppliers. We argue, however, this possibility is also a mechanism of tax avoidance diffusion in a broader sense.

7. Conclusion

Despite the central importance of customer-supplier relationships to many facets of firm behavior, they have been largely ignored in extant tax literature. Our study fills this void by
investigating the effect of customer-supplier relationships on tax avoidance. Consistent with the conjecture that firms in close customer-supplier relationships have more tax planning opportunities and lower tax planning costs, we find that principal customer firms and dependent supplier firms in the Compustat database have lower CASH ETRs than other Compustat firms. In addition, we explore two potential mechanisms through which customer firms and supplier firms reduce their tax rates. We find that customer firms with offshore procurement centers based in tax haven countries have the lowest cash effective tax rates among all customer firms. We also show that dependent supplier firms’ CASH ETRs decline significantly after the establishment of relationship with a principal customer, especially when the principal customer has a low ex-ante CASH ETR. Moreover, tax benefits appear to explain firms’ supply chain organization decisions. Our study extends the recent tax avoidance literature from the shareholder-manager relationship to the customer-supplier relationship. The results also have important implications for tax authorities and policy-makers.
References


APPENDIX I Variable Definitions

<table>
<thead>
<tr>
<th>Key Tax Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CETR</td>
<td>Cash Effective Tax Rate: TXPD/(PI-SPI).</td>
</tr>
<tr>
<td>AF_MTR</td>
<td>Simulated marginal tax rate after interest expense deduction (Graham and Mills, 2008).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Customer-Supplier Relationship Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Firm</td>
</tr>
<tr>
<td>Supplier Firm</td>
</tr>
<tr>
<td>Customer Firm with Long-term Suppliers</td>
</tr>
<tr>
<td>Supplier Firm with Long-term Customers</td>
</tr>
<tr>
<td>Customer Firm’s N of Dependent Suppliers</td>
</tr>
<tr>
<td>Supplier Firm’s Sales to Principal Customers</td>
</tr>
<tr>
<td>Procurement</td>
</tr>
<tr>
<td>Tax Haven Subs</td>
</tr>
<tr>
<td>PC with Procurement</td>
</tr>
<tr>
<td>PC with No Procurement</td>
</tr>
<tr>
<td>PC with Tax Haven Subs</td>
</tr>
<tr>
<td>PC with No Tax Haven Subs</td>
</tr>
<tr>
<td>PC with Procurement &amp; Tax Haven Subs</td>
</tr>
<tr>
<td>PC with Procurement &amp; No Tax Haven Subs</td>
</tr>
<tr>
<td>PC with No Procurement &amp; Tax Haven Subs</td>
</tr>
</tbody>
</table>
PC with No Procurement & No Tax Haven Subs

An indicator that takes the value of one if a customer firm’s annual report (i.e., 10-K) does not mention the words “procure,” “procurement” or “procurement center” in a specific year and it does not have any subsidiary in a tax haven country as defined by Dyreng and Lindsay (2009).

Distance

The distance between the customer firm and the supplier firm based on the Zip codes of the headquarters.

Control Variables

ROA

Return on assets, calculated as pre-tax income (PI) divided by lagged total assets (AT).

Leverage

Financial leverage at the end of the year, calculated as long-term debt (DLTT) scaled by total assets (AT).

Loss Carryforward

An indicator variable that equals one if net operating loss carryforwards is positive (Compustat: TLCF).

Change in Loss Carryforward

Change in net operating loss carryforwards (Compustat TLCF) scaled by lagged total assets (AT).

Foreign Assets

Foreign assets, estimated following Oler et al. (2007).

New Investments

New investment, calculated as Compustat (XRD+CAPX+AQC-SPPE-DPC), scaled by lagged total assets (AT).

Property, Plant, and Equipment

Net property, plant, and equipment at the end the year, calculated as Compustat PPENT scaled by lagged total assets (AT).

Intangible Assets

Intangible assets at the end of the year, calculated as Compustat INTAN scaled by lagged total assets (AT). If INTAN = ‘C’, then INTAN = GDWL.

Equity Income in Earnings

Equity income in earnings, calculated as Compustat ESUB scaled by lagged total assets (AT).

Firm Size

The natural logarithm of market value of equity at the end of the year, calculated as Compustat PRCC_F ×CSHO.

Market-to-Book

Market-to-book ratio at the end of the year, calculated as the market value of equity (Compustat PRCC_F ×CSHO) divided by the book value of equity (Compustat CEQ).

Abnormal Accruals

The absolute value of discretionary accruals, estimated from the performance-adjusted modified cross-sectional Jones model.

Cash Holdings

Cash holdings at the end of the year, calculated as Compustat CHE scaled by lagged total assets (AT).

Delaware

An indicator variable that is equal to one if a firm is incorporated in Delaware, and zero otherwise.

Log(Total Assets)

The natural logarithm of book value of total assets.

Log(Age)

The natural logarithm of one plus firm age in Compustat (i.e., the number of years since a firm first appears in Compustat database).

SP500

An indicator variable that is equal to one if a firm is a S&P 500 index constituent, and zero otherwise

Log(Distance to USA)

The natural logarithm of one country’s distance to the U.S.A., according to the estimation of Google Map.

English Speaking

Percentage of English speaking population provided by Wikipedia.
Log(GDP Per Capita)  The natural logarithm of GDP Per Capita (based on 2005 US Dollar) of a country/region, from World Bank’s “Countries and Economies” databank.

GDP Growth Rate  Annual GDP growth rate of a country/region, from World Bank’s “Countries and Economies” databank.

Import Growth Rate  Annual import growth rate of a country/region, from World Bank’s “Countries and Economies” databank.

Inflation Rate  Annual inflation rate of a country/region based on consumer price index (CPI), from World Bank’s “Countries and Economies” databank.

Log(Labor Population)  The natural logarithm of labor population of a country/region, from World Bank’s “Countries and Economies” databank.

**Other Tax Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GETR</td>
<td>GAAP Effective Tax Rate, TXT/(PI-SPI).</td>
</tr>
<tr>
<td>CETR3</td>
<td>Three-year Cash ETR: TXPD/(PI-SPI). Both TXPD and (PI-SPI) are cumulated over three years before calculation.</td>
</tr>
<tr>
<td>CETR5</td>
<td>Five-year Cash ETR: TXPD/(PI-SPI). Both TXPD and (PI-SPI) are cumulated over five years before calculation.</td>
</tr>
<tr>
<td>CASH_RATIO</td>
<td>Cash ratio: TXPD/(OANCF+TXPD-XIDOC).</td>
</tr>
<tr>
<td>BF_MTR</td>
<td>Simulated marginal tax rate before interest expense deduction (Graham and Mills, 2008).</td>
</tr>
<tr>
<td>CTD</td>
<td>Cash tax differential: TXPD-0.35*(PI-SPI), scaled by lagged total assets (AT).</td>
</tr>
</tbody>
</table>
## APPENDIX II A List of Dependent Suppliers for Caterpillar

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Supplier Name</th>
<th>Sales to Caterpillar</th>
<th>Total Sales</th>
<th>Pct Sales to Caterpillar</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>DONALDSON CO INC</td>
<td>69.107</td>
<td>593.503</td>
<td>11.64%</td>
</tr>
<tr>
<td>1994</td>
<td>NEW BASTION DEVELOPMENT INC</td>
<td>10.519</td>
<td>21.946</td>
<td>47.93%</td>
</tr>
<tr>
<td>1994</td>
<td>RAYTECH CORP</td>
<td>26.818</td>
<td>167.615</td>
<td>16.00%</td>
</tr>
<tr>
<td>1994</td>
<td>TWIN DISC INC</td>
<td>18.355</td>
<td>141.193</td>
<td>13.00%</td>
</tr>
<tr>
<td>1994</td>
<td>SCHWITZER INC</td>
<td>41.383</td>
<td>153.271</td>
<td>27.00%</td>
</tr>
<tr>
<td>1994</td>
<td>ATCHISON CASTING CORP</td>
<td>12.292</td>
<td>82.519</td>
<td>14.90%</td>
</tr>
<tr>
<td>1995</td>
<td>DONALDSON CO INC</td>
<td>88.199</td>
<td>703.959</td>
<td>12.53%</td>
</tr>
<tr>
<td>1995</td>
<td>NEW BASTION DEVELOPMENT INC</td>
<td>11.412</td>
<td>22.353</td>
<td>51.05%</td>
</tr>
<tr>
<td>1995</td>
<td>RAYTECH CORP</td>
<td>24.850</td>
<td>177.498</td>
<td>14.00%</td>
</tr>
<tr>
<td>1995</td>
<td>TWIN DISC INC</td>
<td>19.708</td>
<td>164.232</td>
<td>12.00%</td>
</tr>
<tr>
<td>1995</td>
<td>ATCHISON CASTING CORP</td>
<td>18.611</td>
<td>141.579</td>
<td>13.15%</td>
</tr>
<tr>
<td>1996</td>
<td>DONALDSON CO INC</td>
<td>91.668</td>
<td>833.348</td>
<td>11.00%</td>
</tr>
<tr>
<td>1996</td>
<td>NEW BASTION DEVELOPMENT INC</td>
<td>15.368</td>
<td>25.194</td>
<td>61.00%</td>
</tr>
<tr>
<td>1996</td>
<td>RAYTECH CORP</td>
<td>32.827</td>
<td>234.475</td>
<td>12.41%</td>
</tr>
<tr>
<td>1996</td>
<td>MORTON INDUSTRIAL GRP INC</td>
<td>119.445</td>
<td>151.196</td>
<td>79.00%</td>
</tr>
<tr>
<td>1998</td>
<td>ACTIVE POWER INC</td>
<td>29.976</td>
<td>251.966</td>
<td>11.90%</td>
</tr>
<tr>
<td>1998</td>
<td>NEW BASTION DEVELOPMENT INC</td>
<td>30.716</td>
<td>247.464</td>
<td>12.41%</td>
</tr>
<tr>
<td>1998</td>
<td>RAYTECH CORP</td>
<td>4.677</td>
<td>92.368</td>
<td>60.00%</td>
</tr>
<tr>
<td>1999</td>
<td>A S V INC</td>
<td>8.914</td>
<td>50.081</td>
<td>17.80%</td>
</tr>
<tr>
<td>2000</td>
<td>RAYTECH CORP</td>
<td>31.139</td>
<td>239.532</td>
<td>13.00%</td>
</tr>
<tr>
<td>2000</td>
<td>ACTIVE POWER INC</td>
<td>4.048</td>
<td>71.091</td>
<td>57.00%</td>
</tr>
<tr>
<td>2001</td>
<td>TECHNOLOGY SOLUTIONS CO</td>
<td>14.779</td>
<td>92.368</td>
<td>16.00%</td>
</tr>
<tr>
<td>2001</td>
<td>A S V INC</td>
<td>14.023</td>
<td>44.237</td>
<td>31.70%</td>
</tr>
<tr>
<td>2002</td>
<td>ACTIVE POWER INC</td>
<td>10.910</td>
<td>13.499</td>
<td>81.00%</td>
</tr>
<tr>
<td>2002</td>
<td>COMMERICAL VEHICLE GROUP INC</td>
<td>31.947</td>
<td>298.678</td>
<td>10.70%</td>
</tr>
<tr>
<td>2003</td>
<td>TECHNOLOGY SOLUTIONS CO</td>
<td>5.020</td>
<td>45.640</td>
<td>11.00%</td>
</tr>
<tr>
<td>2003</td>
<td>A S V INC</td>
<td>52.049</td>
<td>96.387</td>
<td>54.00%</td>
</tr>
<tr>
<td>2003</td>
<td>ACTIVE POWER INC</td>
<td>5.334</td>
<td>8.890</td>
<td>60.00%</td>
</tr>
<tr>
<td>2003</td>
<td>COMMERICAL VEHICLE GROUP INC</td>
<td>31.255</td>
<td>287.579</td>
<td>10.87%</td>
</tr>
<tr>
<td>2004</td>
<td>RAYTECH CORP</td>
<td>26.968</td>
<td>227.313</td>
<td>11.86%</td>
</tr>
<tr>
<td>2004</td>
<td>WOODWARD INC</td>
<td>83.562</td>
<td>709.805</td>
<td>11.77%</td>
</tr>
<tr>
<td>2005</td>
<td>COMMERCIAL VEHICLE GROUP INC</td>
<td>39.022</td>
<td>380.445</td>
<td>10.26%</td>
</tr>
<tr>
<td>Year</td>
<td>Company</td>
<td>Value 1</td>
<td>Value 2</td>
<td>Percentage</td>
</tr>
<tr>
<td>------</td>
<td>--------------------------</td>
<td>---------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>2005</td>
<td>WOODWARD INC</td>
<td>102.018</td>
<td>827.726</td>
<td>12.33%</td>
</tr>
<tr>
<td>2005</td>
<td>A S V INC</td>
<td>95.582</td>
<td>245.082</td>
<td>39.00%</td>
</tr>
<tr>
<td>2005</td>
<td>ACTIVE POWER INC</td>
<td>7.471</td>
<td>17.788</td>
<td>42.00%</td>
</tr>
<tr>
<td>2005</td>
<td>COMMERCIAL VEHICLE GROUP INC</td>
<td>82.813</td>
<td>754.481</td>
<td>10.98%</td>
</tr>
<tr>
<td>2006</td>
<td>A S V INC</td>
<td>81.225</td>
<td>246.137</td>
<td>33.00%</td>
</tr>
<tr>
<td>2006</td>
<td>HAWK CORP</td>
<td>36.049</td>
<td>212.050</td>
<td>17.00%</td>
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<tr>
<td>2006</td>
<td>ACTIVE POWER INC</td>
<td>8.760</td>
<td>25.029</td>
<td>35.00%</td>
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<tr>
<td>2006</td>
<td>COMMERCIAL VEHICLE GROUP INC</td>
<td>93.590</td>
<td>918.751</td>
<td>10.19%</td>
</tr>
<tr>
<td>2007</td>
<td>HAWK CORP</td>
<td>38.192</td>
<td>228.695</td>
<td>16.70%</td>
</tr>
<tr>
<td>2007</td>
<td>ACTIVE POWER INC</td>
<td>10.416</td>
<td>33.601</td>
<td>31.00%</td>
</tr>
<tr>
<td>2007</td>
<td>COMMERCIAL VEHICLE GROUP INC</td>
<td>76.646</td>
<td>696.786</td>
<td>11.00%</td>
</tr>
<tr>
<td>2008</td>
<td>WOODWARD INC</td>
<td>145.853</td>
<td>1258.204</td>
<td>11.59%</td>
</tr>
<tr>
<td>2008</td>
<td>HAWK CORP</td>
<td>51.503</td>
<td>269.648</td>
<td>19.10%</td>
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<tr>
<td>2008</td>
<td>ACTIVE POWER INC</td>
<td>10.144</td>
<td>42.985</td>
<td>23.60%</td>
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<tr>
<td>2008</td>
<td>COMMERCIAL VEHICLE GROUP INC</td>
<td>83.984</td>
<td>763.489</td>
<td>11.00%</td>
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<tr>
<td>2008</td>
<td>ORBCOMM INC</td>
<td>3.280</td>
<td>30.092</td>
<td>10.90%</td>
</tr>
<tr>
<td>2009</td>
<td>HAWK CORP</td>
<td>29.826</td>
<td>172.402</td>
<td>17.30%</td>
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<tr>
<td>2009</td>
<td>ACTIVE POWER INC</td>
<td>12.496</td>
<td>40.311</td>
<td>31.00%</td>
</tr>
<tr>
<td>2009</td>
<td>ORBCOMM INC</td>
<td>4.466</td>
<td>27.566</td>
<td>16.20%</td>
</tr>
</tbody>
</table>
Figure 1: Caterpillar’s Procurement and Sales of Replacement Parts

This figure illustrates the legal title chain for replacement parts in Caterpillar’s procurement tax strategy. Caterpillar used its Swiss subsidiary, CSARL, as its global purchaser of manufactured replacement parts (U.S. Senate, 2014). In the figure, the arrows represent the legal title flow of the replacement parts. The red factories represent third-party suppliers of replacement parts. The green circles represent independently-owned Caterpillar dealers, who in turn sell replacement parts to the end customers. According to the Senate report, by 2008 this procurement strategy resulted in 43% of Caterpillar’s consolidated profits being shifted to its Swiss subsidiary, CSARL, avoiding about $2.4 billion in U.S. tax over the period 2000-2012.
Table 1: Sample Distribution

This table provides sample distributions over years (Panel A) and across industries (Panel B). Our sample period is from 1994 to 2009. Our sample includes all Compustat firms after removing firm-years with negative pre-tax income or book value, with non-positive sales, with total asset of less than $1 million, or firms from the financial services and utilities industries. We also require that all information that we use to compute our key tax avoidance variables must be available from Compustat.

Panel A: Sample Distribution by Year

<table>
<thead>
<tr>
<th>Year</th>
<th>All Firms</th>
<th>Principal Customers</th>
<th>Dependent Suppliers</th>
<th>Other Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>2,595</td>
<td>336</td>
<td>879</td>
<td>1,448</td>
</tr>
<tr>
<td>1995</td>
<td>2,691</td>
<td>338</td>
<td>957</td>
<td>1,472</td>
</tr>
<tr>
<td>1996</td>
<td>2,847</td>
<td>368</td>
<td>1,081</td>
<td>1,488</td>
</tr>
<tr>
<td>1997</td>
<td>2,943</td>
<td>334</td>
<td>1,107</td>
<td>1,596</td>
</tr>
<tr>
<td>1998</td>
<td>2,881</td>
<td>300</td>
<td>1,031</td>
<td>1,627</td>
</tr>
<tr>
<td>1999</td>
<td>3,002</td>
<td>322</td>
<td>814</td>
<td>1,924</td>
</tr>
<tr>
<td>2000</td>
<td>2,843</td>
<td>347</td>
<td>983</td>
<td>1,607</td>
</tr>
<tr>
<td>2001</td>
<td>2,363</td>
<td>292</td>
<td>814</td>
<td>1,342</td>
</tr>
<tr>
<td>2002</td>
<td>2,507</td>
<td>308</td>
<td>888</td>
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<td>Total</td>
<td>42,565</td>
<td>5,289</td>
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<td>23,796</td>
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### Panel B: Sample Distribution by Fama-French 48 Industry Classification

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<tr>
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<th>All Firms</th>
<th>Principal Customers</th>
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<td>270</td>
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<td>139</td>
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<td>101</td>
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<td>671</td>
<td>1,287</td>
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<td><strong>42,565</strong></td>
<td><strong>5,289</strong></td>
<td><strong>14,897</strong></td>
<td><strong>23,796</strong></td>
</tr>
</tbody>
</table>
Table 2: Summary Statistics

This table reports the mean levels for key variables in our analyses. Our sample period is from 1994 to 2009. Our sample includes all Compustat firms after removing firm-years with negative pre-tax income or book value, with non-positive sales, with total asset of less than $1 million, or firms from the financial services and utilities industries. We also require that all information that we use to compute our key tax avoidance variables must be available from Compustat. Detailed definitions of all variables are provided in Appendix I.

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<tr>
<td>Loss Carry Forward</td>
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<tr>
<td>Change in Loss Carry Forward</td>
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<td>Foreign Assets</td>
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<td>Firm Size</td>
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<td>Tax Haven Subs</td>
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Table 3: Status in Customer-Supplier Relationships and Its Impact on the Cash Effective Tax Rate

This table presents the estimates of OLS regressions of cash effective tax rate on the status of principal customers and dependent suppliers. The sample period is from 1994 to 2009. The dependent variable, CETR, is the cash effective tax rate. Detailed definitions of all variables are provided in Appendix I. We control for industry and year fixed effects in all specifications. The two-tailed test t-statistics in parentheses are based on standard errors clustered at both the firm and the year levels. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

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<th>(3)</th>
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<tr>
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<td>-0.008**</td>
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<td></td>
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<td>Supplier Firm’s Sales to Principal Customers</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(-5.27)</td>
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<tr>
<td>Supplier Firm with Long-term Customers</td>
<td></td>
<td></td>
<td>-0.011**</td>
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<td>-0.046***</td>
<td>-0.046***</td>
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<td>(-10.42)</td>
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<td>0.030***</td>
<td>0.031***</td>
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<tr>
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<td>(2.88)</td>
<td>(2.96)</td>
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<td>-0.012</td>
<td>-0.012</td>
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<td>(-1.45)</td>
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<td>0.025**</td>
<td>0.024**</td>
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<tr>
<td></td>
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<td>(2.30)</td>
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<td>-0.090***</td>
<td>-0.091***</td>
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<td>-0.021</td>
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<td>0.012***</td>
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<td>-0.005***</td>
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<td>-0.009**</td>
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Table 4: Customer-Supplier Relationships and Alternative Measures of Tax Avoidance

This table presents the estimates of robustness checks based on alternative measures of tax avoidance. The sample period is from 1994 to 2009. The specification of tests reported in this table is very similar to that reported in Table 3 while we replace cash effective tax rate by eight alternative measures of tax avoidance. Detailed definitions of all dependent and independent variables are provided in Appendix I. We control for industry and year fixed effects in all specifications. The two-tailed test $t$-statistics in parentheses are based on standard errors clustered at both the firm and the year levels. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
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<th>(4) Cash Ratio</th>
<th>(5) BF MTR</th>
<th>(6) AC MTR</th>
<th>(7) CTD</th>
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<td>-0.026***</td>
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<td>-0.002***</td>
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<td>-0.008***</td>
<td>-0.007***</td>
<td>-0.004***</td>
<td>-0.003***</td>
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<td>-0.000</td>
<td>0.026***</td>
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<td>-0.000</td>
<td>-0.000</td>
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<td>-0.010***</td>
<td>0.008***</td>
<td>0.006</td>
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<td>Property, Plant, and Equipment</td>
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<td>-0.004***</td>
<td>-0.002***</td>
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<td>-0.004***</td>
<td>0.002***</td>
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<td>Abnormal Accruals</td>
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<td>-0.016</td>
<td>0.017</td>
<td>0.103***</td>
<td>-0.010**</td>
<td>-0.012**</td>
<td>-0.027***</td>
</tr>
<tr>
<td>Cash Holdings</td>
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<td>-0.008***</td>
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<td>-0.0027***</td>
<td>-0.018***</td>
<td>-0.027***</td>
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<tr>
<td>Delaware</td>
<td>0.009**</td>
<td>-0.008**</td>
<td>-0.008**</td>
<td>-0.003</td>
<td>-0.010***</td>
<td>-0.013***</td>
<td>-0.002***</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Year Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
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<td>Adjusted R-squared</td>
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<td>0.090</td>
<td>0.101</td>
<td>0.156</td>
<td>0.602</td>
<td>0.601</td>
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</table>

(Table 4 Continued)
Table 5: Status in Customer-Supplier Relationships, Offshore Procurement in Tax-Haven Countries and Its Impact on the Effective Tax Rate

This table presents the estimates of OLS regressions of cash effective tax rate on the status in customer-supplier relationships and offshore procurement in tax-haven countries/regions. The sample period is from 1994 to 2009. The dependent variable in all columns, $CETR$, is the cash effective tax rate. Detailed definitions of all independent variables are provided in Appendix I. We control for industry and year fixed effects in all specifications. The two-tailed test $t$-statistics in parentheses are based on standard errors clustered at both the firm and the year levels. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
(Table 5 Continued)

<table>
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<th>VARIABLES</th>
<th>(1) CETR</th>
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<th>(3) CETR</th>
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<td>-0.038***</td>
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<td></td>
<td></td>
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<tr>
<td>PC with No Procurement</td>
<td>-0.015**</td>
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<td></td>
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<tr>
<td>PC with Tax Haven Subs</td>
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<td>-0.042***</td>
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</tr>
<tr>
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</tr>
<tr>
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<td>-0.010</td>
<td></td>
</tr>
<tr>
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<td>(-1.62)</td>
<td></td>
</tr>
<tr>
<td>PC with Procurement &amp; Tax Haven Subs</td>
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<td>-0.044***</td>
<td></td>
</tr>
<tr>
<td>PC with Procurement &amp; Tax Haven Subs</td>
<td></td>
<td>(-6.42)</td>
<td></td>
</tr>
<tr>
<td>PC with Procurement &amp; No Tax Haven Subs</td>
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<td>-0.026***</td>
<td></td>
</tr>
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<td>PC with Procurement &amp; No Tax Haven Subs</td>
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<td>(-3.33)</td>
<td></td>
</tr>
<tr>
<td>PC with No Procurement &amp; Tax Haven Subs</td>
<td></td>
<td>-0.039***</td>
<td></td>
</tr>
<tr>
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<td>(-4.88)</td>
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<td>Procurement</td>
<td>-0.003</td>
<td>0.000</td>
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<td>Procurement</td>
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<td></td>
<td>(0.11)</td>
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<td>0.006</td>
<td>0.013**</td>
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<td>(2.55)</td>
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<td>Procurement × Tax Haven Subs</td>
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<td>-0.016***</td>
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<td>Supplier Firm</td>
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<td>-0.013***</td>
<td>-0.013***</td>
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<tr>
<td>Supplier Firm</td>
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<td>(-3.42)</td>
<td>(-3.39)</td>
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<tr>
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<td>0.004</td>
<td>0.006</td>
<td>0.004</td>
</tr>
<tr>
<td>ROA</td>
<td>(0.16)</td>
<td>(0.22)</td>
<td>(0.17)</td>
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<td>Leverage</td>
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<td>-0.082***</td>
<td>-0.081***</td>
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<td>Leverage</td>
<td>(-6.34)</td>
<td>(-6.48)</td>
<td>(-6.43)</td>
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<tr>
<td>Loss Carry Forward</td>
<td>-0.045***</td>
<td>-0.046***</td>
<td>-0.045***</td>
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<td>(-10.38)</td>
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<td>(-10.53)</td>
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<td>Change in Loss carry Forward</td>
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<td>0.031***</td>
<td>0.032***</td>
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<td>Change in Loss carry Forward</td>
<td>(3.00)</td>
<td>(2.98)</td>
<td>(3.02)</td>
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<tr>
<td>Foreign Assets</td>
<td>-0.012</td>
<td>-0.012</td>
<td>-0.013</td>
</tr>
<tr>
<td>Foreign Assets</td>
<td>(-1.44)</td>
<td>(-1.47)</td>
<td>(-1.50)</td>
</tr>
<tr>
<td>New Investments</td>
<td>0.024***</td>
<td>0.024***</td>
<td>0.024***</td>
</tr>
<tr>
<td>New Investments</td>
<td>(2.30)</td>
<td>(2.23)</td>
<td>(2.27)</td>
</tr>
<tr>
<td>Property, Plant, and Equipment</td>
<td>-0.091***</td>
<td>-0.090***</td>
<td>-0.091***</td>
</tr>
<tr>
<td>Property, Plant, and Equipment</td>
<td>(-8.99)</td>
<td>(-8.70)</td>
<td>(-8.78)</td>
</tr>
<tr>
<td>Intangible assets</td>
<td>-0.020</td>
<td>-0.020</td>
<td>-0.020</td>
</tr>
<tr>
<td>Intangible assets</td>
<td>(-1.47)</td>
<td>(-1.49)</td>
<td>(-1.48)</td>
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<tr>
<td>Equity income in earnings</td>
<td>-0.518</td>
<td>-0.486</td>
<td>-0.485</td>
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<td>(-1.37)</td>
<td>(-1.37)</td>
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<td>0.011***</td>
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<td>(8.71)</td>
<td>(8.65)</td>
</tr>
<tr>
<td>Market-to-Book</td>
<td>-0.005***</td>
<td>-0.005***</td>
<td>-0.005***</td>
</tr>
<tr>
<td>Market-to-Book</td>
<td>(-6.65)</td>
<td>(-6.59)</td>
<td>(-6.53)</td>
</tr>
<tr>
<td>Abnormal Accruals</td>
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<td>-0.062***</td>
<td>-0.061***</td>
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<td>Abnormal Accruals</td>
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<td>(-2.98)</td>
<td>(-2.92)</td>
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<td>-0.089***</td>
<td>-0.088***</td>
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<td>Cash Holdings</td>
<td>(-9.75)</td>
<td>(-9.89)</td>
<td>(-9.78)</td>
</tr>
<tr>
<td>Delaware</td>
<td>-0.008**</td>
<td>-0.009**</td>
<td>-0.008**</td>
</tr>
<tr>
<td>Delaware</td>
<td>(-2.22)</td>
<td>(-2.48)</td>
<td>(-2.43)</td>
</tr>
</tbody>
</table>

| Industry Fixed Effects                         | Yes                       | Yes                       | Yes                       |
| Year Fixed Effects                             | Yes                       | Yes                       | Yes                       |
| Observations                                   | 42,565                    | 42,565                    | 42,565                    |
| Adjusted R-squared                             | 0.072                     | 0.072                     | 0.072                     |
Table 6: Marginal Tax Rate, Customer-supplier Relationships and Decision of Procurement through Tax-haven Subsidiaries

This table reports the estimates from the linear probability models on how the marginal tax rate and the status of customer-supplier relationship interactively affect a firm’s decision of taking tax-haven procurement strategy. The sample period is from 1994 to 2009. The dependent variable in columns (1) and (2), \( \text{Tax Haven Subs}_{t+1} \), is a dummy variable that is equal to one if a firm has at least one subsidiary in tax haven countries/regions in year \( t+1 \); the dependent variable in columns (3) and (4), \( \text{Procurement}_{t+1} \), is a dummy variable that is equal to one if the annual report (i.e., 10-K) of a firm mentions the words “procure” or “procurement” in year \( t+1 \); the dependent variable in columns (5) and (6), \( \text{Procurement \& Tax Haven Subs} \), is a dummy variable that equals one if both \( \text{Procurement} \) and \( \text{Tax Haven Subs} \) are equal to one for year \( t+1 \). To ensure our results reflect initiations of procurement and tax haven strategies in year \( t+1 \), in each specification we exclude observations where the dependent variable corresponding to year \( t \) is equal to one. All independent variables, as defined in Appendix I, reflect information in year \( t \). We control for both industry and year fixed effects in all specifications. The two-tailed test t-statistics in parentheses are based on standard errors clustered at both the firm level and the year level. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.
(Table 6 Continued)

<table>
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<th>VARIABLES</th>
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<th>Procurement&lt;sub&gt;t+1&lt;/sub&gt;</th>
<th>Procurement &amp; Tax Haven Subs&lt;sub&gt;t+1&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>AF&lt;sub&gt;_MTR&lt;/sub&gt;</td>
<td>0.125***</td>
<td>0.083***</td>
<td>0.031</td>
</tr>
<tr>
<td></td>
<td>(3.69)</td>
<td>(2.58)</td>
<td>(-0.67)</td>
</tr>
<tr>
<td>AF&lt;sub&gt;_MTR&lt;/sub&gt; × Customer Firm</td>
<td>1.089***</td>
<td>1.453***</td>
<td>0.031***</td>
</tr>
<tr>
<td></td>
<td>(4.21)</td>
<td>(5.34)</td>
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<tr>
<td>Customer Firm</td>
<td>0.147***</td>
<td>0.136***</td>
<td>0.031***</td>
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<tr>
<td></td>
<td>(8.31)</td>
<td>(6.01)</td>
<td>(3.20)</td>
</tr>
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<td>Supplier Firm</td>
<td>0.007</td>
<td>0.024***</td>
<td>0.010***</td>
</tr>
<tr>
<td></td>
<td>(1.38)</td>
<td>(4.80)</td>
<td>(3.13)</td>
</tr>
<tr>
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<td>-0.100***</td>
<td>-0.017</td>
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<tr>
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<td>(-0.73)</td>
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<td>0.033**</td>
<td>0.012*</td>
</tr>
<tr>
<td></td>
<td>(1.98)</td>
<td>(2.17)</td>
<td>(2.36)</td>
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<tr>
<td>Loss Carry Forward</td>
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<td>0.018***</td>
<td>0.011**</td>
</tr>
<tr>
<td></td>
<td>(3.78)</td>
<td>(3.81)</td>
<td>(2.38)</td>
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<td>0.016</td>
<td>-0.004</td>
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<td>(1.04)</td>
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<td>0.117***</td>
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<td>(9.86)</td>
<td>(9.81)</td>
<td>(11.59)</td>
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<td>0.032**</td>
<td>0.017</td>
</tr>
<tr>
<td></td>
<td>(1.98)</td>
<td>(2.14)</td>
<td>(1.47)</td>
</tr>
<tr>
<td>Property, land, and Equipment</td>
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<td>-0.035***</td>
<td>-0.034***</td>
</tr>
<tr>
<td></td>
<td>(-4.34)</td>
<td>(-4.58)</td>
<td>(-4.53)</td>
</tr>
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<td>Intangible assets</td>
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<td>-0.009</td>
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<td>0.025**</td>
<td>0.022***</td>
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<tr>
<td></td>
<td>(9.70)</td>
<td>(10.07)</td>
<td>(14.25)</td>
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<tr>
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<td>0.001*</td>
<td>0.001*</td>
</tr>
<tr>
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<td>(1.79)</td>
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<td>0.012*</td>
</tr>
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<td>(2.26)</td>
<td>(1.76)</td>
<td>(1.59)</td>
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<td>(1.01)</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
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<td>0.107</td>
<td>0.111</td>
<td>0.067</td>
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</tbody>
</table>

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Table 7: Tax Haven Procurement Strategy Adoption and Strength of Customer-Supplier Relationships

This table reports the estimates from OLS models on how the strength of customer-supplier relationships changes around the adoption of tax-haven procurement strategies. The sample period is from 1994 to 2009. The dependent variable in columns (1) and (2), \( \Delta \text{Purchase from All Suppliers} \), is the change of the percentage input purchased from all dependent suppliers in cost of goods sold (COGS) between year \( t \) and year \( t+1 \). The dependent variable in columns (3) and (4), \( \Delta \text{Purchase from Existing Suppliers} \), is the change of the percentage input purchased from existing dependent suppliers (i.e., excluding new suppliers in year \( t+1 \)) in cost of goods sold (COGS) between year \( t \) and year \( t+1 \). We define year \( S \) as the first year when a firm adopts the tax-haven procurement strategy (here, we require that \( \text{Procurement} & \text{ Tax Haven Subs} \) must equal to 0 from year \( S-3 \) to year \( S-1 \) and equal to 1 in at least two years from year \( S \) to year \( S+2 \)). \( \text{Pre_Adoption}(S-3,S-1) \) is a dummy variable that is equal to one if a firm will adopt tax-haven procurement strategy in the following three years and zero otherwise; \( \text{Post_Adoption}(S,S+2) \) is a dummy variable that is equal to 1 if a firm adopted the tax-haven procurement strategy within the last three years and zero otherwise. All other independent variables, as defined in Appendix I, reflect information in year \( t \). We partition the entire sample into two equal sub-groups according to the level of marginal tax rates and run regressions in two sub-groups. We compare the coefficients of \( \text{Pre_Adoption}(S-3,S-1) \) and \( \text{Post_Adoption}(S,S+2) \) estimated from two sub-groups with statistical tests. The two-tailed test t-statistics in parentheses are based on standard errors clustered at both the firm level and the year level. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
<table>
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<th>High MTR</th>
</tr>
</thead>
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<td>Pre_Adoption(S-3,S-1)</td>
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<td>0.007**</td>
<td>-0.003</td>
<td>0.008**</td>
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<td></td>
<td>(-0.24)</td>
<td>(2.16)</td>
<td>(-1.10)</td>
<td>(2.50)</td>
</tr>
<tr>
<td>Post_Adoption(S, S+2)</td>
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<td>0.012***</td>
<td>-0.002</td>
<td>0.012***</td>
</tr>
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<td>(3.64)</td>
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<td>(-1.18)</td>
<td>(0.57)</td>
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<td>0.013*</td>
<td>-0.001</td>
<td>0.012</td>
<td>-0.001</td>
</tr>
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<td>(1.77)</td>
<td>(-1.11)</td>
<td>(1.34)</td>
<td>(-0.05)</td>
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<tr>
<td>Leverage</td>
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<td>-0.005</td>
<td>0.003</td>
<td>-0.010</td>
</tr>
<tr>
<td></td>
<td>(-1.37)</td>
<td>(-0.55)</td>
<td>(0.46)</td>
<td>(-0.98)</td>
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<tr>
<td>Loss Carry Forward</td>
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<td>0.003</td>
<td>0.000</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(-0.63)</td>
<td>(1.02)</td>
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<td>(0.30)</td>
</tr>
<tr>
<td>Change in Loss carry Forward</td>
<td>0.005</td>
<td>0.034</td>
<td>0.010*</td>
<td>0.004</td>
</tr>
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<td>(0.74)</td>
<td>(1.59)</td>
<td>(1.74)</td>
<td>(0.16)</td>
</tr>
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<td>Foreign Assets</td>
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<td>-0.004</td>
<td>0.004</td>
<td>-0.001</td>
</tr>
<tr>
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<td>(1.78)</td>
<td>(-0.77)</td>
<td>(1.18)</td>
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<td>-0.002</td>
<td>0.006</td>
<td>-0.006</td>
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<td>(-0.63)</td>
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<td>Property, Plant, and Equipment</td>
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<td>0.011*</td>
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<td>0.008</td>
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<td>Intangible assets</td>
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<td>0.002</td>
<td>-0.005</td>
<td>0.006</td>
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<td>-0.277</td>
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<td>0.003***</td>
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<td>-0.000</td>
<td>0.000</td>
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<td>(1.63)</td>
<td>(-0.33)</td>
<td>(0.66)</td>
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<tr>
<td>Abnormal Accruals</td>
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<td>0.025</td>
<td>0.007</td>
<td>0.015</td>
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<tr>
<td></td>
<td>(-0.03)</td>
<td>(1.38)</td>
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<td>(0.72)</td>
</tr>
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<td>Cash Holdings</td>
<td>-0.002</td>
<td>0.013*</td>
<td>-0.002</td>
<td>0.013*</td>
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<td></td>
<td>(-0.52)</td>
<td>(1.86)</td>
<td>(-0.47)</td>
<td>(1.85)</td>
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<td>Delaware</td>
<td>-0.000</td>
<td>-0.001</td>
<td>-0.001</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(-0.45)</td>
<td>(-0.58)</td>
<td>(-0.98)</td>
<td>(0.06)</td>
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Pre_Adoption(S-3,S-1): High - Low

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<td>Pre_Adoption(S-3,S-1)</td>
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<td>0.011***</td>
<td>(3.60)</td>
<td>(5.85)</td>
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<tr>
<td>Post_Adoption(S, S+2)</td>
<td>0.014***</td>
<td>0.014***</td>
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<td>(7.29)</td>
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Industry Fixed Effects

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Year Fixed Effects

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<th>Yes</th>
<th>Yes</th>
</tr>
</thead>
</table>

Adjusted R-squared

|                       | 0.003       | 0.008       | 0.003       | 0.008       |

Observations

|                       | 13,830      | 13,831      | 13,830      | 13,831      |
Table 8 Tax Avoidance, Customer-Supplier Relationships and Firm Value

This table presents the estimates of OLS regressions of firm value on the status in customer-supplier relationships and offshore procurement in tax-haven countries/regions. The sample period is from 1994 to 2009. The dependent variable in columns (1)-(3) is a firm’s Tobin’s Q. The dependent variable in columns (4)-(6) is the adjusted Tobin’s Q, which is defined as Tobin’s Q minus its industry median of that year. Detailed definitions of all independent variables are provided in Appendix I. We control for industry and year fixed effects in specifications reported in columns (1)-(3) and we control for year fixed effects in specifications reported in columns (4)-(6). The two-tailed test $t$-statistics in parentheses are based on standard errors clustered at both the firm and the year levels. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
(Table 8 Continued)

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<tr>
<td></td>
<td>(1)</td>
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<td>(4)</td>
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<tr>
<td><strong>PC with Procurement</strong></td>
<td>0.426***</td>
<td>0.347***</td>
<td></td>
<td>0.595***</td>
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<tr>
<td></td>
<td>(5.00)</td>
<td>(4.13)</td>
<td></td>
<td>(5.48)</td>
</tr>
<tr>
<td><strong>PC with No Procurement</strong></td>
<td>0.254***</td>
<td>0.141*</td>
<td>0.549***</td>
<td>0.179**</td>
</tr>
<tr>
<td></td>
<td>(2.96)</td>
<td>(1.72)</td>
<td>(4.73)</td>
<td>(2.96)</td>
</tr>
<tr>
<td><strong>PC with Tax Haven Subs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PC with No Tax Haven Subs</strong></td>
<td>0.179**</td>
<td>0.083</td>
<td>0.254***</td>
<td>0.141**</td>
</tr>
<tr>
<td></td>
<td>(2.49)</td>
<td>(1.14)</td>
<td>(5.00)</td>
<td>(1.99)</td>
</tr>
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<td><strong>PC with Procurement &amp; Tax Haven Subs</strong></td>
<td>0.145***</td>
<td>0.151***</td>
<td>0.274***</td>
<td>0.241***</td>
</tr>
<tr>
<td></td>
<td>(5.67)</td>
<td>(4.69)</td>
<td>(2.88)</td>
<td>(6.20)</td>
</tr>
<tr>
<td><strong>PC with Procurement &amp; No Tax Haven Subs</strong></td>
<td>0.144**</td>
<td>0.120***</td>
<td>0.512***</td>
<td>0.262***</td>
</tr>
<tr>
<td></td>
<td>(1.99)</td>
<td>(3.16)</td>
<td>(6.20)</td>
<td>(6.23)</td>
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<td><strong>Procurement</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tax Haven Subs</strong></td>
<td>0.095**</td>
<td>0.084**</td>
<td>0.270***</td>
<td>0.262***</td>
</tr>
<tr>
<td></td>
<td>(2.53)</td>
<td>(2.24)</td>
<td>(-5.83)</td>
<td>(6.23)</td>
</tr>
<tr>
<td><strong>Log(Total Asset)</strong></td>
<td>-0.082***</td>
<td>-0.090***</td>
<td>-0.270***</td>
<td>-0.286***</td>
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<td>(-5.43)</td>
<td>(-5.90)</td>
<td>(-5.68)</td>
<td>(-5.30)</td>
</tr>
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<td><strong>Log(Age)</strong></td>
<td>0.187***</td>
<td>0.157***</td>
<td>0.177***</td>
<td>0.170***</td>
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<td>(5.54)</td>
<td>(5.39)</td>
<td>(5.49)</td>
<td>(5.46)</td>
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<td><strong>Delaware</strong></td>
<td>0.905***</td>
<td>0.816***</td>
<td>0.841***</td>
<td>0.762***</td>
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<td>(9.47)</td>
<td>(9.44)</td>
<td>(9.55)</td>
<td>(9.12)</td>
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<td>Industry Fixed Effects</td>
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<td>Yes</td>
<td>Yes</td>
<td>No</td>
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<td>Year Fixed Effects</td>
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<td>47,029</td>
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<td>0.065</td>
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<td>(9.44)</td>
<td>(9.55)</td>
<td>(9.12)</td>
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</table>

63
Table 9: Tax Avoidance Diffusion along the Supply Chain

This table presents the estimates of OLS regressions of suppliers’ cash effective tax rates on their customers’ cash effective tax rates and the geographical distance between the suppliers and the customers. The sample period is from 1994 to 2009. The dependent variable in columns (1) and (2), Supplier’s CETR, is the cash effective tax rate. Detailed definitions of all independent variables are provided in Appendix I. We control for suppliers’ industry, state and year fixed effects in all specifications. The two-tailed test t-statistics in parentheses are based on standard errors clustered at both the firm (i.e., the supplier) and the year levels. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

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<th>(2) Supplier’s CETR</th>
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<td>Customer’s CETR</td>
<td>0.034**</td>
<td>0.073**</td>
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<td>(2.00)</td>
<td>(2.28)</td>
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<td>Customer’s CETR × Distance</td>
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<td>-0.043**</td>
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<tr>
<td></td>
<td></td>
<td>(-2.48)</td>
</tr>
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<td>Distance</td>
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</tr>
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<td></td>
<td>(1.27)</td>
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</tr>
<tr>
<td>ROA</td>
<td>0.086**</td>
<td>0.097***</td>
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<td></td>
<td>(2.46)</td>
<td>(2.62)</td>
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<td>Leverage</td>
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<td>-0.105***</td>
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<td>(-3.59)</td>
<td>(-3.51)</td>
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<td>-0.054***</td>
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<tr>
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<td>(-8.26)</td>
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<td>Change in Loss carry Forward</td>
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<td>0.028</td>
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<td>(1.46)</td>
<td>(1.60)</td>
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<td>-0.001</td>
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<td>(-0.07)</td>
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<td>0.068***</td>
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<tr>
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<td>(3.00)</td>
<td>(3.10)</td>
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<tr>
<td>Property, Plant, and Equipment</td>
<td>-0.141***</td>
<td>-0.142***</td>
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<td>(-5.58)</td>
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<tr>
<td>Intangible assets</td>
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<td>-0.015</td>
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<td>(-0.71)</td>
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<td>Equity income in earnings</td>
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<td>-1.973***</td>
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<td>Firm Size</td>
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<td>(4.74)</td>
<td>(4.59)</td>
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<td>Market-to-Book</td>
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<td>-0.006***</td>
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<td>Abnormal Accruals</td>
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<td>(-1.39)</td>
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<td>Supplier State Fixed Effects</td>
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<td>Adjusted R-squared</td>
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<td>0.109</td>
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Table 10: Relationship Establishment and Tax Avoidance of Dependent Suppliers

This table reports the impact of relationship establishment on the cash effective tax rate (CETR) based on a difference-in-difference approach. The sample period is from 1994 to 2009. Relationship establishment is defined as when a firm reports a principal customer that accounts for at least 10% of its total sales for the first time in year $t$ and the relationship lasts for at least 2 years (i.e., year $t+1$ and year $t+2$). For all tests reported in this table, the pre-establishment period is year $t-2$ (i.e., 2 years before the principal customer is first reported) and the post-establishment period is year $t+2$ (i.e., 2 years after the principal customer is first reported). We combine two observations for the pre-establishment period and the post-establishment period for each relationship establishment into one pair. After Relationship Establishment is a dummy variable that equals 0 for pre-establishment period and 1 for post-establishment period. The dependent variable in Columns (1)-(3) is $CETR$, the cash effective tax rate of dependent suppliers; the dependent variable in Columns (4)-(6) is $Adj. CETR$, the adjusted cash effective tax rate of dependent suppliers. The $Adj. CETR$ is the difference between $CETR$ and the average $CETR$ of benchmark firms that are neither principal customers nor dependent suppliers between year $t-2$ and $t+2$. We require that, in year $t-2$, the incumbent supplier and the benchmark firms must belong to the same size and $CETR$ quintiles in the same industry. In addition to the tests for the full sample reported in Columns (1) and (4), we also partition all observations into two groups based on the cash effective tax rate of the principal customers. Columns (2) and (5) report the results based on the sample where the principal customer’ $CETR$ is lower than the 25th percentile (Q1) of $CETR$ within its industry; columns (3) and (6) report the results based on the sample where the principal customer’ $CETR$ is higher than the 25th percentile (Q1) of $CETR$ within its industry. In all specifications, we control for pair fixed effects. The two-tailed test $t$-statistics in parentheses are based on standard errors clustered by both firm and the year of relationship establishment. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
(Table 10 Continued)

<table>
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<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<td>Customer Tax Rate&gt;Industry Q1</td>
<td>All</td>
<td>Customer Tax Rate≤Industry Q1</td>
<td>Customer Tax Rate&gt;Industry Q1</td>
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<td>After Relationship Establishment</td>
<td>-0.025***</td>
<td>-0.045**</td>
<td>-0.010</td>
<td>-0.027***</td>
<td>-0.038**</td>
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<td>(-2.48)</td>
<td>(-1.29)</td>
<td>(-3.18)</td>
<td>(-2.25)</td>
<td>(-1.41)</td>
</tr>
<tr>
<td>ROA</td>
<td>0.113</td>
<td>0.412**</td>
<td>-0.096</td>
<td>-0.211*</td>
<td>0.051</td>
<td>-0.382*</td>
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<td>(1.19)</td>
<td>(2.11)</td>
<td>(-0.71)</td>
<td>(-1.34)</td>
<td>(0.29)</td>
<td>(-1.74)</td>
</tr>
<tr>
<td>Leverage</td>
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<td>-0.020</td>
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<td>(-1.81)</td>
<td>(-0.85)</td>
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<td>Loss Carry Forward</td>
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<td>Change in Loss carry Forward</td>
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<td>-0.175**</td>
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<td>(-0.65)</td>
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<td>0.060</td>
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<td>(1.52)</td>
<td>(1.84)</td>
<td>(0.83)</td>
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<td>Property, Plant, and Equipment</td>
<td>0.032</td>
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<td>0.128</td>
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<td>(0.93)</td>
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<td>(0.37)</td>
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<td>Intangible assets</td>
<td>-0.053</td>
<td>-0.088</td>
<td>-0.043</td>
<td>-0.094**</td>
<td>-0.129**</td>
<td>-0.090</td>
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<td>(-0.84)</td>
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<td>Equity income in earnings</td>
<td>-4.890**</td>
<td>-6.054**</td>
<td>-2.792*</td>
<td>-2.741</td>
<td>-3.896</td>
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<td>(-2.17)</td>
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<td>Firm Size</td>
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<td>0.050***</td>
<td>0.014</td>
<td>0.019</td>
<td>0.016</td>
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<td>(2.09)</td>
<td>(4.04)</td>
<td>(0.51)</td>
<td>(0.93)</td>
<td>(1.28)</td>
<td>(0.26)</td>
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<td>Market-to-Book</td>
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<td>-0.017***</td>
<td>-0.010**</td>
<td>-0.009**</td>
<td>-0.011***</td>
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<td>-0.027</td>
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<td>(-0.15)</td>
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<td>-0.072</td>
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<td>(-1.16)</td>
<td>(1.08)</td>
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<td>Yes</td>
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<td>674</td>
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<td>Adjusted R-squared</td>
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<td>0.264</td>
<td>0.365</td>
<td>0.098</td>
<td>0.092</td>
<td>0.132</td>
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Table 11: Colocation Choices of Foreign Subsidiaries in the Supply Chain

This table reports the estimate from linear probability model (LPM) regressions of suppliers’ colocation choices of foreign subsidiaries in tax-haven countries/regions where customers have subsidiaries. For each year $t$ between 1994 and 2009, we match all supplier firms with all possible foreign countries/regions documented in Dyreng and Lindsey (2009). The dependent variable, Supplier Subsidiary, is a dummy variable that is equal to one if a supplier operates a subsidiary in this country in year $t$, and zero otherwise. Customer Subsidiary is a dummy variable that is equal to one if at least one of the principal customers of this supplier operates a subsidiary in this country in year $t$, and zero otherwise. Tax Haven is a dummy variable that is equal to one if this country/region is defined as a tax haven in Dyreng and Lindsey (2009). Detailed definitions of all other variables are defined in Appendix I. We require that the supplier did not have a subsidiary in this country/region in year $t-1$. In this case, if Supplier Subsidiary is equal to one in year $t$, it must be driven by a new establishment of subsidiary in the country in year $t$. We control for firm and year fixed effects in all specifications. The two-tailed $t$-statistics in parentheses are based on standard errors clustered at the firm level. The superscripts ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

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<td>(27.95)</td>
<td>(22.91)</td>
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<td>0.000***</td>
<td>0.005***</td>
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<td>(13.26)</td>
<td>(2.91)</td>
<td>(23.65)</td>
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<td>Customer Subsidiary × Tax Haven</td>
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<td>0.022***</td>
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<td></td>
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<td>English Speaking</td>
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<td>0.002***</td>
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<td>(12.25)</td>
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<td>Inflation Rate</td>
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<td></td>
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<td>Log(Labor Population)</td>
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