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The Effect of Tax-Motivated Transfer Pricing on U.S. Aggregate Trade Statistics

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Abstract

The prices that multinational corporations set for transactions among international affiliates—referred to as transfer prices—play an important role in determining where income is taxed. Many factors affect how multinationals set their transfer prices, including tax considerations. If tax considerations affect transfer prices, then those changes in transfer prices may distort aggregate trade and income statistics. In this paper, we analyze how corporate income tax rates affect trade flows between the affiliates of multinationals—known as related-party trade—to examine whether transfer prices are sensitive to tax differentials. To do so, we construct a simple model of related-party trade based on Egger and Seidel (2013) and test that model empirically using aggregate trade data. We find that changes in related-party exports and imports associated with changes in corporate tax differentials are consistent with that model’s predictions for tax-sensitive transfer pricing by multinationals. In addition, we use the 2017 reduction in the U.S. statutory corporate tax rate as an example and estimate that the 13.1 percentage-point decline in the U.S. corporate tax rate may increase the U.S. trade balance by as much as 9 percent through its effect on related-party trade.

Keywords: related-party trade, international taxation, profit shifting

JEL Classification: H25, H26, F23

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Introduction

Multinational corporations—businesses that are incorporated and operate in one country but also maintain operations in other countries—are composed of affiliates, which trade with one another. That trade between affiliates is referred to as related-party trade. In order to determine the taxable income of each individual affiliate, a price has to be assigned for each related-party transaction. That price is often called the transfer price. A number of factors influence the transfer prices set by multinational corporations. Among those factors are the costs incurred in the production of the traded product as well as the price of comparable products sold in open markets.

Tax considerations may also affect how corporations set transfer prices. Because transfer prices play a role in determining where the profits of the multinational corporation are taxed, there is a potential incentive for companies to set those prices in a way that reduces overall tax liability. That setting of transfer prices is one of several strategies that multinational corporations may use to lower their tax liabilities by shifting profits from countries with high corporate tax rates to lower-tax jurisdictions.¹ That incentive exists for trade in goods and services and for transfers of intellectual property and other intangible assets. Because of the high statutory corporate income tax rate in the United States relative to other countries in the Organisation for Economic Co-operation and Development (OECD), multinational corporations had a particularly strong incentive to shift their profit out of the United States before the enactment of Public Law 115-97 (originally called the Tax Cuts and Jobs Act and referred to in this paper as the 2017 tax act).² The reduction of the top U.S. statutory corporate income tax rate from 35 percent to 21 percent has most likely contributed to reducing, but not completely eliminating, the incentive to shift profits out of the United States.³

¹ Those other strategies involve the allocation of debt between affiliates and the assignment of ownership of intellectual property. Each of those strategies reallocates profits from affiliates that face relatively high tax rates to affiliates that face lower tax rates: In the first case, affiliates in higher-tax countries take on debt for the entire company because interest deductions in those jurisdictions are worth more than those in places with lower taxes; in the second case, ownership of intellectual property is assigned to affiliates in lower-tax countries, allowing the royalties to be taxed at lower rates. By looking at earnings before interest, it is possible to distinguish between tax minimization through the allocation of debt and other methods of tax minimization. However, that approach cannot distinguish between the effects of tax-motivated transfer pricing and the tax-motivated allocation of intellectual property.

² The OECD's Base Erosion and Profit Shifting project and its action items on transfer pricing and other profit-shifting mechanisms highlight the concern that the United States and many other countries have about profit shifting.

³ In 2017, the top U.S. statutory rate was 35 percent, but lower rates applied to corporate income below certain thresholds. In practice, most corporate income was subject to the 35 percent rate. That rate was higher than the statutory corporate income tax rate in all other OECD countries. Of those countries, France had the second highest rate—34.4 percent.

Most countries follow transfer-pricing guidelines from the OECD or the United Nations and require that corporations set the transfer price for a transaction equal to the “arm’s length” price—that is, the price that would be set for a comparable transaction between two unrelated parties.⁴ For any transaction with a clear comparable, that standard limits the flexibility that corporations have to select a price that reduces overall tax liability. However, for some transactions, there are few or no comparable transactions and so the allocation of profits that should result from the related-party transaction is less clear. That is especially likely to be true for transactions that involve services or differentiated goods.⁵ For those transactions, it may be difficult for tax authorities to determine specific transactions to which that transfer price should be benchmarked. That difficulty implies that there may be instead a wide range of potentially acceptable prices. Corporations, in those cases, have more flexibility to select from the range of prices and potentially use that flexibility to select a price that reduces their overall tax liability.

The incentive to set transfer prices in a way that minimizes total tax liability was first discussed in detail in Horst (1971). Empirical evidence in more recent papers, such as Swenson (2001), Clausing (2003), Bernard, Jensen, and Schott (2006), and Cristea and Nguyen (2016), suggests a relationship between transfer prices for goods and corporate tax rates that is consistent with tax minimization by multinational corporations. As described in detail in Eden (2001), those price distortions would bias the construction of import and export price indexes.

Through its effect on trade price data, the setting of transfer prices also affects data on reported nominal trade flows. Those effects on reported nominal trade flows may, in turn, distort aggregate trade statistics. Evidence of the effect of tax rates on transfer prices is not necessarily sufficient to determine the magnitude of the effect on aggregate trade flows. On the one hand, results suggesting that tax rates have a large effect on prices could indicate a small effect on reported nominal trade flows, if the results are driven by the prices of infrequently traded goods. On the other hand, results suggesting that there are only small distortions to prices could indicate a large effect on nominal trade flows, if the results are driven by the prices of frequently traded goods. A much smaller literature, including Clausing (2000), Bernard, Jensen, and Schott (2006), and Clausing (2006), has examined how the potential relationship between transfer prices and tax rates affects aggregate trade flows.

This paper builds on that literature by using data for a more recent period and by focusing on the way changes in tax rates affect aggregate related-party trade, thereby demonstrating how tax rates affect transfer-pricing decisions for traded goods. However, instead of focusing directly on

⁴ In practice, there often will not be a single comparable transaction. Instead, a company will be required to set a price that either falls within certain bounds determined by a set of similar transactions or results in profits that fall within the range of profits of companies that engage in similar activities.

⁵ Differentiated goods are goods whose characteristics distinguish themselves from other similar products in a way that provides them with a competitive advantage.

flows of related-party trade, we focus on the value of related-party trade as a share of total trade between two countries. We focus on related-party shares of trade because it helps us isolate the relationship between tax rates and related-party trade by controlling for other nontax factors that may affect all trade flows. Previous research has shown that the value of nominal trade flows between two countries is affected by many nontax factors, including exchange rates, the countries' factor endowments, and their level of development. To the extent that those factors are correlated with corporate tax rates, they act as confounding factors when trying to quantify the relationship between corporate tax rates and nominal trade flows. However, most of those nontax variables are expected to affect related-party trade and unrelated-party trade in similar ways. By looking at the relationship between tax rates and related-party shares of trade, we are able to control for nontax factors that affect nominal flows of related-party and unrelated-party trade similarly.

This paper is also related to the broad literature on profit shifting by multinational corporations. Recent papers, including Bruner, Rassier, and Ruhl (2018) and Guvenen and others (2018), indicate that profit shifting by U.S. multinational corporations distorts national income statistics for the United States. However, different methods of profit shifting have different implications for U.S. income accounts, and so it is important to have a greater understanding of the mechanisms that are used. Providing an estimate of how changes to corporate income tax rates affect profit shifting and economic statistics is particularly relevant because of the recent reduction in the top U.S. statutory corporate tax rate from 35 percent to 21 percent. Although research by Grubert (2003), McDonald (2008), and Heckemeyer and Overesch (2017) provides some evidence that a significant amount of profit shifting occurs through the setting of transfer prices, that evidence is not directly based on trade flows. By quantifying how tax-sensitive transfer pricing may cause aggregate trade flows for goods to change with the recent reduction in the U.S. statutory corporate tax rate, our paper bridges the gap between the transfer-pricing literature and the recent literature on aggregate statistical distortions from profit shifting.

To examine the relationship between flows of related-party trade and corporate tax rates, we first develop a simple framework to show how the related-party share of trade for both imports and exports with a given country would be related to the difference in corporate income tax rates between countries. We use that model to generate predictions about how changes in corporate income tax rates would affect flows of related-party trade for the United States.

We then empirically evaluate whether the observed relationship between tax rates and related-party shares of trade in goods is consistent with the pattern of tax-sensitive transfer pricing predicted by our theoretical model. By focusing on related-party shares of trade, we are able to control for unobserved changes in trading patterns over time that affect both related-party trade and unrelated-party trade. For our empirical analysis, we use data on foreign corporate tax rates and aggregate data on related-party trade to explore how the tax differential between the United States and a foreign country and changes to that tax differential affect the value of related-party

trade in goods as a share of total trade in goods. We also examine whether alternative mechanisms may be able to explain that relationship.

Finally, we consider what those findings suggest about the magnitude of the effect of tax-sensitive transfer pricing on U.S. aggregate flows of trade in goods and U.S. economic statistics.⁶ Our simple model suggests that the reduction in the U.S. federal statutory corporate income tax rate from 35 percent to 21 percent would raise the value of the nominal U.S. trade balance by roughly \$51 billion. However, we believe that those estimated effects significantly overstate the effect of transfer prices on aggregate flows of trade in goods and most likely represent an upper bound on that effect. Indeed, other analysts have estimated a substantially smaller effect of transfer pricing for traded goods on the U.S. trade balance.

What Are Transfer Prices and Why Might They Be Sensitive to Tax Rates?

A multinational corporation is an entity that operates in multiple countries and is organized as a collection of separate companies (affiliates) that serve those countries. Those affiliates often trade goods and services with one another. Transactions between international affiliates are referred to as related-party transactions.

There are many reasons affiliated businesses trade with one another. For example, some parent companies allocate stages of a production process to affiliated factories in other countries to take advantage of differences in production costs. The development of that international supply chain necessitates the flow of goods and services between the parent and its affiliates, resulting in flows of related-party trade. Other reasons why companies engage in related-party trade are requirements that some countries have for a local presence or companies' preferences for establishing a presence in certain markets. Countries such as China require foreign businesses in certain industries to open a local affiliate in order to sell products to local consumers. In addition, multinationals may use affiliated suppliers to avoid the risks associated with unrelated-party transactions.⁷

One implication of the structure of a multinational corporation is that multiple countries assess income taxes on the multinational corporation's profits. A specific country will often assess taxes on the multinational corporation on the basis of the profits earned by the affiliate that is located in that country. In order to assign a share of the profits to each individual affiliate, the

⁶ Because we focus only on trade in goods, our analysis does not consider how transfer pricing for intellectual property might affect those aggregate statistics.

⁷ One risk associated with unrelated-party transactions is the "hold-up" problem. The hold-up problem arises when a final-goods producer requires suppliers of intermediate-goods, or goods used as inputs to the production of other goods, to make an investment that is specific to their commercial relationship without the benefit of enforceable contracts. That scenario leads to underinvestment and less trade than would exist if those businesses were affiliated.

multinational corporation must assign prices for its related-party transactions. The prices that are set for transactions between affiliated companies are referred to as transfer prices.

Transfer prices play a necessary role in determining how a multinational corporation's income is allocated for tax and other purposes. Among developed countries, there is a consensus that transfer prices should be set in accordance with the arm's length standard. The arm's length standard requires multinationals to set the transfer price for any product to be equal to the price that would prevail if that product were sold to unrelated corporations. That standard attempts to ensure that a multinational corporation attributes income among its affiliates in the same way that the income would be divided if those related-party transactions happened in public markets—or at arm's length. However, for some transactions, there are few or no comparable transactions and so the allocation of profits that should result from the related-party transaction is less clear. That is especially likely to be true for transactions that involve services or differentiated goods. The OECD has worked with its member countries to develop common guidelines for transfer pricing. However, multinational corporations continue to have some flexibility in determining the transfer prices that they use for certain related-party transactions. As a result, corporations may be able to select from a range of acceptable transfer prices rather than a single arm's length price for some transactions.

A multinational corporation may consider tax implications when setting a transfer price because the corporate income tax rates faced by the corporation's affiliates may vary substantially. For any traded product, the higher the transfer price set for that product, the less income is reported by the importing affiliate and the more income is reported by the exporting affiliate. To minimize profits earned in countries with high corporate tax rates, a multinational corporation might choose the highest price among acceptable prices when an affiliate located in a high-tax country pays for imports from affiliates that face lower tax rates. By choosing the highest possible price, the affiliate in the higher-tax country is able to deduct a larger cost, lowering its taxable income, and the affiliate in the lower-tax country increases the value of its sales, increasing its taxable income. Similarly, there is an incentive to select the lowest acceptable price when an affiliate in a high-tax country exports goods to affiliates that face lower tax rates. Setting transfer prices in that way causes more profit to be reported in lower-tax countries and less profit to be reported in the high-tax country.⁸ The ability to set transfer prices in a way that reduces global tax liabilities may create an additional incentive for multinational corporations to engage in related-party trade.

⁸ However, financial accounting or customs incentives may cause the corporation to decide that different transfer prices are optimal.

How Can Tax-Motivated Transfer Pricing Affect Aggregate Economic Statistics?

If taxes influence transfer prices, then a country's corporate tax rate and the rates of its trading partners would affect the price and value of that country's related-party trade and, in turn, its aggregate economic statistics. Those relationships can have important implications for the way a country's nominal trade balance, nominal gross domestic product (GDP), and other economic aggregates should be interpreted.

If companies located in a high-tax country set transfer prices in a way that minimizes taxes, the country's reported trade balance, and consequently its nominal GDP, could be lower as a result. As discussed above, multinational corporations may have an incentive to set transfer prices in such a way that reduces reported income in high-tax countries and increases reported income in lower-tax countries. For a high-tax country, that tax-sensitive pricing would generally cause related-party exports to be priced lower than they would be in the absence of tax minimization and related-party imports to be priced higher than they otherwise would be. As a result, in the high-tax country, the value of nominal related-party exports would be lower and the value of nominal related-party imports would be higher—thereby reducing that country's trade balance. A lower trade balance would, in turn, reduce the measured nominal GDP of that high-tax country.

Aggregate income measures are also affected by the transfer prices that are set. When multinational corporations shift their income to affiliates in lower-tax countries, domestic corporate profits are lowered in high-tax countries and increased in lower-tax countries.

Tax-motivated transfer pricing has the potential to have a large effect on the United States' aggregate economic statistics because related-party trade is such a large component of U.S. trade flows. In 2016, related-party trade represented about 50 percent of total imports and 30 percent of total exports. Because related-party trade accounts for such a large portion of all export and import flows, even small changes in average prices as a result of cross-country differences in tax rates can significantly affect the measure of the U.S. trade balance and, in turn, estimates of the nation's domestic corporate income.

How Have Other Studies Estimated the Effects of Tax-Motivated Transfer Pricing?

Evidence from previous work suggests that taxes affect the setting of transfer prices and that those distortions may affect aggregate economic statistics. A number of papers have established a link between tax rates and trade prices, whereas other works have examined how taxes affect trade flows. In addition, other works have estimated the effect of profit shifting on aggregate statistics. By estimating the extent to which tax-sensitive transfer pricing may distort aggregate statistics, our paper bridges the gap between the literature on transfer pricing and the papers that estimate aggregate statistical distortions from profit shifting.

Evidence on the Relationship Between Related-Party Trade Prices and Taxes

A number of researchers have attempted to quantify the effect of corporate tax rate differentials and changes in those differentials on related-party trade prices. Swenson (2001) examines aggregate country-level product prices of U.S. imports from Canada, France, Germany, Japan, and the United Kingdom between 1981 and 1988 and uses variations in U.S. tariff rates by product to identify the effect of tax rate changes in the United States and those five countries on transfer prices. Because companies often use the same prices for tax purposes and customs purposes, a higher U.S. tariff rate on imports would reduce the incentive to set the highest acceptable price for U.S. imports from countries with lower tax rates. Using that variation in the incentive to adjust transfer prices among products, Swenson finds that a 5 percent decline in foreign tax rates causes the reported price of affiliated-firm imports to rise by 0.024 percent. The effect on related-party imports is small, but that may be due, in part, to the set of trading partners considered in the analysis. Most of those trading partners had a top statutory rate above the OECD's average in the period considered. Swenson did not look at related-party exports.

Clausing (2003) uses data on trade prices between 1997 and 1999 from the Bureau of Labor Statistics and finds evidence that transfer prices respond differently to tax rates than unrelated-party prices. In particular, each additional percentage-point difference between the tax rate in the United States and any trading partner is associated with the prices of U.S. related-party exports being 1.8 percent lower and the prices of U.S. related-party imports being 2.0 percent higher.⁹

Bernard, Jensen, and Schott (2006) link transaction-level data to company information and look at the difference in the price a company sets when trading a specific product with a related party in a particular country as compared with an unrelated party located in that same country. That linkage allows the authors to control for a variety of unobservable characteristics of the company and the product but greatly limits the number of transactions that can be studied. Using information on export prices, they find evidence that U.S. companies set lower prices for related-party transactions than they do for unrelated-party transactions. That wedge increases with product differentiation and decreases with exchange-rate appreciation. Because their estimates are based on transactions that can be matched, the magnitude may not be relevant for a broader set of transactions because matched transactions are probably also transactions in which companies have limited flexibility in terms of how they can set their transfer prices.

⁹ Neiman (2010) also uses price data from the Bureau of Labor Statistics. He finds that prices for related-party transactions change more often than prices for unrelated-party transactions. However, he concludes that the difference he observes is unlikely to be driven by tax minimization. In the appendix, we discuss other factors that affect related-party trade.

Unlike the data used in this body of literature, our data do not separate trade prices and trade quantities. Instead, we focus on the effect of transfer pricing on nominal trade flows and apply the findings from this literature to support our hypothesis.

Our paper contributes to two existing areas of research. First, it contributes to the literature that has looked for evidence that profit shifting through transfer pricing affects flows of U.S. related-party trade. Second, it contributes to a recent literature that has looked at the effect of profit shifting on U.S. income accounts. This paper bridges those two bodies of literature by attempting to estimate how tax-sensitive transfer pricing causes flows of related-party trade to respond to changes in corporate tax rates and what the implications of that would be for U.S. income accounts.

Evidence on the Relationship Between Flows of Related-Party Trade and Taxes

There are two potential ways that tax-motivated transfer pricing can affect flows of related-party trade. First, by reducing the prices set for related-party exports, tax-motivated transfer pricing would reduce the value of related-party export flows; similarly, by increasing the prices set for related-party imports, the value of related-party import flows would rise. Second, companies might engage in more related-party trade because of the profit-shifting opportunities that tax-motivated transfer pricing provides.

Only a few studies have examined the impact of tax-motivated transfer pricing on trade flows. Clausing (2000) provides evidence that U.S. balances of related-party trade are lower with countries that have low corporate tax rates. Clausing (2006) finds patterns in the U.S. balance of related-party trade and trade flows that are consistent with both mechanisms and calculates that the U.S. related-party trade balance in 1999 would have been \$11.3 billion higher in the absence of tax incentives for tax-motivated transfer pricing. Bernard, Jensen, and Schott (2006) use their estimated price wedge for exports to produce an estimate of the overall effect of tax-motivated transfer pricing on U.S. imports, exports, and tax revenues. They estimate that tax differentials between the United States and its trading partners caused the value of related-party exports to be understated by \$1.9 billion in 2004 and the value of related-party imports to be overstated by \$13 billion. However, that exercise incorporates the assumption that related-party export and import values have an elasticity with respect to tax differentials that is equal to the elasticity that they find on the basis of matched export transactions. That assumption may not be realistic for two reasons: Transactions that can be matched are unlikely to be representative of all related-party trade, and U.S. related-party imports may differ from exports both in terms of the goods traded and in terms of the composition of trading partners.

Our paper is most closely related to Clausing (2006), although we use data from a more recent period, look at import and export flows separately, and present some results that specifically show how U.S. related-party imports and exports change when the tax differential between the United States and its trading partner changes. Separately focusing on those changes in tax rates

may provide more relevant estimates for thinking about how flows of U.S. related-party trade may respond to the recent reduction in the U.S. statutory corporate tax rate. That would be especially true if there was a quantity effect associated with tax-motivated transfer pricing—in other words, if the United States engaged in a great quantity of related-party trade with low-tax countries—and if that quantity effect was relatively inelastic with respect to changes in the tax differential. An elasticity of related-party trade estimated from a cross-sectional regression would capture that quantity effect. That could make the estimated elasticity less relevant for thinking about the effect of changes in tax rates.

Effect of Profit Shifting on U.S. Income Statistics

Recent papers indicate that profit shifting by U.S. multinational corporations distorts national income statistics for the United States. Results from Rassier and Koncz-Bruner (2015) suggest that official statistics understate U.S. income earned domestically by about \$150 billion. The authors arrive at that result by estimating how U.S. multinationals would allocate their income between their headquarters and affiliates if that allocation were based on a specific way of measuring the location's share of economic activity and not each location's reported income allocation.¹⁰ In related work, Guvenen and others (2018) estimate a larger effect of profit shifting on national income statistics for the United States than do Rassier and Koncz-Bruner.¹¹ They find that profit shifting lowered reported income earned in the United States by approximately \$280 billion in 2014.

Different methods of profit shifting have different implications for U.S. income accounts. On the one hand, profit shifting out of the United States through the location of debt affects the United States' net international investment position but does not affect GDP. On the other hand, profit shifting through transferring intellectual property to a low-tax jurisdiction reduces the nation's real (inflation-adjusted) net exports and real GDP because it changes where royalties and other revenues derived from intellectual property are recognized. Tax-motivated transfer pricing that moves profits out of the United States, the focus of this paper, reduces reported nominal exports and increases reported nominal imports. It would, therefore, reduce nominal net exports and nominal GDP.¹² Because of those different effects on U.S. income accounts, understanding the relative use of different profit-shifting mechanisms is important. However, there is limited evidence on that topic. Some research, including studies by Grubert (2003), McDonald (2008),

¹⁰ The approach used in Rassier and Koncz-Bruner (2015) to allocate income among affiliates is known as formulary apportionment.

¹¹ One reason the estimate in Guvenen and others (2018) may be larger than that in Rassier and Koncz-Bruner (2015) relates to differences in the time periods studied. Because Guvenen and others used data from 2014, whereas Rassier and Koncz-Bruner used data from 2009, some of the difference between those estimates may reflect growth in profit shifting over time.

¹² Because tax-motivated transfer pricing alters the prices set for related-party transactions but not the location of actual production, it affects reported nominal GDP but not real GDP.

and Heckemeyer and Overesch (2017), suggests that transfer pricing accounts for a significant portion of profit shifting, but those papers generally do not distinguish between the transfer pricing of goods and transfer pricing associated with intellectual property.

Although this paper does not focus on providing an estimate of total profit shifting out of the United States through tax-motivated transfer pricing of goods, the closer examination of the effect of tax differentials on related-party trade flows does provide some information on the magnitude of profit shifting through that mechanism. Specifically, this paper provides evidence that demonstrates how flows of related-party trade change when there is a change in the tax differential between the United States and one of its trading partners. That estimate can be used to do a back-of-the-envelope estimate of how the recent change in the U.S. statutory corporate tax rate will change profit shifting through tax-motivated transfer pricing and, therefore, how it will affect computations of nominal net exports and nominal GDP.

What Is the Expected Relationship Between Tax Rates and Flows of Related-Party Trade?

As discussed above, tax minimization is one reason that transfer prices could be sensitive to differences in corporate tax rates across countries. Tax differentials alter the incentives faced by multinational corporations when they choose to engage in related-party transactions and set prices for those transactions. Using a simple theoretical model based loosely on Egger and Seidel (2013), we show how changes in tax rates affect both choices.¹³

Model Set-Up

In this model, we explore how transfer-pricing incentives affect aggregate flows of related-party trade and flows of unrelated-party trade. Specifically, we show how those incentives may affect the share of an economy's total trade that occurs between related parties. The model is designed to illustrate how tax incentives may affect businesses when they decide between serving foreign markets through foreign affiliates or by exporting. For that reason, the model purposefully abstracts from a number of factors that may play a role in such decisions; those factors can include uncertainty (policy and economic), trade in intermediates, or differences in production costs that vary by location.

Consider a model of two countries, Home (H) and Foreign (F), each with a continuum of firms. Firms produce differentiated final goods that are consumed in both countries. Consumers in Home and Foreign demand q_i^h and q_i^f , respectively, from firm i at world prices (p_i^w). Production costs are equal to c per unit. Corporate income is taxed in each country at rates τ^h and τ^f .

¹³ See Egger and Seidel (2013).

Domestic firms can choose how to serve their foreign consumers. One option is to export goods directly to foreign consumers at price p_i^w , the world price. Alternatively, firms can open a foreign affiliate to serve as an intermediary in their foreign transactions. When a domestic firm chooses to open a foreign affiliate, the firm pays a per-unit cost, c^{rp} , to operate its affiliate and then sells to that affiliate the goods it wishes to sell in Foreign at price p_i^T , the transfer price. The foreign affiliate then resells q_i^f to consumers in the foreign market at the world price.

Firms can choose transfer prices that deviate from the world price for each good. However, tax authorities may penalize a firm if its transfer price deviates from the world price. The size of that penalty depends on two factors. The first factor is the magnitude of the deviation of the transfer price from the world price. The second factor is a firm-specific penalty, λ_i . That penalty denotes a firm-specific cost of deviating from the world price, reflecting the firm's ability to avoid detection from tax authorities. The idiosyncratic penalty for deviating from world prices represents a key difference between firms in this model. That penalty could be interpreted as the ease with which tax authorities can detect whether a product is improperly priced, in which case differences in that penalty among firms could reflect differences in the level of product differentiation.

Each firm chooses between serving the foreign market through trade between unrelated parties or through related parties. If the firm chooses unrelated-party trade, it will expect to earn profit, π_i^{AL} ; if, instead, that firm chooses to establish an affiliate as an intermediary, it will expect to earn profit, π_i^{RP} .

$$\pi_i^{AL} = (1 - \tau^h) \{ (p_i^w q_i^h + p_i^w q_i^f - c(q_i^h + q_i^f)) \} \quad (1)$$

$$\begin{aligned} \pi_i^{RP} = & (1 - \tau^h) (p_i^w q_i^h + p_i^T q_i^f - c(q_i^h + q_i^f)) \\ & + (1 - \tau^f) (p_i^w q_i^f - p_i^T q_i^f) \\ & - \frac{\lambda_i q_i^f}{2} (p_i^w - p_i^T)^2 - c^{rp} q_i^f \end{aligned} \quad (2)$$

Transfer prices are chosen to maximize profit, yielding the first-order condition:

$$p_i^T = p_i^w - \frac{(\tau^h - \tau^f)}{\lambda_i} \quad (3)$$

The resulting optimal transfer price depends on the tax differential and each firm's idiosyncratic penalty. The greater the tax differential, the greater the incentive to deviate from the world price, but firms with higher penalty costs choose transfer prices closer to the world price.

A firm will choose to operate an affiliate if $\pi_i^{RP} - \pi_i^{AL} > 0$, or when:

$$\frac{(\tau^h - \tau^f)^2}{2\lambda_i} > c^{rp} \quad (4)$$

Given the optimal transfer price, one can solve for the set of all penalty values for which a firm will choose to operate through an affiliate. A firm will choose to open an affiliate when its penalty value, λ_i , is less than or equal to a threshold penalty value, $\hat{\lambda}$. That threshold value can be solved for using a break-even condition in Equation 4:

$$\hat{\lambda} = \begin{cases} 1 & \text{if } \frac{(\tau^h - \tau^f)^2}{2c^{rp}} \geq 1 \\ \frac{(\tau^h - \tau^f)^2}{2c^{rp}} & \text{if } \frac{(\tau^h - \tau^f)^2}{2c^{rp}} < 1 \end{cases} \quad (5)$$

To estimate the share of total goods traded among related parties, we need to make some additional simplifying assumptions. First, assume that $\lambda_i \sim U(0,1)$ and $q_i^f = 1$ for all firms. Then, define total exports, $Q^X \equiv \int_0^1 q_i^f d\lambda_i = 1$. Finally, we can define our variable of interest, the related-party export share, RP^X , as the ratio of total nominal related-party exports to total nominal exports. Related-party shares of trade abstract from any factors that increase or reduce trade among both related parties and unrelated parties. Thus, the shares enable us to distinguish between the effects of taxes on those different categories of trade. Focusing on related-party shares of trade allows us to examine how taxes affect related-party and unrelated-party trade in different ways. If we assume that $p_i^w = p_w \forall i$ and define $\widehat{p^T} \equiv \int_0^{\hat{\lambda}} p_i^T f(\lambda) d\lambda_i$, then we can calculate the related-party share of exports:

$$RP^X = \left(\frac{\widehat{p^T}}{p^w} \right) \left(\frac{(\tau^h - \tau^f)^2}{2c^{rp}} \right) \quad (6)$$

Using a similar method, and assuming identical foreign firms, we can calculate the related-party share of imports:

$$RPM = \left(\frac{\widehat{p^T}}{p^w} \right) \left(\frac{(\tau^h - \tau^f)^2}{2c^{rp}} \right) \quad (7)$$

This model can also be extended to analyze the decisions about how best to service the domestic market by multinationals that produce goods abroad. That extension would yield the same results for equilibrium related-party shares of trade.

Predictions for Related-Party Shares of Trade

The equations derived for related-party shares of trade show the two mechanisms through which tax-motivated transfer pricing affects those trade shares. The first mechanism, also the first term in Equations 6 and 7, is the *price effect*. Relative to arm's length prices, multinational corporations in a high-tax country understate related-party prices on exports to affiliates in low-tax countries and overstate prices for related-party imports to high-tax countries. For a high-tax country, that wedge between transfer prices and arm's length prices reduces the related-party export share and raises the related-party import share.

The second way through which tax-motivated transfer pricing affects the related-party share of trade is through trade quantities—the *quantity effect*. The quantity effect is represented by the second term in Equations 6 and 7. When tax differentials rise, more firms are encouraged to take advantage of those differences by establishing foreign affiliates and engaging in related-party trade (or expanding existing foreign affiliates). As a result, when tax differentials widen, the quantity of related-party exports and the related-party export share from the high-tax country both rise. Because those same incentives exist for imports as well, the quantity effect also increases both related-party imports and the related-party import share in the high-tax country. Unlike the price effect, the quantity effect does not depend on the penalty function for deviating from world prices, but it is smaller if the cost of operating a foreign affiliate is high.

The model provides clear implications for how related-party import shares are likely to react to widening tax differentials but less clear-cut implications for export shares. Those implications are summarized in the table below. When tax differentials between high-tax countries and low-tax countries widen, the related-party import share in the high-tax country (such as the United States before enactment of the 2017 tax act) should rise unambiguously. That expected rise in the related-party import share reflects not only a positive quantity effect but also a positive price effect. For that country's related-party export share, the effect of falling foreign tax rates is unclear. A falling related-party export share would be consistent with a price effect that dominated the quantity effect. However, the converse would be true if the quantity effect dominated. Consequently, both a rising and falling related-party export share could be consistent with tax-motivated transfer pricing.

	Price Effect on Related-Party Trade	Quantity Effect on Related-Party Trade	Total Effect on Related-Party Shares of Trade
Imports	+	+	+
Exports	-	+	?

What Data Do We Use to Identify the Effect of Tax-Motivated Transfer Pricing on Aggregate Trade Flows?

Employing data on tax rates and trade flows, we empirically test the theoretical predictions from our model. That empirical analysis uses information on trade between the United States and foreign countries collected by the Census Bureau and information on statutory corporate income tax rates from the Organisation for Economic Co-operation and Development and KPMG International.

Census Related-Party Trade Database

Publicly available data on related-party and unrelated-party trade are available from the Census Bureau.¹⁴ That data set provides information on the nominal value of related-party and total trade flows between the United States and its trading partners and spans the period from 2002 to 2016. The data are available at the industry level and categorized using the North American Industry Classification System. The related-party trade database only captures trade in goods; it does not include trade in services. Because the data do not include information on trade in services (an area of trade particularly vulnerable to profit shifting), we are able to analyze only a small portion of all the trade subject to tax-motivated transfer pricing. The value of exports reported in the database also does not include re-exports.

In the Census data set, a related-party export transaction is defined as a transaction between a U.S. exporter and an ultimate consignee, wherein either party owns, directly or indirectly, 10 percent or more of the other party. A related-party import transaction is defined by the Census Bureau as an international transaction between parties with various types of relationships including “any person directly or indirectly owning, controlling, or holding with power to vote, 5 percent or more of the outstanding voting stock or shares of any organization and such organization.” By using those relatively broad definitions of related-party transactions, the

¹⁴ Some companies may maintain different transfer prices for customs purposes than they do for tax purposes, especially because the price that minimizes customs duties can be different from the price that would minimize corporate taxes. If companies do set different prices, then our use of customs data would limit our ability to pick up responses to changes in tax rates.

Census data set may label transactions as being between related parties that, in practice, are much more comparable to unrelated-party transactions.

Our analysis focuses on the 50 U.S. trading partners with the largest shares of U.S. trade—both for imports and for exports.¹⁵ The largest U.S. import partners include China, Canada, and Australia, and the largest U.S. export partners include Japan, the United Kingdom, and Brazil.

Statutory Corporate Income Tax Rates

We combine information on top statutory corporate income tax rates from two sources: the OECD and KPMG International.¹⁶ The OECD Tax Database includes information on the top national and subnational corporate income tax rates for 95 countries, starting in 2000; KPMG publishes information on statutory corporate income tax rates for various countries after 2002. Our measure of statutory corporate income tax rates includes both the national and the subnational tax applied to corporations. We choose to use the statutory tax rate because it comes closest to capturing the incentive that companies have to move profits between countries.¹⁷ Some countries may allow special agreements that lower the tax rate that profits from certain transactions would actually face. For countries with those arrangements, our measure of the tax differential with the United States could understate the actual differential.

Is the Empirical Relationship Between Tax Rates and Related-Party Shares of Trade Consistent With Tax-Motivated Transfer Pricing?

Corporate income tax rates are generally positively correlated with the value of related-party trade between companies located in the United States and their foreign affiliates. Table 1 shows that countries with low corporate income tax rates or other favorable tax provisions, such as Ireland, the Netherlands, and Singapore, exhibited larger than average related-party shares of trade with the United States in 2016. For example, 46 percent of U.S. exports to the Netherlands were between related parties, significantly above the 31 percent average share. Similarly, related-party imports from Ireland accounted for 91 percent of total imports, considerably higher than the 51 percent average related-party share of imports.

¹⁵ We define the top 50 U.S. import partners by summing the value of U.S. imports for all years and ranking trading partners on the basis of that total value. The same process is used to define the top 50 U.S. export partners. Because trade with the largest trading partners accounts for most of U.S. trade flows, including all trading partners would not change the results of our analysis.

¹⁶ For information on the statutory corporate income tax rates collected by the OECD, see <https://stats.oecd.org/>. KPMG's corporate tax rates table is available at <https://tinyurl.com/qbf9wmu%20>.

¹⁷ Other measures would be more appropriate if we were instead considering how companies decide where to locate investment. For more information on cross-country differences in corporate taxation, see Congressional Budget Office (2017).

Results from our empirical analysis suggest that the relationship between corporate income tax rate differentials and related-party shares of trade is generally consistent with tax-motivated transfer pricing. In our analysis, we focus on the United States in the years from 2002 through 2016, when the country had one of the highest statutory corporate income tax rates among OECD nations. Examining cross-sectional differences, we show that the United States tended to have a greater related-party share of imports and a lower related-party share of exports with countries that had lower corporate income tax rates—and thus there were greater corporate income tax rate differentials (CITRD) between the United States and those countries.

Furthermore, changes in tax differentials between the United States and its trading partners are correlated with changes in related-party shares of trade that are consistent with the predictions of our theoretical model.¹⁸ Then, we pool periods in which tax differentials change and examine how related-party shares of trade adjust during and after those events. Results from that analysis are also consistent with the existence of tax-motivated transfer pricing.

How Do Related-Party Shares of Trade and Tax Rate Differentials Vary Across U.S. Trading Partners?

A simple examination of the observed relationship between tax differentials and related-party shares of trade across U.S. trading partners suggests that tax-motivated transfer pricing may affect U.S. trade flows. Figure 1 presents correlations between corporate income tax rate differentials and U.S. related-party shares of trade for top U.S. trading partners in each year between 2002 and 2015. In those years, the United States had a relatively high statutory corporate income tax rate. Therefore, in this analysis, we would expect tax-motivated transfer pricing to understate the prices for U.S. related-party exports while overstating the prices for U.S. related-party imports. Given positive quantity effects for both related-party exports and imports, we would expect to see a positive relationship between tax differentials and the related-party share of imports. However, the expected relationship for related-party exports could be either positive or negative, depending on whether the price effect or the quantity effect dominates.

Consistent with our theory of tax-motivated transfer pricing, Figure 1 shows that wider tax differentials between the United States and each partner are associated with larger related-party shares of U.S. imports. In other words, U.S. imports tend to have a larger share of related-party trade when the incentive for tax-motivated transfer pricing is strongest—that is, when trading with partners with lower corporate tax rates.

¹⁸ In many cases, transfer-pricing arrangements are negotiated between the company and the two countries involved in the transaction. As a result, a company may have limited ability to adjust its transfer price in response to a change in the tax differential because doing so could attract the attention of the tax authorities in one or both countries. However, even with that potential for limited flexibility, we find that changes in tax rates are associated with changes in related-party shares of trade.

The observed negative correlation between tax differentials and the related-party share of U.S. exports also might be indicative of tax-motivated transfer pricing. That consistent negative correlation suggests that the price effect may play an important role in suppressing reported nominal export values when tax differentials are larger. If tax differentials were positively correlated with the quantity of goods exported, as theory would suggest, the influence of tax differentials on the prices set for related-party transactions would be even larger than predicted by the correlation between tax differentials and related-party exports.

In addition, the correlations for both imports and exports appear to be strengthening over time. That trend may be indicative of an increase in the use or intensity of tax-motivated transfer pricing. If true, that hypothesis would help explain the changes to both of those correlations in the years around the global financial crisis that occurred between 2008 and 2010. Slow growth in corporate profits in those years may have encouraged multinational corporations to reduce tax liabilities through profit shifting. That increase in profit-shifting behavior is demonstrated in the following way: The import correlation rises, and the export correlation falls over time. Both patterns are consistent with an increase in tax-motivated transfer pricing.

Although the correlations presented in Figure 1 are generally consistent with tax-motivated transfer pricing, other factors may be driving those correlations and some of the fluctuations in those correlations. There are a number of nontax determinants of related-party trade; those include factors related to the economy, specific types of transactions, institutions, and nonrate features of the tax systems. For example, higher tax rate differentials could be positively correlated with both the U.S. related-party import shares from foreign countries and those foreign countries' GDP per capita. In that case, higher related-party import shares could reflect the fact that the volume (but not the price) of goods imported from that foreign country are higher because of its stronger economic activity. (See the appendix for a more detailed discussion of some of the factors, other than tax rates, that affect related-party trade.)

To control for those other factors that might affect related-party shares of trade, we employ regression analysis. In those regressions, we attempt to control for the different characteristics of U.S. trading partners that might also affect the related-party shares of trade between the United States and foreign countries. We include measures of trading partners' GDP per capita, unemployment rates, capital endowment, economic freedom, and institutional quality.¹⁹ The

¹⁹ The choice of explanatory variables is based on previous work on this topic. See, for example, Lanz and Miroudot (2011). Measures of physical and human capital endowment are defined in Hall and Jones (1999). The measures of economic freedom were developed by the Heritage Foundation and include indexes for business, investment, trade, and financial freedom. (For details, see <http://www.heritage.org/index/explore?view=by-region-country-year>.) The Worldwide Governance Indicators were constructed by the World Bank and include indexes for voice and accountability, regulatory quality, rule of law, and control of corruption. (See <http://info.worldbank.org/governance/wgi/#home>.)

results for the related-party import regressions are presented in Table 2, and the regressions on related-party export shares are shown in Table 3.

The import share regression results shown in Table 2 are generally supportive of the hypothesis that tax differentials affect the related-party share of imports in a way that is consistent with tax-motivated transfer pricing. In all regressions in which tax differentials have statistically significant explanatory power, we find that a 1 percentage-point increase in the tax differential is associated with a 0.24 to 0.51 percentage-point increase in the related-party import share. That relationship reflects both positive price and quantity effects. The results are robust to including variables that capture economic and institutional differences across countries, though the magnitude of the coefficient decreases as those variables are added. The decrease in the magnitude of the coefficient could, for example, reflect reductions in partner countries' corporate income tax rates being accompanied by other changes that protect property rights or improve institutions that protect foreign investment. In our analysis, rate differentials are positively correlated with indexes for business (0.25), investment (0.11), trade (0.26), and financial freedom (0.16); with indexes for regulatory quality (0.19), rule of law (0.14), and control of corruption (0.13); and with measures of a country's physical capital (0.13) and human capital (0.07). Those measures are also positively correlated with flows of related-party trade, therefore limiting the positive effect of rate differentials on those flows.²⁰

In the export share regressions, in Table 3, we find a robust negative relationship between tax differentials and the U.S. related-party export share. In those regressions, we find that a 1 percentage-point increase in the tax differential is associated with a 0.32 to 0.51 percentage-point reduction in the related-party export share. That result echoes the observation in Figure 1 that the price effect that pushes down the related-party export share is likely to dominate the quantity effect that should raise the related-party export share.

How Do Changes in Tax Rate Differentials Affect Related-Party Shares of Trade?

To better understand the effect that tax differentials have on flows of related-party trade, we examine how changes in tax differentials affect related-party shares of trade. Exploiting instances from 2003 through 2015 in which statutory corporate tax rates changed, this analysis tries to identify how the resulting changes in the tax differentials affected related-party trade, on average, for all U.S. trading partners by eliminating the influence of some of the other factors that may affect flows of related-party trade (to the extent that those other factors are independent of the changes in tax rates).

²⁰ However, it is possible that the measures of the legal, regulatory, and administrative environment used here capture institutional changes with some delay, therefore biasing the contemporaneous effect of rate differentials on trade flows, even after controlling for contemporaneous changes in the institutional environment. Whether that delayed effect on trade flows would be different for related- and unrelated-party trade is unclear.

To examine how changes in tax differentials affect related-party shares of trade, we first present evidence that shows how related-party shares of trade change over long periods in response to changes in tax differentials. That evidence is shown in Figure 2, which plots the relationship between changes in related-party shares of trade over the period from 2002 through 2016 among the United States and its trading partners and the changes in the statutory corporate tax rate in the intervening years from 2003 through 2015 for those trading partners.²¹ Those changes were measured as the differences in the statutory corporate tax rates and related-party shares of trade over those years. We focus on the years 2003 through 2015 for tax changes to remove the possibility that tax changes in 2002 influenced the measure of the related-party share of trade in that initial year for which data were available. We did not include tax changes in 2016 because changes in tax rates in that year would probably take some time to be reflected in trade data.

Over a long period, it appears that related-party shares of trade respond to changes in tax differentials in a way that is consistent with tax-motivated transfer pricing. Panel A shows a negative correlation between changes in tax rate differentials and related-party export shares, whereas Panel B shows a positive correlation between changes in tax rate differentials and related-party import shares. Consistent with tax-motivated transfer pricing, this evidence suggests that U.S. trading partners whose tax rates fell the most over the 2003–2015 window also experienced larger declines in U.S. related-party export shares and larger increases in U.S. related-party import shares.

We next examine how related-party shares of trade change in the periods before and after changes to tax differentials. Restricting our analysis to a selected set of changes in rate differentials is preferable because it allows us to more precisely isolate the effect of rate differentials on related-party shares of trade. However, it comes at the cost of lowering the size of the sample we use and therefore the statistical precision of our estimates. Specifically, we select all instances in the years from 2002 to 2016 for which tax rate differentials changed and examine the change in the trade shares in the two years preceding and following the enactment of the new rate.²² From that sample, we exclude all instances in which another change in the rate differential occurs over those four years and instances in which trade data are unavailable between the United States and that trading partner for the entirety of that same window.²³ That

²¹ The evidence presented is robust to excluding countries with no changes in corporate income tax rates and oil-producing countries.

²² Focusing on longer periods around changes in rate differentials would reduce the set of changes considered in the analysis. Focusing on shorter periods would increase the set of changes considered but would prevent us from checking for trends before changes occurred and from identifying longer-term effects on trade after the changes occurred.

²³ In addition, we exclude changes in rate differentials lower than 0.5 percentage points because they are mostly driven by changes in local rather than federal rates. We also exclude tax changes in oil-producing countries. Their inclusion would not affect our results.

sample includes 22 changes in tax rate differentials in the top 50 export partners and 21 changes in tax rate differentials in the top 50 import partners, all of which involved increases in tax differentials.²⁴ The events included in that sample are presented in Panel A of both Figure 3 and Figure 4, for exports and imports, respectively.

When tax differentials change, U.S. related-party shares of trade tend to move in a way that would be consistent with tax-motivated transfer prices. Panel B in Figure 3 depicts the average movement of the U.S. related-party export share within a two-year window around a change in a tax differential between the United States and a trading partner. On average, the related-party share of exports decreases after an increase in the tax rate differential. As shown previously, the price effect appears to dominate the quantity effect for related-party exports. The movement in the related-party export share implies that a 1 percentage-point increase in the tax differential reduces the related-party export share by roughly 0.24 percentage points.²⁵ That effect is smaller in magnitude than the estimates from Table 2. One important difference is that the estimates in Table 2 are based not just on changes in tax differentials, but also on cross-country differences in tax rate differentials in any given year. A second important difference is that this exercise includes a smaller subset of countries experiencing a change in corporate tax rates. Focusing exclusively on a selected set of changes in rate differentials allow us to control for the effect of permanent differences in country-specific characteristics on related-party export shares. The relationship for imports is depicted in Figure 4. As expected, on average, the related-party share of U.S. imports increases around changes in rate differentials. The change in the related-party import share implies that a 1 percentage-point increase in the tax differential raises the related-party import share by roughly 0.29 percentage points. That estimate is larger in magnitude than the estimate reported in Column 6 of Table 3, which takes into account economic and institutional differences across import partners. Focusing on changes in rate differentials enables us to control for permanent differences in country-specific characteristics that we do not take into account in Table 3.

Importantly, isolating the effect of changes in rate differentials does not alter the nature of the results. The evidence presented in Figure 3 and Figure 4 is consistent with companies' adjusting their transfer prices in a way that would reduce taxes in response to a change in the tax

²⁴ Over that period, all changes in the corporate tax rates of trading partners were reductions, whereas the federal statutory corporate tax rate in the United States did not change.

²⁵ That estimate is computed by calculating the difference between the related-party share of exports two years after the change in rate differential and that share one year before the change and then dividing that difference by the average change in the rate differential.

differential.²⁶ However, when we control for the rise in related-party shares of trade for other large trading partners that did not experience changes in corporate income tax rates over those years, the elasticities adjust fairly substantially—specifically, the import elasticity falls to -0.06, and the export elasticity falls to -0.36.²⁷ In particular, Panel A of Figure 5 shows the difference in related-party exports between those countries within the top 50 export partners that experienced an increase in tax differential (our treatment group) and those within the top 50 export partners that did not experience a change in that same year or in the two years preceding or following that year (our control group). The difference between the two groups is normalized to the difference one year before the change in the tax differential. Similarly, Panel B of that same figure shows the difference in related-party imports between countries within the top 50 import partners that experienced an increase in tax differential and those within the top 50 import partners that did not experience a change in that same year or in the two years preceding or following that year.

The graphical evidence presented in Figure 5 is consistent with the elasticities reported in Table 4. Figure 5 plots the estimated difference in the movement of the related-party shares of trade between our treatment and control groups in the years around changes in rate differentials. Columns (1) and (3) of Table 4 estimate the following equation:

$$\text{RP Trade Share} = \alpha + \beta * \text{Treat} + \sum_{j=-2}^2 [I_j (\rho_j + \gamma_j * \text{Treat})] + \varepsilon \quad (8)$$

In Equation 8, the estimates for γ_j show the average difference in the related-party share of trade between the treatment and control groups j years after the change in rate differential relative to the year before that change (ρ_{-1} and γ_{-1} are set to zero). The variable I_j indicates the position of each observation within a two-year window around a change in rate differentials. We estimate that, relative to the year before the tax change, the related-party share of imports decreased by 0.86 percentage points (though the effect is not statistically significant) and the related-party share of exports decreased by 2.41 percentage points two years after the change in rate differential.

After estimating the average differences between treatment and control groups in response to tax rate changes, we use an alternative specification to estimate differences in the response of the treatment and control groups to a 1 percentage-point increase in the tax rate differential. Columns (2) and (4) of Table 4 show the results of this specification:

²⁶ Changes in tax differentials for large trading partners are prevalent in 2008 and 2009, as shown in Panel A of both Figure 3 and Figure 4. However, as shown in Figure A-1, related-party exports and imports change in a way that is consistent with tax-motivated transfer pricing even around changes in tax differentials in other years.

²⁷ We exclude the largest import partner (China) and the largest export partner (Canada) from this exercise because trade between the United States and those countries is substantially larger than trade with other countries. Therefore, excluding those countries improves the comparability between the treatment and control groups.

$$\text{RP Trade Share} = \alpha + \beta * \Delta\text{CITRD} + \sum_{j=-2}^2 [I_j(\rho_j + \gamma_j * \Delta\text{CITRD})] + \varepsilon \quad (9)$$

Here, γ_j is the estimated effect of a 1 percentage-point increase in the rate differential (ΔCITRD) on the difference between the treatment and control groups j years after the change in that rate differential relative to the year before that change (ρ_{-1} and γ_{-1} are set to zero). Our estimates of γ_j suggest that a 1 percentage-point increase in the rate differential is associated with a reduction of 0.06 percentage points in the related-party share of imports and of 0.36 percentage points in the related-party share of exports two years after the tax change. We use those estimates to calculate the effects on aggregate trade flows.

Alternative Explanations for the Observed Relationship Between Tax Rates and Related-Party Shares of Trade

The empirical relationship between tax differentials and related-party shares of trade is consistent with our theoretical predictions of how tax differentials affect related-party shares of trade under tax-motivated transfer pricing. However, there are other reasons that there might be a relationship between tax differentials and related-party trade, but those explanations might imply trade patterns that are different from those that are observed. Any alternative explanations would need to indicate why increasing the difference between the U.S. corporate tax rate and foreign corporate tax rates raises the U.S. related-party share of imports while reducing its related-party share of exports. The most plausible of those alternative explanations are tax-motivated offshoring and an income effect.

Offshoring

Tax-motivated offshoring could potentially explain the observed relationship between tax rates and related-party trade. Unlike tax-motivated transfer pricing, tax-motivated offshoring would describe a change that involves firms relocating their production in response to a change in tax rates.

There are a variety of ways through which offshoring might affect trade flows, but only one way that is consistent with the observed relationship between tax rates and related-party shares of trade. A reduction in foreign tax rates might encourage firms in the home country to minimize their tax liability by shifting production to affiliates in that foreign country. Consumers in the foreign country would then substitute locally produced goods for exports from the home country; in addition, foreign firms that were operating affiliates abroad might respond to a tax reduction in the home country by reshoring their production. Those changes in the location of firms would affect domestic trade flows by reducing exports and increasing imports. However, if that locational adjustment affected both related-party and unrelated-party trade equally, it would yield no change in related-party shares of trade.

For offshoring to explain the observed relationship between tax rates and related-party shares of trade, it must be the case that it is easier for multinationals to shift production to foreign affiliates than it is for firms that did not already have foreign affiliates. If that were the case, a reduction in foreign tax rates would elicit a greater decline in related-party exports than unrelated-party exports and a greater increase in related-party imports than arm's length imports. The resulting changes to related-party shares of trade would be consistent with the observed relationship.

However, there are a number of reasons to doubt this hypothesis. The offshoring hypothesis implies a model of trade with horizontally integrated firms that have flexible capacities. For firms that are vertically integrated or rely on production inputs that are specific to a certain location, it may not be possible to readily relocate production. In addition, this explanation would imply a relationship between tax rate changes, direct investment flows, and trade flows that is not borne out in the data. In Figure 6, we show that related-party export flows tend to increase in countries that are recipients of outward foreign direct investment (FDI).²⁸ That relationship suggests that, in the aggregate, FDI and exports tend to be complements rather than substitutes—indicating that offshoring is not likely to be the source of the observed relationship between tax rates and flows of related-party trade.

Income Effect

When a country's average corporate tax rate falls, after-tax corporate earnings rise as less revenue is needed to satisfy tax liabilities. That increase in corporate income could be used to capitalize additional investments, be paid to owners, or be passed through to consumers in the form of lower prices. Any of those uses of the new income would stimulate additional trade flows. New investments typically require some share of imported capital goods, whereas lower product prices would most likely stimulate additional exports and additional imports of intermediate inputs.

It is possible that income effects may explain the observed relationship between corporate tax rates and the related-party share of trade. Results from a recent paper by Lakatos and Ohnsorge (2017) suggest that the income elasticity of U.S. unrelated-party exports is 20 percent larger than the income elasticity of exports for affiliated firms but is positive for both types of trade flows. That finding implies that the negative correlation between the U.S. related-party share of exports and corporate income tax rate differentials may be explained by an income effect. However, the findings in Lakatos and Ohnsorge suggest that unrelated-party trade is generally more responsive than related-party trade to economic conditions such as income and exchange rates. That conclusion is not at odds with our hypothesis that tax rates are key drivers of differences between unrelated-party and related-party trade.

²⁸ A similar positive correlation between the change in related-party exports and U.S. foreign direct investment abroad holds when excluding China from the sample.

How Might Changes to Corporate Tax Rates Affect Macroeconomic Statistics Through Changes in Transfer Prices?

Using our results, we can illustrate how a change in corporate tax rates might affect statistics that measure trade in goods and other aggregate statistics. To do so, we use as an example the reduction in the U.S. corporate tax rate made by the 2017 tax act. Beginning in 2018, the top U.S. federal statutory corporate income tax rate fell 14 percentage points to 21 percent. The reduction had a slightly smaller effect on the combined federal and average state rate because state taxes are deductible. The combined rate fell 13.1 percentage points—from 38.9 percent in 2017 to 25.8 percent in 2018. That reduction in the corporate tax rate reduced tax differentials between the U.S. and its trading partners and, in turn, reduced the incentive for multinationals to use transfer prices to shift income out of the United States. However, because we cannot prove that transfer pricing is the only factor driving the observed relationship between tax rates and flows of related-party trade, our estimated effects can be interpreted as an upper bound on the effect of transfer pricing on trade flows and macroeconomic statistics.

In this exercise, we apply the results of our analysis to calculate a back-of-the-envelope estimate of how changes in the U.S. corporate income tax rate may alter related-party shares of imports and exports. For that calculation, we rely on our analysis of the effect of changes in tax rates on related-party shares of trade (in Figure 6 and Table 4). Although it is based on a smaller set of observations, that analysis is preferable because it allows us to more precisely isolate the effect of tax rate differentials on related-party shares of trade. Unlike the results presented in Table 2 and Table 3, that calculation relies only on changes in rate differentials and controls for the effects of permanent differences in country-specific characteristics that are correlated with both rate differentials and related-party shares of trade. That analysis provides estimates for the elasticities of export and import related-party shares of trade with respect to tax differentials. Those estimates imply that a 1 percentage-point increase in the tax differential reduces the related-party share of imports by roughly 0.06 percentage points and the related-party share of exports by roughly 0.36 percentage points.

To estimate the effect of the recent tax change on flows of aggregate U.S. trade, we apply those adjusted elasticities in conjunction with the 13.1 percentage-point reduction in the statutory corporate income tax rate that resulted from the 2017 tax act.²⁹ That estimate provides us with an expected change in both the related-party share of U.S. exports and the related-party share of

²⁹ For those computations, we need to make the assumption that those elasticities are constant and symmetric. Those assumptions, while necessary, are inconsistent with recent evidence presented in Dowd, Landefeld, and Moore (2017). However, their results measure the elasticity of reported income with respect to tax rates, so they capture the effects of all methods of profit shifting. For some of those methods, such as the choice of where to locate intellectual property, shifting will occur only to the lowest-tax affiliate, which would cause the elasticity to be nonconstant. The relationship between tax rates and transfer prices is more likely to be something approaching constant and symmetric because that opportunity for minimizing taxes arises with all affiliates, not just the lowest-tax affiliate.

imports. Then, to calculate how those changes are likely to affect related-party and overall flows of trade, we hold the value of unrelated-party trade constant and assume that the only adjustment taking place is to the value of related-party trade flows. Without that assumption, we would be unable to estimate aggregate effects on trade. With that assumption, we can calculate the extent to which the value of related-party trade flows would need to change to adjust the related-party share of trade for both exports and imports. Those changes to related-party imports would, in turn, affect total nominal exports and imports. By applying the average elasticities to each bilateral trade relationship, we estimate country-by-country trade effects. Those bilateral effects are then summed across all trading partners to calculate aggregate effects. For those calculations, we use data on aggregate trade in goods and related-party trade in goods for 2016.

Our calculations suggest that the reduction in the U.S. tax rate is likely to have a large effect on nominal trade values through a reduction in tax-motivated transfer pricing. Using the reduction in the U.S. statutory rate and the estimated elasticities, we calculate that the related-party share of exports would rise 5 percentage points, whereas the related-party share of imports would rise by 1 percentage point. Those changes would increase aggregate exports by \$93 billion, aggregate imports by \$42 billion, and in turn, the U.S. trade balance by roughly \$51 billion. Those effects would reduce the roughly \$552 billion U.S. trade deficit in 2016 by about 9 percent.³⁰ The reduction in the trade deficit resulting from the decline in tax-motivated transfer pricing would also raise both GDP and corporate income in the United States by 0.3 percent and 2.5 percent, respectively.

However, those estimates most likely represent an upper bound on the effect of transfer pricing on aggregate statistics for a number of reasons. First, it is unclear whether transfer pricing is the only factor driving the observed relationship between tax rates and related-party shares of trade. Second, the elasticities we calculated probably overstate the expected effect of the recent reduction of the statutory tax rate on U.S. trade flows. Research suggests that the effect of tax differentials on profit shifting might not be symmetric. In other words, a 1 percentage-point increase in tax differentials would most likely lead to a greater increase in profit shifting than a 1 percentage-point decrease in tax differentials would reduce profit shifting. Because the sample of tax differential changes that generated those parameters includes only increases in tax differentials, the estimated parameters might imply a larger-than-expected effect on profit shifting from a 13.1 percentage-point reduction in tax differentials. Third, our estimates probably overstate the effect of transfer pricing because the laws in place to prevent tax-motivated transfer pricing might limit the ability of multinational companies to reverse their transfer-pricing practices. Those limits might prevent large adjustments to trade prices and aggregate economic statistics. Fourth, limits on tax minimization through transfer pricing have most likely been

³⁰ If we instead set the effect on imports to be zero because of the unexpected, and statistically insignificant, negative effect of changes in rate differentials on related-party shares of imports that we estimate in Column 2 of Table 4, the U.S. trade deficit in 2016 would change by roughly \$93 billion, or 17 percent.

tightened over time because of the OECD's Base Erosion and Profit Shifting project and increased requirements for transfer-pricing documentation among countries. Consequently, our estimates of the responsiveness of the related-party shares of trade to changes in tax rates, which use tax rate changes as far back as 2004, could overstate the ability that corporations have had to adjust their transfer prices in more recent years.

Our estimate of the effect of transfer pricing on the U.S. trade balance is significantly larger than the effects estimated in previous papers. Evidence from Clausing (2006) and Bernard, Jensen, and Schott (2006) suggested that the reported U.S. trade deficit would have been \$10 billion to \$15 billion smaller if not for tax-motivated transfer pricing. Though we believe that our \$51 billion estimate overstates the effect of transfer pricing on the U.S. trade balance, the estimates from previous papers would probably be larger if those analyses were updated using recent data. Evidence from Guvenen and others (2018) indicates that the amount of profit shifted out of the United States increased substantially in the years after those analyses were completed. Therefore, it is probable that the effect of transfer pricing on the U.S. trade balance is now greater than the \$10 billion to \$15 billion estimates from more than 10 years ago.

Although the estimated effect of the 2017 tax act on transfer pricing that is described in this paper is certainly overstated, it is still worth noting that, at \$51 billion, it is larger than estimates that CBO has previously published. In the agency's analysis of the 2017 tax act described in its April 2018 *Budget and Economic Outlook*, CBO estimated that the tax act would reduce the amount of profit shifted out of the United States by roughly \$65 billion per year, on average.³¹ In that analysis, only a small portion of the reduction in profit shifting was attributed to changes in transfer pricing.³² That small estimated effect of the 2017 tax act on transfer pricing and aggregate economic statistics was informed by CBO's calculations and by the previous estimates from the literature. The analysis presented here suggests some upside risk to that previous estimate and points to an area that warrants further research.

Conclusion

In this paper, we provide evidence that tax-motivated transfer pricing affects aggregate trade statistics for the United States. That evidence suggests that, for the period studied, tax-motivated transfer pricing, through its effect on flows of related-party trade, had a large negative effect on U.S. export prices and nominal export values and a smaller positive effect on U.S. import prices and nominal import values. The 2017 tax act lowered the U.S. corporate income tax rate substantially and, by doing so, reduced the incentive for multinationals to shift profit out of the United States through tax-motivated transfer pricing. We estimate the effect of that change in tax

³¹ See Congressional Budget Office (2018).

³² CBO attributed the majority of that reversal in profit-shifting behavior to a reduction in the use of other profit-shifting strategies such as debt location and intellectual-property transfers.

rates and find that the resulting decline in tax-motivated transfer pricing would raise the U.S. trade balance by 9 percent and reported U.S. nominal GDP by 0.3 percent. However, because changes in taxation probably have nonlinear effects on the incentive to shift profits and because of the fact that legal restrictions limit the flexibility corporations have to alter their transfer prices, those effects probably overestimate the overall impact of the 2017 tax act on trade statistics.

Given the findings in this paper, a natural extension of this work would be to determine how much of the observed relationship between tax rates and related-party shares of trade is driven by price changes versus quantity changes. With detailed related-party trade data that separate trade prices and quantities, it would be possible to do just that. Those data would allow us to differentiate between competing explanations for the findings in this paper. For example, a stronger price effect could eliminate offshoring as a competing explanation. In addition, more detailed data would allow us to examine how different industries' trade prices respond to changes in tax rates. The ability to answer those questions would significantly improve our understanding of how multinational corporations set transfer prices.

Appendix: Factors Affecting Related-Party Flows of Trade

The existing literature has identified a number of reasons why multinational corporations engage in related-party trade. The determinants of related-party trade can be divided into four broad groups: economic, transaction-specific, institutional, and tax-related factors.

Economic Factors

The economic resources of the trading partner are important determinants of related-party trade. For example, previous work shows that multinational corporations' exports of intermediate goods to their foreign affiliates allow those corporations to take advantage of differences in factor prices and foreign countries' lower production costs.³³ Endowments of physical and human capital have also been shown to have a positive effect not just on total trade, but also on intrafirm trade more specifically.

More broadly, the existing empirical evidence points to the positive correlation between related-party trade and the gross domestic product (GDP) per capita of foreign trading partners. Researchers have found that U.S. related-party trade into and out of the United States mainly occurs with developed countries rather than developing economies.³⁴

Transaction-Specific Factors

Related-party trade also depends on the nature of the transaction being conducted. Specifically, recent empirical research has shown that intrafirm trade increases if products are more complex or more difficult to contract.³⁵ The main reason behind this empirical finding is that related-party trade helps mitigate the "hold-up" problem, which is the tendency of multinational corporations to underinvest when engaging in a contractual agreement with a foreign counterparty because of the fear that the counterparty will not comply with the contract.

The empirical literature also shows that intrafirm trade tends to be more prevalent in capital- and skill-intensive industries, where vertical integration alleviates the hold-up problem.³⁶ That empirical finding is consistent with the predictions of theoretical models showing that, when the bargaining power of the supplier of capital is low, capital cost-sharing with the final producer of goods can reduce the hold-up problem. A similar arrangement is harder to achieve in labor-

³³ See Lanz and Miroudot (2011).

³⁴ See Lakatos and Ohnsorge (2017).

³⁵ See Corcos and others (2013); and Costinot, Oldenski, and Rauch (2011).

³⁶ See Nunn and Trefler (2008, 2013); and Bernard and others (2010).

intensive industries, where the potential for cost sharing is more limited and mainly applies to labor training.³⁷

Measures of product contractibility often interact with institutional factors, which are described in the next paragraph, but there is contrasting evidence on that relationship. Some studies find that more imports will be intrafirm if a product is difficult to contract and that this is especially true for countries with weak governance.³⁸ Other studies find that intrafirm imports are higher in relationship-specific industries from countries with a strong “rule of law” (generally referring to the quality of contract enforcement, property rights, law enforcement, and the judicial system).

Institutional Factors

The quality of contract enforcement and property rights, as well as policies and regulations that facilitate private-sector development, are also important determinants of related-party trade. Previous research has shown that a country’s contracting environment has a positive effect on international trade and that an increase in the quality of institutions favors intrafirm trade.³⁹ For example, a well-functioning judicial system has been found to be associated with higher intrafirm trade.

The regulatory and infrastructure environments, which can constrain the efficient operation of businesses in foreign countries, have also been emphasized as important determinants of related-party trade.⁴⁰ For example, regulatory restrictions on foreign investment (such as restrictions on payments, transfers, and capital transactions), the existence of investment treaties, and measures mandating local presence to gain access to foreign markets are all believed to increase intrafirm trade.

Additionally, the independence of the financial sector from government interference or control also matters for related-party trade. For instance, recent empirical evidence shows that intrafirm trade is more likely to occur with affiliates in countries that have unstable financial institutions, and that the effect of financial development is larger when trade involves complex goods.⁴¹

³⁷ For theories on how integration and intrafirm trade are more prevalent in capital-intensive industries, see Antràs (2003); and Antràs and Helpman (2004, 2008).

³⁸ See Bernard and others (2010).

³⁹ For an empirical study on the effect of institutions on trade, see Levchenko (2007). For evidence on the link between intrafirm trade and the quality of institutions, see Antràs and Helpman (2004); Bernard and others (2010); and Corcos and others (2013).

⁴⁰ For a comprehensive list of institutional determinants of related-party trade, see Lanz and Miroudot (2011).

⁴¹ See Carluccio and Fally (2012).

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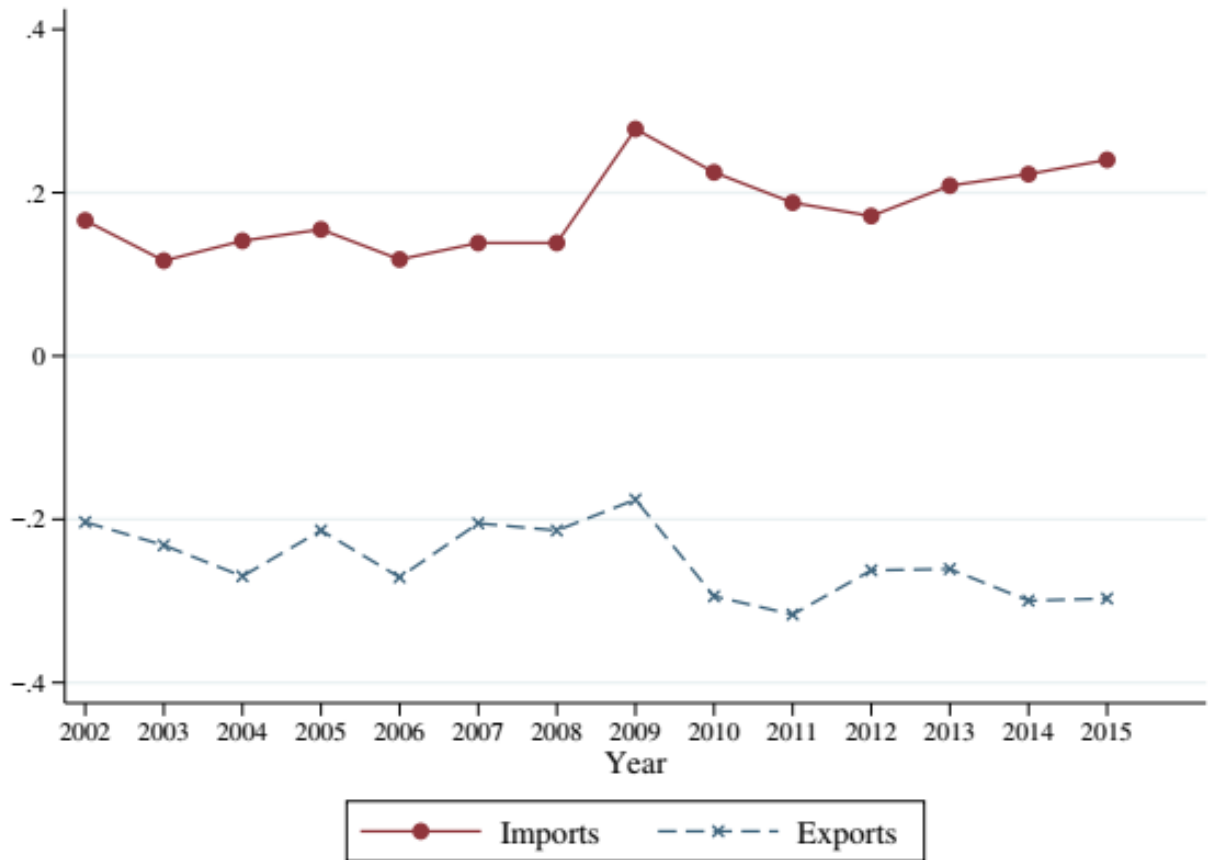
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Figures

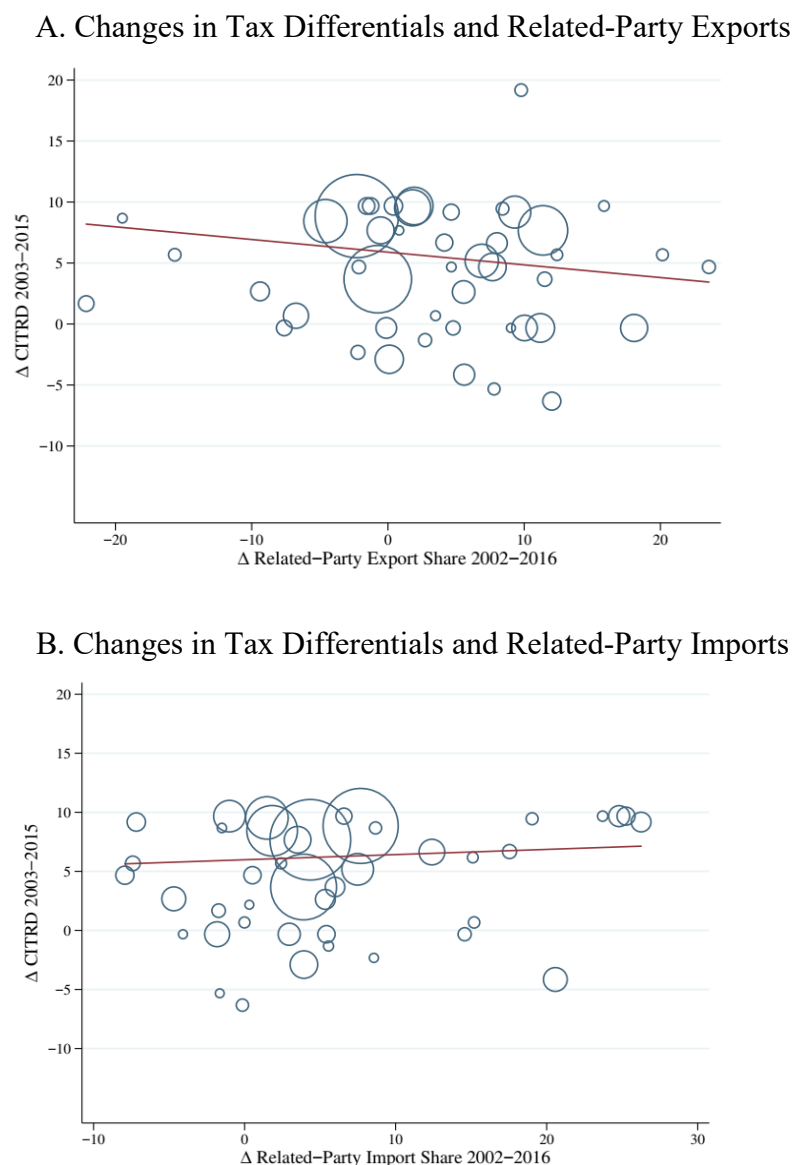
Figure 1.
Tax Rate Differentials and Related-Party Shares of Trade



Source: Authors' calculations, using trade data from the Census Bureau and statutory corporate income tax rates from KPMG and the Organisation for Economic Co-operation and Development.

The figure shows the annual correlation between corporate income tax rate differentials—which are defined by subtracting tax rates in foreign countries from the tax rate in the United States—and the related-party share of imports (solid red line) and exports (dashed blue line). The correlations are computed by considering the largest (in terms of the value of trade with the United States) 50 import and export partners over the 2002–2016 period.

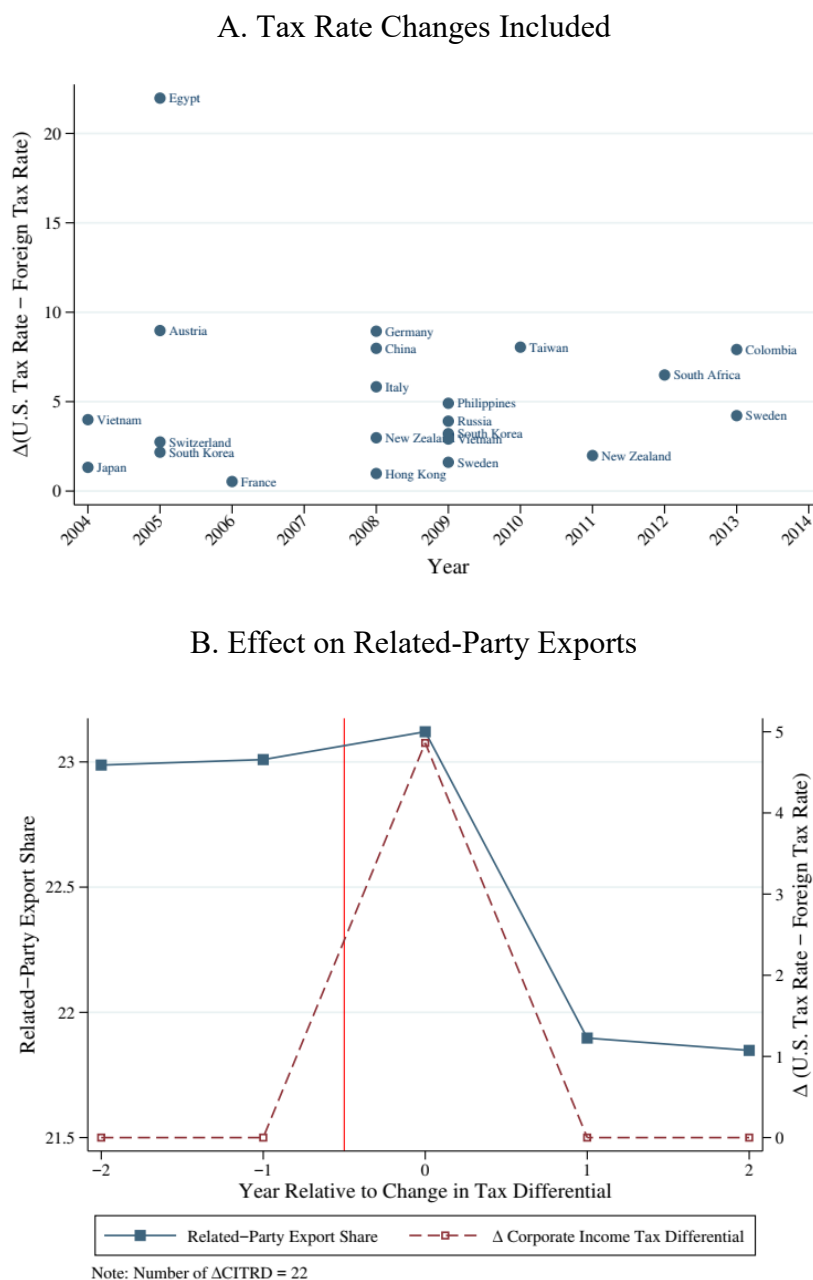
Figure 2.
Changes in Corporate Income Tax Rate Differentials and Related-Party Shares of Trade
Percentage Points



Source: Authors' calculations, using trade data from the Census Bureau and statutory corporate income tax rates from KPMG and the Organisation for Economic Co-operation and Development.

The figures plot the change in the corporate income tax rate differential (CITRD) between the United States and foreign countries from 2003 to 2015 against the change in related-party shares of trade from 2002 to 2016 for the largest (in terms of the value of trade with the United States) 50 import and export partners over the 2002–2016 period. Panel A focuses on exports, and Panel B focuses on imports. The size of the circles reflects the total value of trade (exports or imports) over the 2002–2016 period, and the red line is a linear fit that uses the total trade value as weight. The data underlying these figures are provided in Table A-1.

Figure 3.
Effect of Changes in Tax Rate Differentials on Related-Party Exports
 Percentage Points

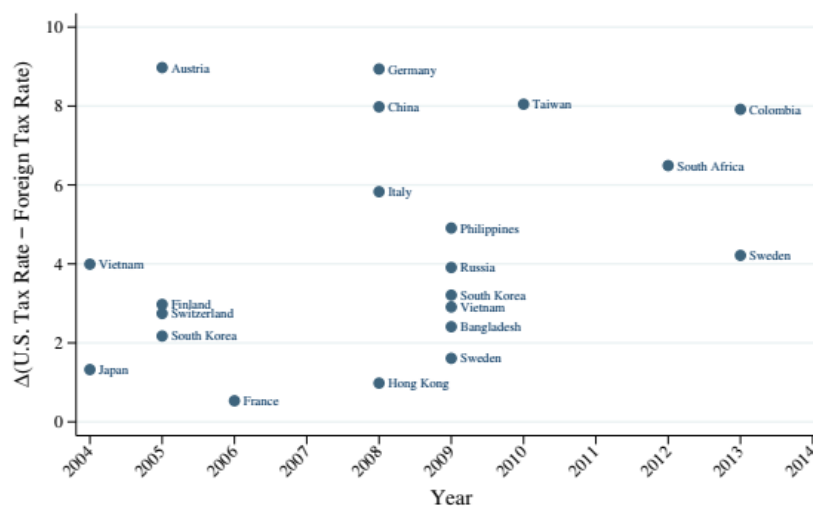


Source: Authors' calculations, using trade data from the Census Bureau and statutory corporate income tax rates from KPMG and the Organisation for Economic Co-operation and Development.

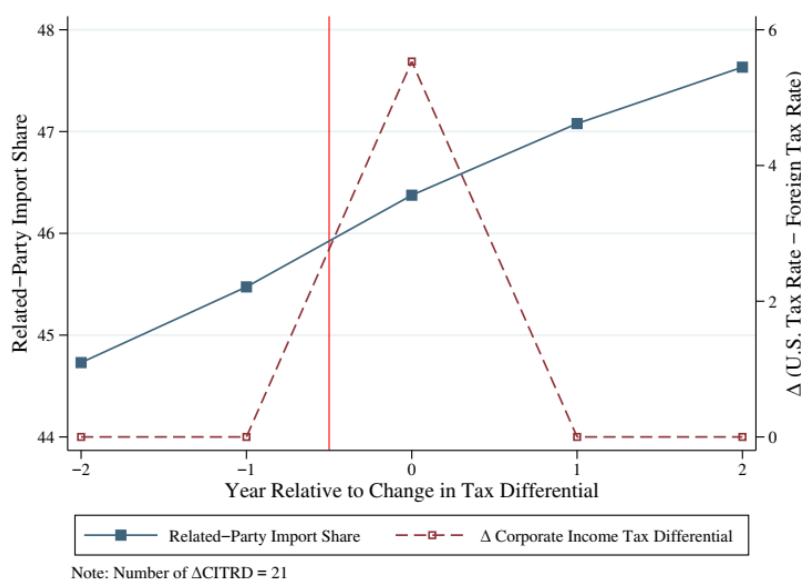
Panel A shows the tax rate changes included in the analysis, by year and magnitude of the change. Panel B shows the average related-party share of exports and change in the tax rate differential in the $[-2, +2]$ years around increases in the tax rate differential between the United States and the foreign trading partner. Observations are weighted by total exports two years before the increase in the tax rate differential.

Figure 4.
Effect of Changes in Tax Rate Differentials on Related-Party Imports
 Percentage Points

A. Tax Rate Changes Included



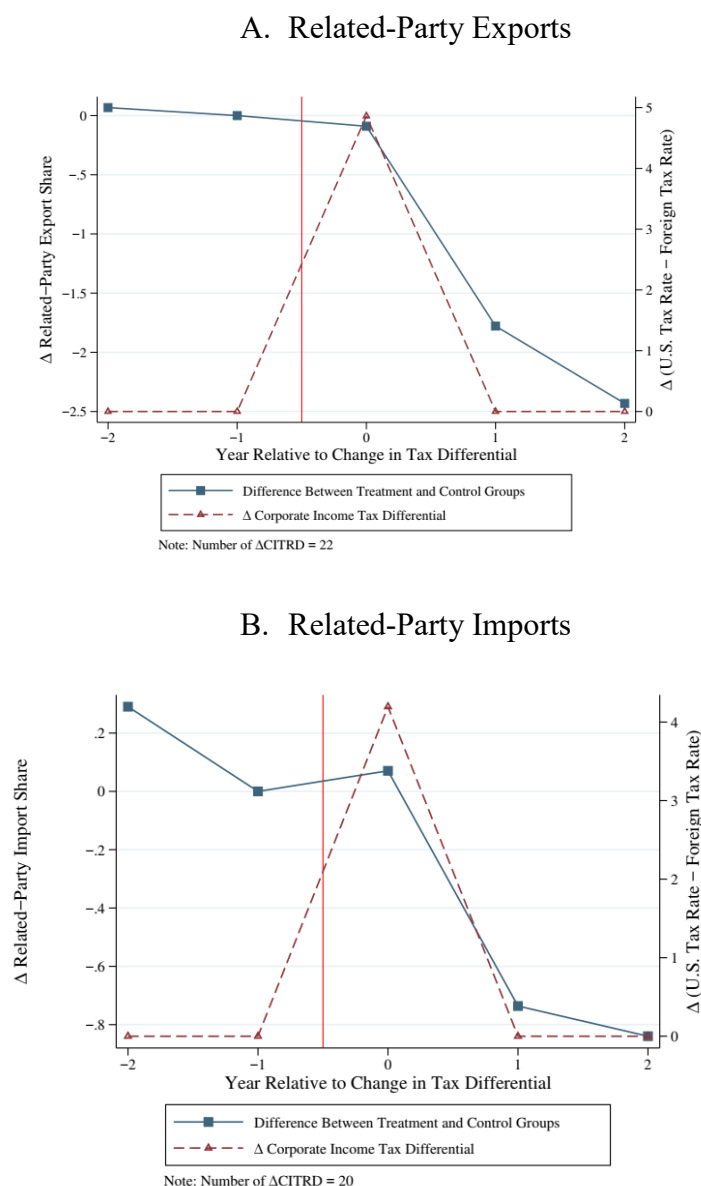
B. Effect on Related-Party Imports



Source: Authors' calculations, using trade data from the Census Bureau and statutory corporate income tax rates from KPMG and the Organisation for Economic Co-operation and Development.

Panel A shows the tax changes included in the analysis by year and magnitude of the change. Panel B shows the average related-party share of imports and change in the tax rate differential in the [-2,+2] years around increases in the tax rate differential between the United States and the foreign trading partner. Observations are weighted by the total imports two years before the increase in the tax rate differential.

Figure 5.
Effect of Changes in Tax Rate Differentials on Related-Party Trade Using a Control Group
Percentage Points



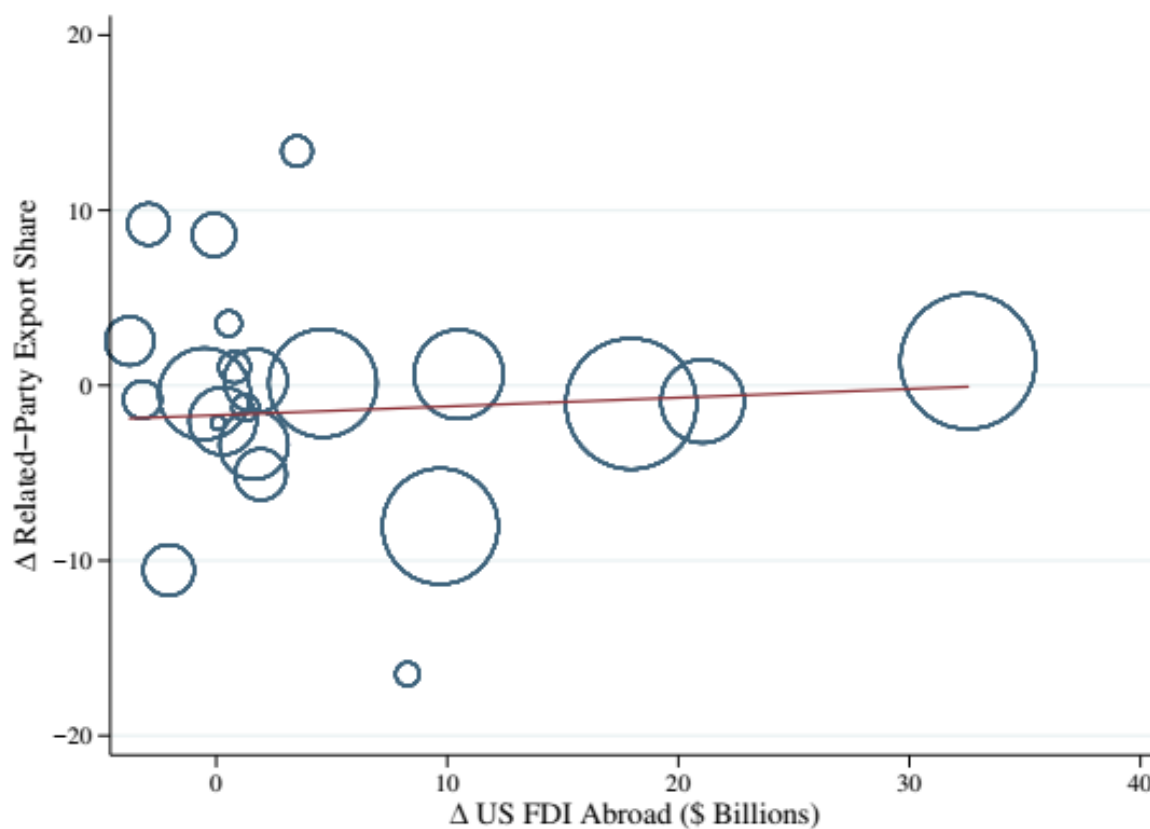
Source: Authors' calculations, using trade data from the Census Bureau and statutory corporate income tax rates from KPMG and the Organisation for Economic Co-operation and Development.

Panel A shows the differences in related-party export shares and the tax rate differentials between the largest (in terms of the value of trade with the United States) 50 export partners that experienced a change in rate differential (the treatment group) and the largest 50 export partners that did not experience a change in that year or in the two years preceding or following that year (the control group), excluding the largest export partner. Observations are weighted by the total exports two years before the increase in the tax rate differential. The difference between the treatment and control groups is normalized to the difference one year before the change in tax differential. Panel B does the same for related-party import shares for the largest 50 import partners, excluding the largest import partner.

Figure 6.

Relationship Between U.S. FDI Flows and the Related-Party Share of Exports to U.S. Trading Partners

Percentage Points



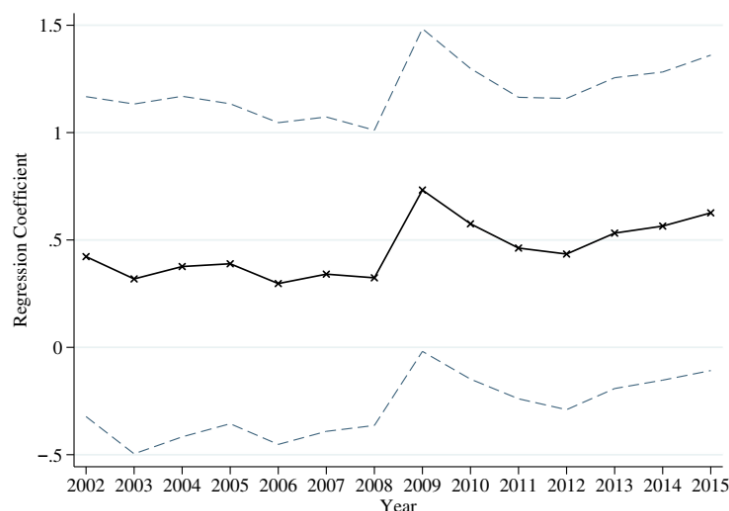
Source: Authors' calculations, using trade data from the Census Bureau and foreign direct investment (FDI) data from the Bureau of Economic Analysis.

The figure plots the change in U.S. FDI outflows and the change in the related-party share of exports between the United States and foreign countries in the $[-2,+2]$ years around increases in the tax rate differential between the United States and the foreign trading partner. Observations are weighted by the total exports two years before the increase in the tax rate differential. The data underlying this figure are provided in Table A-2.

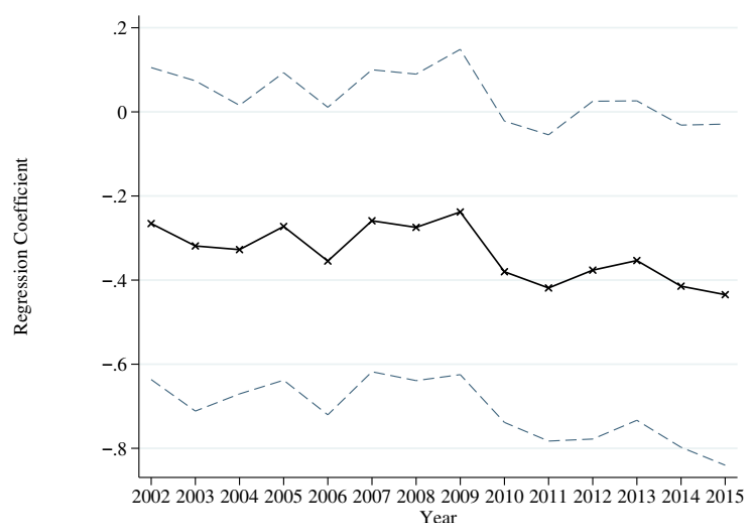
Figure A-1.

Tax Rate Differentials and Related-Party Shares of Trade

A. Rate Differentials and Related-Party Imports



B. Rate Differentials and Related-Party Exports



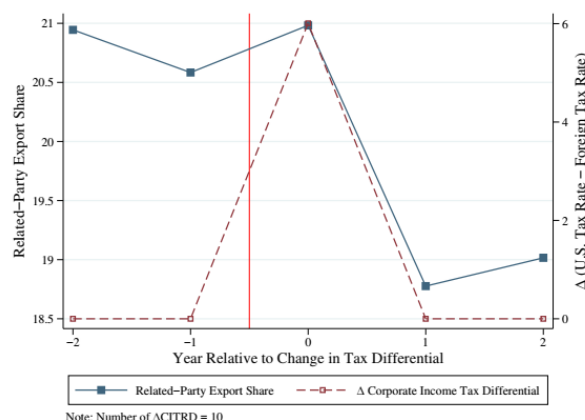
Source: Authors' calculations, using trade data from the Census Bureau and statutory corporate income tax rates from KPMG and the Organisation for Economic Co-operation and Development.

The figure shows regression coefficients from year-by-year regressions of the related-party import share (Panel A) and export share (Panel B) on corporate income tax rate differentials between the United States and foreign countries. The coefficients are computed by considering the largest (in terms of the value of trade with the United States) 50 import and export partners over the 2002–2016 period. The dashed lines are 95 percent confidence intervals.

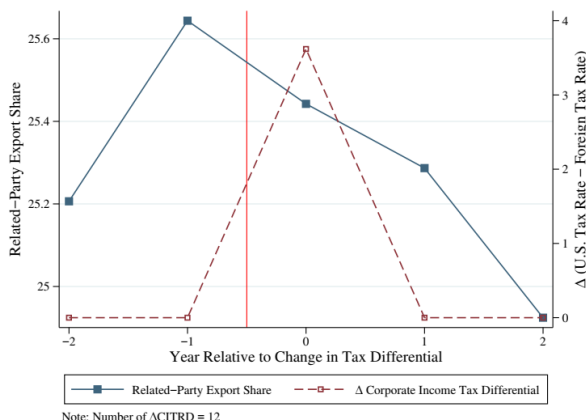
Figure A-2.

Effect of Changes in Tax Rate Differentials on Related-Party Shares of Trade
Percentage Points

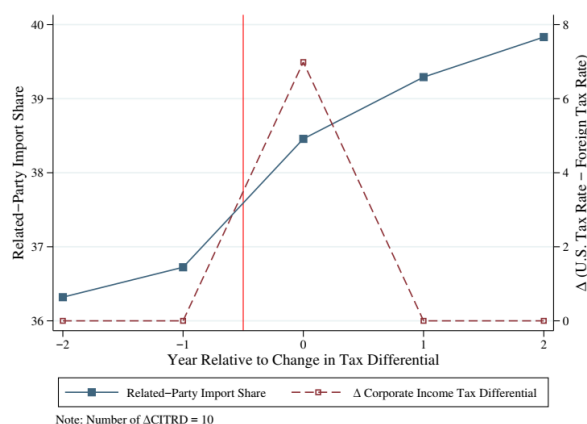
A. Related-Party Exports, 2008–2009



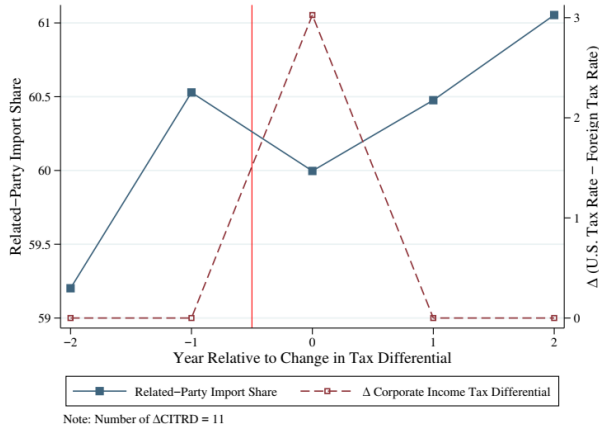
B. Related-Party Exports, Other Years



C. Related-Party Imports, 2008–2009



D. Related-Party Imports, Other Years



Source: Authors' calculations, using trade data from the Census Bureau and statutory corporate income tax rates from KPMG and the Organisation for Economic Co-operation and Development.

Panel A shows the average related-party share of exports and change in the tax rate differential in the $[-2,+2]$ years around increases in the tax rate differential between the United States and the foreign trading partner that occurred in 2008 or 2009. Panel B does the same for other years. Observations are weighted by the total exports two years before the increase in the tax rate differential. Panels C and D do the same for the related-party import share.

Tables

Table 1.
Related-Party Share of Trade by Foreign Trading Partner, 2016

COUNTRY	EXPORTS	COUNTRY	IMPORTS
NETHERLANDS	0.46	IRELAND	0.91
CANADA	0.41	JAPAN	0.77
MEXICO	0.40	SINGAPORE	0.74
SINGAPORE	0.38	DENMARK	0.71
EURO AREA	0.37	MEXICO	0.67
IRELAND	0.36	EURO AREA	0.64
AVERAGE	0.31	NETHERLANDS	0.57
JAPAN	0.31	CANADA	0.53
UNITED KINGDOM	0.24	AVERAGE	0.52
CHINA	0.19	UNITED KINGDOM	0.51
DENMARK	0.11	CHINA	0.29

Source: Authors' calculations, using trade data from the Census Bureau.

The table shows the ratio of related-party trade to total trade between the United States and some of its foreign trading partners in 2016.

Table 2.
Corporate Income Tax Rate Differentials and Related-Party Share of Imports

	Related-Party Import Share					
	(1)	(2)	(3)	(4)	(5)	(6)
CITRD	0.51*** (0.094)	0.46*** (0.084)	0.46*** (0.084)	0.38*** (0.094)	0.27*** (0.096)	0.24** (0.12)
GDP per Capita	No	Yes	Yes	Yes	Yes	Yes
URate	No	No	Yes	Yes	Yes	Yes
Capital Endowment	No	No	No	Yes	Yes	Yes
Index of Economic Freedom	No	No	No	No	Yes	Yes
Worldwide Governance Indicators	No	No	No	No	No	Yes
R ²	0.041	0.27	0.27	0.27	0.31	0.34
Observations	679	663	663	627	623	623

Source: Authors' calculations, using trade data from the Census Bureau and statutory corporate income tax rates from KPMG and the Organisation for Economic Co-operation and Development.

The table shows regression coefficients when regressing related-party import shares on corporate income tax rate differentials (CITRD) between the United States and its foreign trading partners, and on other country-specific characteristics. Economic characteristics include the World Bank's World Development Indicator measures of gross domestic product (GDP) per capita and the unemployment rate (URate), and measures of physical and human capital endowment from Hall and Jones (1999). Institutional characteristics include indexes of economic freedom, world measures of business, investment, trade and financial freedom from the Heritage Foundation, and Worldwide Governance Indicators (voice and accountability, regulatory quality, rule of law, and control of corruption) constructed by the World Bank.

*** Indicates that the estimated coefficient is statistically different from zero at the 1 percent level.

** Indicates that the estimated coefficient is statistically different from zero at the 5 percent level.

Table 3.
Corporate Income Tax Rate Differentials and Related-Party Shares of Exports

	Related-Party Export Share					
	(1)	(2)	(3)	(4)	(5)	(6)
CITRD	-0.32*** (0.048)	-0.38*** (0.048)	-0.38*** (0.049)	-0.35*** (0.053)	-0.44*** (0.053)	-0.51*** (0.067)
GDP per Capita	No	Yes	Yes	Yes	Yes	Yes
URate	No	No	Yes	Yes	Yes	Yes
Capital Endowment	No	No	No	Yes	Yes	Yes
Index of Economic Freedom	No	No	No	No	Yes	Yes
Worldwide Governance Indicators	No	No	No	No	No	Yes
R ²	0.060	0.12	0.12	0.17	0.24	0.25
Observations	697	681	681	642	642	642

Source: Authors' calculations, using trade data from the Census Bureau and statutory corporate income tax rates from KPMG and the Organisation for Economic Co-operation and Development.

The table shows regression coefficients when regressing related-party export shares on corporate income tax rate differentials (CITRD) between the United States and its foreign trading partners, and on other country-specific characteristics. Economic characteristics include the World Bank's World Development Indicator measures of gross domestic product (GDP) per capita and the unemployment rate (URate), and measures of physical and human capital endowment from Hall and Jones (1999). Institutional characteristics include indexes of economic freedom, world measures of business, investment, trade and financial freedom from the Heritage Foundation, and Worldwide Governance Indicators (voice and accountability, regulatory quality, rule of law, and control of corruption) constructed by the World Bank.

*** Indicates that the estimated coefficient is statistically different from zero at the 1 percent level.

Table 4.
Selected Changes in Corporate Income Tax Rate Differentials and Related-Party Shares of Trade

	Related-Party Import Shares		Related-Party Export Shares	
	Δ From Year -1 (1)	Δ for 1 p.p. Increase in Rate Differential (2)	Δ From Year -1 (3)	Δ for 1 p.p. Increase in Rate Differential (4)
α	57.8*** (4.33)	58.1*** (4.50)	25.9*** (2.68)	25.8*** (2.63)
β	-1.40 (4.58)	-1.00 (1.05)	-2.87 (3.38)	-0.43 (0.54)
ρ_{-2}	-0.99** (0.42)	-0.99** (0.39)	-0.13 (0.22)	-0.11 (0.22)
ρ_0	0.83** (0.31)	0.79** (0.31)	0.19 (0.23)	0.16 (0.24)
ρ_{+1}	1.47** (0.67)	1.41** (0.67)	0.66* (0.34)	0.62* (0.34)
ρ_{+2}	2.07* (1.15)	2.00* (1.13)	1.25** (0.48)	1.19** (0.48)
γ_{-2}	0.32 (0.87)	0.067 (0.16)	0.11 (0.42)	-0.026 (0.096)
γ_0	0.036 (0.45)	0.099 (0.067)	-0.082 (0.52)	0.065 (0.093)
γ_{+1}	-0.74 (0.72)	-0.044 (0.15)	-1.77* (0.94)	-0.27 (0.18)
γ_{+2}	-0.86 (1.11)	-0.061 (0.17)	-2.41** (1.04)	-0.36* (0.21)
R ²	0.0038	0.011	0.012	0.0099
Observations	1025	1025	1245	1245

Source: Authors' calculations, using trade data from the Census Bureau and statutory corporate income tax rates from KPMG and the Organisation for Economic Co-operation and Development.

The table shows regression coefficients when regressing related-party trade shares on indicator variables for each year around selected changes in corporate income tax rate differentials (CITRD) between the United States and its foreign trading partners. Two groups are compared: The treatment group includes observations experiencing changes in CITRD without additional changes in the two years before or following that change; the control group includes the other 50 largest trading partners, which did not experience changes in rate differentials in that same year or in the two years preceding or following that year. Columns (1) and (3) are based on this specification:

RP Trade Share = $\alpha + \beta * \text{Treatment} + \sum_{j=-2}^2 [I_j(\rho_j + \gamma_j * \text{Treatment})] + \varepsilon$, where ρ_{-1} and γ_{-1} are set to zero so that ρ_j and γ_j are estimates of the average difference between the related-party trade share in a given year and that share one year before the CITRD change. Columns (2) and (4) are instead based on this specification:

RP Trade Share = $\alpha + \beta * \Delta \text{CITRD} + \sum_{j=-2}^2 [I_j(\rho_j + \gamma_j * \Delta \text{CITRD})] + \varepsilon$, where ρ_{-1} and γ_{-1} are set to zero so that ρ_j and γ_j are estimates of the effect of a 1 percentage-point increase in ΔCITRD in year zero when comparing the related-party trade share in a given year and that share one year before the CITRD change. Observations are weighted by the total imports (for Columns (1) and (2)) or exports (for Columns (3) and (4)) two years before the increase in the tax rate differential. Standard errors are clustered at the trading-partner level.

p.p. = percentage points.

*** Indicates that the estimated coefficient is statistically different from zero at the 1 percent level.

** Indicates that the estimated coefficient is statistically different from zero at the 5 percent level.

* Indicates that the estimated coefficient is statistically different from zero at the 10 percent level.

Table A-1.
Changes in Corporate Income Tax Rate Differentials and Related-Party Shares of Trade

Country	Δ CITRD 2003-2015	Δ Related-Party Export Share 2002-2016	Δ Related-Party Import Share 2002-2016
Argentina	-0.3	4.8	-4.1
Australia	-0.3	10	14.6
Austria	8.7	-19.5	8.7
Bahamas	-0.3	9	-
Bangladesh	2.2	-	0.3
Belgium	-0.3	18.1	5.4
Brazil	-0.3	11.2	3
Canada	8.8	-2.3	7.7
Chile	-6.3	12	-0.1
China	7.7	11.4	4.4
Colombia	9.7	0.4	6.6
Costa Rica	5.7	-15.6	2.4
Denmark	6.2	-	15.1
Dominican Republic	-2.3	-2.2	8.6
Egypt	19.2	9.8	-
Finland	8.7	-	-1.5
France	-2.9	0.1	3.9
Germany	9.5	1.8	1.5
Guatemala	5.7	20.2	-
Honduras	-5.3	7.8	-1.6
Hong Kong	0.7	-6.8	15.2
India	-4.2	5.6	20.6
Indonesia	4.7	-2.1	0.5
Ireland	-0.3	-7.6	-1.8
Israel	9.2	4.6	26.3
Italy	6.6	8	12.4
Japan	8.4	-4.6	1.8
Malaysia	2.7	-9.4	-4.7
Mexico	3.7	-0.7	3.9
Netherlands	9.2	9.3	-7.2
New Zealand	4.7	4.7	-
Norway	0.7	3.5	0
Panama	4.7	23.6	-
Peru	-1.3	2.7	5.6
Philippines	1.7	-22.1	-1.7
Poland	7.7	0.8	-
Russia	3.7	11.5	6
Singapore	4.7	7.7	-7.9

Continued

Table A-1. **Continued**
Changes in Corporate Income Tax Rate Differentials and Related-Party Shares of Trade

Country	Δ CITRD 2003-2015	Δ Related-Party Export Share 2002-2016	Δ Related-Party Import Share 2002-2016
South Africa	9.5	8.4	19
South Korea	5.2	6.9	7.5
Spain	6.7	4.1	17.5
Sweden	5.7	12.4	-7.4
Switzerland	2.6	5.6	5.3
Taiwan	7.7	-0.5	3.5
Thailand	9.7	-1.6	24.8
Turkey	9.7	-1.3	23.7
United Arab Emirates	-0.3	-0.1	-
United Kingdom	9.7	1.9	-1
Vietnam	9.7	15.9	25.3

Source: Authors' calculations, using trade data from the Census Bureau and statutory corporate income tax rates from KPMG and the Organisation for Economic Co-operation and Development.

The table shows changes in the corporate income tax rate differential (CITRD) between the United States and foreign countries from 2003 to 2015 and changes in related-party shares of trade from 2002 to 2016 considering the largest (in terms of the value of trade with the United States) 50 import and export partners over the 2002–2016 period, after excluding oil-producing countries. A dash in the imports (exports) column indicates that a country is not included in the largest 50 import (export) partners.

Table A-2.**Relationship Between U.S. FDI Flows and the Related-Party Share of Exports to U.S. Trading Partners**

Country	Year in Which CITRD Changed	Δ U.S. FDI Abroad (\$ Billions)	Δ Related-Party Export Share
Austria	2005	8.3	-16.5
China	2008	32.5	1.4
Colombia	2013	0.3	-2
Egypt	2005	3.5	13.4
France	2006	21.1	-0.9
Germany	2008	9.7	-8
Hong Kong	2008	1.6	-3.4
Italy	2008	1.7	0.3
Japan	2004	18	-1
New Zealand	2008	0.8	1
New Zealand	2011	1.3	-1.3
Philippines	2009	-2.1	-10.5
Russia	2009	-3.7	2.5
South Africa	2012	-0.1	8.6
South Korea	2005	10.5	0.4
South Korea	2009	4.6	0.1
Sweden	2009	-3.2	0.8
Sweden	2013	-2.9	9.2
Switzerland	2005	1.9	-5.1
Taiwan	2010	-0.5	-0.5
Vietnam	2004	0.1	2.1
Vietnam	2009	0.5	3.5

Source: Authors' calculations, using trade data from the Census Bureau and foreign direct investment (FDI) data from the Bureau of Economic Analysis.

The table shows changes in U.S. FDI outflows and changes in the related-party share of exports between the United States and foreign countries in the [-2,+2] years around increases in the corporate income tax rate differential (CITRD) between the United States and the foreign trading partner.