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Tax-motivated transfer pricing and US intrafirm trade prices[☆]

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Abstract

This paper analyzes monthly data on US international trade prices between 1997 and 1999 in order to investigate the impact of tax influences on intrafirm trade prices. Results indicate that there is substantial evidence of tax-motivated transfer pricing in US intrafirm trade prices. There is a strong and statistically significant relationship between countries' tax rates and the prices of intrafirm transactions. Controlling for other variables that affect trade prices, as country tax rates are lower, US intrafirm export prices are lower, and US intrafirm import prices are higher. This finding is consistent with theoretical predictions regarding tax-motivated income shifting behavior.

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1. Introduction

Approximately 40% of all US international trade is intrafirm trade, or international trade that occurs within the firm. This paper utilizes monthly data from the Bureau of Labor Statistics (BLS) on international trade prices in 1997, 1998, and

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1999 to undertake an empirical investigation of US intrafirm trade prices. It finds important differences in the behavior of intrafirm trade prices when compared with arms-length trade.

Most importantly, the use of this hitherto unutilized data set allows for a direct test of the influence of tax-motivated income shifting on US intrafirm trade. Multinational firms can effectively shift income to more lightly-taxed locations by manipulating transfer prices on intrafirm transactions. There is a large literature that has considered indirect evidence of transfer pricing (see Hines (1997) for a review), relying on statistical relationships between country tax rates and affiliate profitabilities or tax liabilities. However, this is the first comprehensive study to consider *direct* evidence of how the prices of intrafirm transactions differ from those of non-intrafirm transactions.¹

The paper finds evidence of tax motivated income-shifting that is consistent with theoretical expectations and robust to different approaches and specifications. As country tax rates are lower, US intrafirm international trade transactions exhibit lower export prices, and higher import prices, than non-intrafirm trade transactions. This is consistent with theoretical expectations regarding multinational firms' tax-minimizing behavior. These results are found using both statutory and effective tax rates as explanatory variables, and controlling for other influences that may affect trade prices.

2. Background

2.1. The behavior of intrafirm trade

It is useful to first discuss the theoretical reasons why one might suspect that intrafirm trade prices would be influenced by tax motivations. Following Horst (1971) and Kant (1995), one can produce a simple model that generates the prediction that intrafirm trade prices will be affected by the tax minimization strategies of multinational firms. Consider a multinational firm with some degree of market power that is operating in two countries. It produces and sells in each country, and also exports part of its output from the home country (1) to the affiliate abroad (2).² For now, assume that the affiliate is fully owned.³

Profit functions for operations in the two countries are given by the following equations:

¹There are, however, two less comprehensive studies that use price data. Lall (1973) considers pharmaceutical import prices in Colombia. Bernard and Weiner (1990) consider oil prices between 1973 and 1984.

²It is straightforward to extend this model to consider trade that originates in the affiliate country. One can also consider this trade to be in intermediate products without affecting the basic insights developed here.

³The implications of relaxing this assumption are considered in Kant (1995) and briefly discussed below.

$$\pi_1 = R_1(s_1) - C_1(s_1 + m) + pm \quad (1)$$

$$\pi_2 = R_2(s_2) - C_2(s_2 - m) - pm \quad (2)$$

π_1 is profit in the home country, which depends on revenues R_1 that are a function of sales, s_1 , and costs C_1 that are a function of production. Production includes both those goods sold at home, and those sent to the affiliate abroad, m . The output that is exported to the affiliates abroad is given the transfer price p .

Consider the case where tax rates at home are greater than tax rates abroad ($t_1 > t_2$) and deferral is allowed. Let f represent the fraction of profits that are repatriated. The effective tax rate on income earned in the affiliate country is then:

$$t_2^e = t_2 + (t_1 - t_2)f. \quad (3)$$

The net profit function for the firm's global operations is:

$$\pi = (1 - t_1)\pi_1 + (1 - t_2^e)\pi_2. \quad (4)$$

To illustrate how the firm may choose a transfer price in order to maximize these net profits, consider the derivative of (4) with respect to the transfer price, p

$$\pi_p = (1 - t_1)m - (1 - t_2^e)m. \quad (5)$$

Substituting for t_2^e using (3) and rearranging,

$$\pi_p = -(t_1 - t_2)(1 - f)m. \quad (6)$$

So, if $t_1 > t_2$, the above expression is negative, and the firm's net profits decrease with the transfer price. Thus, firms have an incentive to underprice goods sold to low tax countries in order to shift profits to low tax locations. Similarly, one can show that firms have an incentive to overprice goods sold to high tax affiliates when $t_2 > t_1$.^{4,5}

As is clear from this model, incurring income in low-tax countries is advantageous so long as some fraction of that income is not repatriated immediately. Of

⁴Note that these models implicitly assume that there is only one transfer price p ; that is, firms keep just one set of books. Firms in reality may keep more than one set of books, using one set of prices to minimize tax liabilities and other sets of prices for other purposes such as determining the relative performance of affiliates.

⁵As Kant (1990) reminds us, though, two considerations may interfere with this motivation. First of all, firms may be subject to penalties if their manipulation of transfer prices is too flagrant. If the probability of receiving a penalty increases as the transfer price is further from the arms-length price, firms will likely choose a transfer price that balances the gain from profit shifting with the possibility of a penalty. This consideration alters the degree of transfer price manipulation, but would not alter the desired direction of underpricing or overpricing. Secondly, affiliates may not be wholly owned. This creates a second profit shifting incentive, as firms may choose to overprice shipments to affiliates to transfer profits to sources that are wholly owned and away from partially owned sources. While this consideration may influence the desired direction of transfer price changes, it also assumes that firms are free to manipulate transfer prices without the need to be responsive to the profits of their minority interests.

course, in the arcane world of international taxation, nothing is quite so simple. For instance, there are numerous aspects of US tax law which may complicate the incentives. For instance, under the ‘Subpart F’ provisions of US tax law, US firms are not eligible to defer taxation on unrepatriated foreign income that is derived from passive investments or foreign base company income.⁶ In addition, US tax law permits firms with excess foreign tax credits (i.e. firms where foreign taxes paid exceed their US tax liability on that income) to reduce their tax obligations in other years. US firms use all of their worldwide income to calculate the appropriate foreign tax credit limit under a system of ‘worldwide averaging’. A more detailed description of these provisions is provided in Hines (1997, 1999).

While these considerations are important, it is nonetheless widely recognized that it is advantageous for many (although not all) firms to incur income in low-tax locations, and to avoid incurring income in high-tax locations. Working from this premise, many empirical studies (such as Lall, 1973; Jenkins and Wright, 1975; Kopits, 1976; Bernard and Weiner, 1990; Grubert and Mutti, 1991; Harris et al., 1993; Hines and Rice, 1994; Collins et al., 1998) have estimated the magnitude of tax-induced transfer pricing. Hines (1997) provides a thorough review of this literature. Due to data limitations, the previous evidence is necessarily indirect, relying on statistical relationships between country tax rates and affiliate profitabilities or tax liabilities. Still, most studies indicate that transfer prices are likely to be influenced by tax considerations. Jenkins and Wright (1975) examine the profitability of US oil companies, finding that affiliates in low tax rate countries are more profitable. Grubert and Mutti (1991) find that high taxes decrease after-tax profitabilities of local operations. Hines and Rice (1994) find even larger effects, suggesting that 1% tax rate differences are associated with 2.3% differences in before-tax profitability.

In a previous paper (Clausing, 2001), I have demonstrated that US intrafirm trade flows appear to be affected by the tax minimization strategies of multinational firms. In particular, the evidence suggests that the United States has less favorable *intrafirm* trade balances with low tax countries. This result is anticipated if multinational firms are manipulating transfer prices in order to shift income to low tax countries. For example, there would be an incentive to underprice US intrafirm exports to low tax countries and overprice US intrafirm imports from such countries, following the opposite strategy with respect to transactions with high-tax countries.

This finding provides more direct evidence that transfer pricing is occurring since it considers the direct relationship between the taxes faced by affiliates abroad and their actual intrafirm trade transactions. Still, it is more desirable to have data on the intrafirm trade prices themselves, as this would allow the most direct test of the model above and the most direct evidence regarding transfer price

⁶This includes foreign income derived from sales of goods between related parties where the goods are manufactured outside the base country and sold for use outside the base country.

manipulation. In the following section, I make use of a unique data set on trade prices, collected as part of the international price program of the Bureau of Labor Statistics (BLS), and described further below.

Such price data have not been previously employed for this purpose. Analysis of these data will allow one to detect how the prices of intrafirm transactions differ from those of non-intrafirm transactions, and how such differences are related to tax influences. The analysis will not be able to detect other methods of tax-motivated income shifting, such as altering overhead cost allocations or manipulating the terms of financial transactions within the firm.

3. Data analysis

This paper will undertake an empirical analysis of BLS data on export and import prices with the aim of understanding how intrafirm trade prices behave. The central question of interest is whether there is evidence of tax-motivated transfer pricing for intrafirm trade. In particular, is there evidence that the prices of intrafirm trade transactions are sensitive to the tax rates of the countries in question?

The International Price Program (IPP) of the BLS is charged with producing data on the prices of US international trade. The IPP collects monthly information on prices for approximately 22,000 items, and uses this information to generate import and export price indexes. The program publishes over 700 detailed and aggregate trade price indexes. These indexes are used for a variety of purposes, including deflating trade volume statistics, measuring inflation, performing elasticity studies, deriving terms of trade indexes and real exchange rates, and forming trade contracts.

Export and import price indexes are meant to represent the universe of goods that are traded, and hence include substantial amounts of intrafirm trade transactions. These transactions are flagged as intrafirm based on the respondents acknowledgement as to whether the trade is between ‘related parties’. For imports, the preferred price collected is the price free on board at the foreign port of exportation before insurance, freight, or duty are added. For exports, the preferred price collected is the price of the item at the US port of embarkation.⁷

The analysis employs monthly data on trade prices over 3 years: 1997, 1998, and 1999. Table 1 describes some of the key features of these data. There are over 425,000 observations of monthly prices. In total, 33% of these observations are for exports, and 38% of observations are intrafirm trade. (The remainder of the observations are for imports and non-intrafirm trade, respectively.) A wide variety of countries are included. However, for the analysis that includes tax variables, I

⁷See <http://www.bls.gov/opub/hom/homch15.a.htm> for the BLS description of this data.

Table 1
Descriptive statistics

Number of monthly observations	426,670
% of observations that are exports	33.1
% of observations that are intrafirm transactions	38.2
% of observations that are inputed	42.0
% of observations where a link price is available	0.3
Mean effective tax rate for observations in the sample	32.1% (S.D. = 14.2)
Mean statutory tax rate for observations in the sample	32.9% (S.D. = 6.7)

Note: inputed prices are generated by the BLS when data are missing. This process is discussed in detail in Feenstra and Diewert (2000). A link price is calculated by the BLS when survey items have changed in nature. The aim is to calculate a price at which the old item would have traded in the new time period. In the analysis of this paper, I use the non-link prices rather than the link prices, noting that the presence of link prices may lead to expected changes in the non-link prices. For example, if the quality of the good has improved, using the normal price rather than a link price would lead to a higher observed price. The tax rate variables are discussed in the text.

have limited the data set to observations from 54 countries;⁸ this data set is described in Table 1.

Before undertaking the regression analysis, it is instructive to consider some basic features of the data. Table 2 shows comparisons of intrafirm and non-intrafirm trade price changes, considering the average price changes for observations in the entire sample. Both average price changes and the average absolute value of price changes display patterns that are almost indistinguishable for intrafirm and non-intrafirm trade. Slightly larger differences in price patterns stand out if one considers the frequency of monthly price changes. When one divides the sample into exports and imports, larger differences are observed for the price change variables, and intrafirm trade continues to exhibit less frequent monthly price changes.

The similarity in price patterns for intrafirm and non-intrafirm trade is also demonstrated in Fig. 1. Fig. 1 shows the average monthly price changes for all of the observations in the sample over the period January 1997 to December 1999. Fig. 1a shows both exports and imports, while Fig. 1b and c shows exports and imports separately. Price trends for intrafirm and non-intrafirm trade are very similar, particularly for imports, but also for exports.

⁸In particular, there are data on tax information from the Bureau of Economic Analysis and from Price Waterhouse for this set of countries; these are also the countries for which I have collected exchange rate data.

Table 2
Price changes for intrafirm and non-intrafirm trade

	Intrafirm	Non-intrafirm
All trade		
% Change in price, year over year, sample average	−1.3	−1.1
Absolute value of % change in price, year over year, sample average	7.4	7.5
% of observations with a change in observed price, month to month	40.8	45.1
Exports		
% Change in price, year over year, sample average	−0.2	−0.6
Absolute value of % change in price, year over year, sample average	8.0	6.9
% of observations with a change in observed price, month to month	36.9	40.3
Imports		
% Change in price, year over year, sample average	−1.7	−1.4
Absolute value of % change in price, year over year, sample average	7.2	7.8
% of observations with a change in observed price, month to month	42.3	47.7

These figures indicate the average values for intrafirm and non-intrafirm trade, over the entire sample. Data are from the Bureau of Labor Statistics.

3.1. Regression analysis

After the above introduction to the data, the pattern of intrafirm trade price *changes* appears to be similar to those of non-intrafirm trade. However, despite the fact that average price change patterns are similar, the effect of tax influences on intrafirm trade remains to be investigated. In the model above, tax influences are expected to affect the *level* of intrafirm trade prices.

In the following analysis, I have merged the BLS data on monthly trade prices together with data on tax rates across countries. I employ data on the effective tax rate of the destination/origin countries gathered from the Bureau of Economic Analysis surveys on US direct investment abroad. The effective tax rate is calculated as the foreign income taxes paid by US affiliates in a given country divided by their pre-tax net income. This tax variable is generated using data from 1997 and 1998.⁹ I also employ statutory tax rate data for 1997, 1998, and 1999 from Price Waterhouse.

⁹For 1999, I use 1998 data as the 1999 data are not yet available from the BEA.

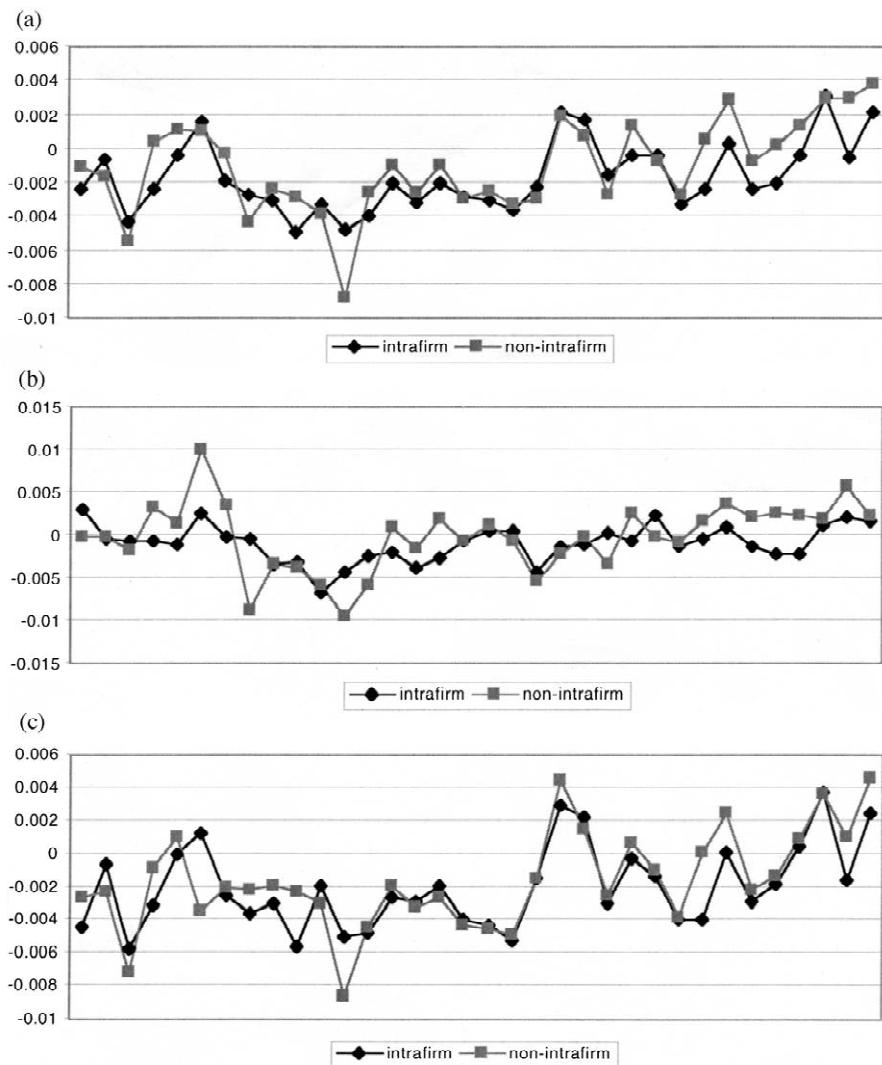


Fig. 1. (a) Average monthly price changes, all trade; (b) average monthly price changes, exports; (c) average monthly price changes, imports.

In terms of testing the above model, there are a few subtleties that need to be discussed. The first is the determination of the appropriate tax rate. As noted in the above model, the incentive to shift income between countries should depend on the marginal tax savings from doing so. This would imply that the ideal tax rate to use is the marginal tax rate. The calculated effective tax rates are imperfect proxies for the marginal tax rate, as they represent foreign income taxes paid relative to net

before-tax income. Still, the published statutory rates are also imperfect proxies for the marginal rate. For instance, there are sometimes multiple published statutory rates that depend on the individual circumstances of the firm. Further, any given rate is unlikely to account for the many subtleties (tax holidays, ad hoc arrangements, special allowances, etc.) that determine the true tax treatment of firms and that often affect the marginal tax rate. Several previous studies (Bernard and Weiner, 1990; Hines and Rice, 1994; Collins et al., 1998) that have employed tax rates as independent variables have relied on effective tax rates, although Hines and Rice (1994) check their results with statutory rates, and Grubert and Mutti (1991) use both statutory and effective tax rates as independent variables.¹⁰ I will perform the following analysis utilizing both average effective tax rates from the Bureau of Economic Analysis and statutory rates from Price Waterhouse. The correlation for these two tax rate variables in my data set is 0.68.

In addition, the BLS data allow one to distinguish intrafirm trade from arms-length trade, but they do not allow one to distinguish US parent multinational firms from foreign-owned multinational firms. Tax incentives will vary in strength based on the tax system of the parent firm's country. For example, many countries tax corporate income on a resident basis, allowing a tax credit for foreign income taxes paid as in the above model. However, several countries (including Australia, Canada, France, Germany and Switzerland) exempt foreign income from taxation, as noted in Hines (1996). Such tax systems provide an even greater incentive to incur income in low-tax countries and to avoid incurring income in high-tax countries.

Countries also vary by the extent to which their corporate income tax system is integrated with the personal income tax system.¹¹ Of course, as noted above, even US firms likely differ with respect to their income shifting incentives depending on their excess credit status and whether they are incurring Subpart F income. These complications imply a substantial heterogeneity in these intrafirm price data; some prices will likely reflect stronger income shifting incentives than do others. Still, the tested hypotheses remain the same. In particular, many multinational firms have an incentive to shift income to more lightly-taxed locations. Analyzing these data will provide evidence regarding the importance of these incentives for the entire body of US international price data. Yet we will not be able to distinguish the behavior of US and foreign multinational firms, nor variance in the strength of these tax incentives due to the individual circumstances of firms.

Tables 3 and 4 estimate regressions explaining the prices of products in the sample, estimating intrafirm trade prices together with non-intrafirm prices. A

¹⁰Studies have shown that effective tax rates are commonly quite different from statutory rates. See, for example, Buijink et al., 1999.

¹¹I am grateful to a referee for providing the following example. In France, credits on corporate income taxes are only passed through to shareholders if a domestic tax has been paid at the corporate tax level. This may therefore provide French firms with an incentive to incur domestic income.

dummy variable is included to indicate when trade is intrafirm. In addition, interaction terms are included to indicate whether, when trade is intrafirm, its responsiveness to tax rates differs. The equation estimated is:

$$\begin{aligned} \ln(\text{Price}_{it}) = & \alpha + \beta_1 \ln(1 - \text{Tax rate}_{ky}) + \beta_2 \ln(1 - \text{Tax rate}_{ky}) \\ & \times \text{Intrafirm dummy}_{it} + \beta_3 \ln(\text{Exchange rate index}_{kt}) \\ & + \beta_4 \ln(\text{Exchange rate index}_{kt}) \times \text{Intrafirm dummy}_{it} \\ & + \beta_5 \text{Intrafirm dummy}_{it} + \beta_6 \text{Inpute}_{it} + \beta_7 \text{Link}_{it} \\ & + \beta_8 \text{No dollar}_{it} + \beta_z \text{Industry dummies} + \nu_{it} \end{aligned}$$

All variables except dummy variables are in natural logs; i indicates individual products, k indicates countries, t indicates months, and y indicates years. If tax-motivated transfer pricing is important, the coefficient β_2 is expected to be negative for exports and positive for imports. In particular, intrafirm exports to low-tax countries should have lower prices as multinational firms attempt to shift profits to such locations whereas intrafirm imports from such low-tax countries should have higher prices.

Other variables are included to control for other factors that may affect price levels. All prices are either reported in dollars, or converted to dollars by the BLS. To control for the influence of exchange rates, I have included data on monthly exchange rates. The monthly exchange rate data have been used to derive a monthly exchange rate index for each country in order to allow exchange rates to affect prices over this time period.¹² Dummy variables are used for goods where the price has been inputed and for goods where a ‘link price’ has been estimated. (See Table 1 notes for a description of BLS methodology for inputed and linked prices.) In addition, a dummy variable is included for goods where the price is not originally expressed in dollars. In addition, dummy variables are included for SITC 4-digit industries. Expectations regarding the coefficients are as follows

	Expected sign	Justification
β_1	0	Prices for non-intrafirm trade should not be effected by tax rates.
β_2	– for exports	For low tax countries, (where $1 - \text{Tax rate}$ is high), intrafirm export
	+ for imports	prices should be lower and intrafirm import prices should be higher.
β_3	–	As the dollar is stronger, export and import prices should both be lower.

¹²I use monthly exchange rate data from the University of British Columbia web site <http://pacific.commerce.ubc.ca/xr/data.html>. This page and the FX database software are ©1998–99 by Prof. Werner Antweiler, University of British Columbia, Vancouver, Canada.

β_4	?	If intrafirm trade is more sensitive to exchange rates, this coefficient will be negative. If intrafirm trade is less sensitive to exchange rates, this coefficient will be positive.
β_5	?	Intrafirm prices may be systematically lower or higher than non-intrafirm prices.
β_6	?	Inputed prices may be higher or lower than normal.
β_7	+ ?	When link prices are estimated, prices may be higher or lower than normal. An improvement in quality would generally raise prices. ¹³
β_8	?	When prices are not quoted in dollars, prices may be higher or lower than usual.
β_z	+ or –	Prices are likely to vary by industry.

Results here are shown in Tables 3 and 4; Table 3 employs effective tax rates as explanatory variables while Table 4 employs statutory tax rates as explanatory variables. Consider first Table 3, Eqs. (1) (for exports) and (3) (for imports). Lower prices are associated with countries with low effective tax rates. However, for trade that is intrafirm, export prices are lower, while import prices are higher. Both of these tax interaction terms are highly statistically significant. The estimates indicate that a tax rate 1% lower is associated with intrafirm export prices that are 0.94% lower and intrafirm import prices that are 0.64% higher, relative to the tax effects for non-intrafirm goods.¹⁴ This is consistent with tax minimization incentives.

All trade is associated with the exchange rate index variable in the hypothesized direction: when the dollar is 1% more appreciated, this is associated with export prices 0.35% lower and import prices 0.42% lower. Intrafirm trade is even more strongly associated with the exchange rate variable. A dollar exchange rate index that is 1% more appreciated is associated with a further 0.69% reduction in intrafirm export prices and a further 0.19% reduction in intrafirm import prices. The coefficient on the intrafirm dummy variable indicates that intrafirm prices are typically larger, controlling for the other variables in the regression. Prices are higher when the price is inputed and when the transaction is not denominated in dollars. All specifications include industry dummies for industries at the SITC 4-digit level of aggregation. These dummies are typically highly statistically significant, and they also improve the explanatory power of the regression as a whole.

¹³However, there are many other reasons for a link price including unit changes, discounts, or others.

¹⁴The tables show elasticities with respect to (1 – Effective tax rate). In the text, I discuss the implied elasticities with respect to the tax rate, which are calculated at the mean effective tax rate for the sample.

Table 3
Price regressions, using effective tax rates as explanatory variables

Independent variables	Eq. (1): exports	Eq. (2): exports	Eq. (3): imports	Eq. (4): imports
1 – Effective tax rate	−0.7964 (0.0741)	0.1370 (0.0862)	−1.814 (0.0398)	−0.8718 (0.0445)
Intrafirm dummy	−1.997 (0.1300)	−1.728 (0.1308)	1.354 (0.0638)	1.972 (0.0651)
×(1 – Effective tax rate)				
Exchange rate	−0.3543 (0.0552)	0.1232 (0.0602)	−0.4228 (0.0263)	0.3574 (0.0295)
Intrafirm dummy	−0.6869 (0.1157)	−0.5969 (0.1156)	−0.1946 (0.0520)	−0.1897 (0.0517)
× Exchange rate				
Intrafirm dummy	2.060 (0.5571)	1.693 (0.5568)	1.860 (0.2488)	0.1098 (0.2473)
GDP		0.1720 (0.0093)		0.1711 (0.0056)
GDP per-capita		0.0454 (0.0096)		0.2861 (0.0043)
Inpute	0.1712 (0.0143)	0.1753 (0.0143)	0.0336 (0.0091)	0.0545 (0.0090)
Link	0.0367 (0.1087)	0.0436 (0.1085)	0.0911 (0.0808)	0.1257 (0.0800)
No dollar	0.1823 (0.0411)	0.1156 (0.0412)	0.3152 (0.0157)	0.0720 (0.0159)
Industry dummies (4 digit)	Yes	Yes	Yes	Yes
# of obs.	128,600	128,600	269,877	269,877
Adjusted R^2	0.528	0.530	0.512	0.522
F	643.9	642.7	1217	1257
Prob>F	0.000	0.000	0.000	0.000

Note: all variables except dummy variables are in natural logs. Standard errors are in parentheses.

Eqs. (2) and (4) consider the same specifications, including other country-level variables that may affect prices. In particular, country-level data on GDP and GDP per-capita are included. The coefficients on these variables are positive and statistically significant, indicating that prices are higher for transactions with countries that are richer or that have larger economies. The inclusion of these variables affects some of the other variables. For instance, in the export equation, there is no longer a statistically significant relationship between the tax rate of the country and the overall level of export prices. Still, the negative relationship between low tax rates and *intrafirm* export prices persists. In both export and import equations, exchange rates are no longer associated with overall trade prices in the hypothesized direction, while they are still associated with intrafirm trade prices in the hypothesized direction. This result is likely capturing the fact that the dollar tended to be stronger with respect to small, poor economies during this time period (which encompassed the Asian financial crisis). Thus, the GDP and GDP

Table 4
Price regressions, using statutory tax rates as explanatory variables

Independent variables	Eq. (1): exports	Eq. (2): exports	Eq. (3): imports	Eq. (4): imports
1 – Statutory tax rate	−0.4308 (0.1569)	1.401 (0.1691)	−3.963 (0.0891)	−3.889 (0.1068)
Intrafirm dummy	−3.694 (0.2707)	−3.580 (0.2700)	4.092 (0.1288)	5.309 (0.1280)
×(1 – Statutory tax rate)				
Exchange rate	−0.3479 (0.0563)	0.1118 (0.0600)	−0.1596 (0.0258)	0.4031 (0.0275)
Intrafirm dummy	−0.8815 (0.1162)	−0.5622 (0.1164)	−0.5192 (0.0518)	0.0287 (0.0517)
× Exchange rate				
Intrafirm dummy	2.363 (0.5784)	0.8641 (0.5789)	4.295 (0.2537)	1.943 (0.2527)
GDP		0.2132 (0.0083)		0.0956 (0.0058)
GDP per-capita		0.0386 (0.0097)		0.3229 (0.0044)
Inpute	0.1721 (0.0143)	0.1748 (0.0143)	0.0318 (0.0091)	0.0522 (0.0090)
Link	0.0354 (0.1089)	0.0420 (0.1085)	0.0625 (0.0808)	0.1083 (0.0798)
No dollar	0.2214 (0.0412)	0.1291 (0.0412)	0.3240 (0.0157)	0.0580 (0.0158)
Industry dummies (4 digit)	Yes	Yes	Yes	Yes
# of obs.	128,600	128,600	269,877	269,877
Adjusted R^2	0.527	0.530	0.512	0.524
F	642.7	642.6	1216	1266
Prob>F	0.000	0.000	0.000	0.000

Note: all variables except dummy variables are in natural logs. Standard errors are in parentheses.

per-capita variables are likely picking up some of these exchange rate effects. The explanatory power shown by regressions (2) and (4) is quite similar to that of regressions (1) and (3).

Table 4 shows the same specifications as Table 3, including statutory tax rates rather than effective tax rates as explanatory variables. The overall inferences based on this table are all the same, although the tax effects are statistically significantly larger. Again, the tax interaction terms are highly statistically significant. The estimates from Eqs. (1) and (3) indicate that a tax rate 1% lower is associated with intrafirm export prices that are 1.8% lower and intrafirm import prices that are 2.0% higher, relative to the tax effects for non-intrafirm goods. These regressions perform almost identically to those in Table 3, with very similar R^2 and F statistics.

In an attempt to discern between these two sets of specifications, I also ran regressions including both tax variables and their interaction terms with the

intrafirm dummy. In the export equation, both tax interaction effects were about 50% smaller but statistically significant. The two tax interaction variables achieved very similar statistical significance (*t* statistics of 6). In the import equation, the effective tax rate interaction coefficient was about one quarter its previous size, while the statutory tax rate interaction coefficient was nearly identical to its previous size. The statutory tax rate interaction term was more statistically significant (*t* statistic of 27) than the effective tax rate interaction term (*t* statistic of 4). A table of results is available upon request. These findings, combined with theoretical reasons for preferring statutory tax rates, give me a small preference for the statutory tax rate as an explanatory variable.

All of the above results are pooled OLS specifications. I tested these baseline regressions for robustness in several ways. Firstly, I tried three sets of specifications that included: (1) time dummies, (2) country level fixed effects (assuming that the countries in this sample represent almost the entire universe of intrafirm trade relationships), and (3) country level random effects (under the hypothesis that these countries are a subset of the universe of countries). None of these specifications altered any of the important results. The time effects and the country random effects produced coefficients that were almost identical on all variables. The country fixed effects sometimes altered some of the country level variables, but did not alter inferences based on the tax interaction terms.

Secondly, the baseline regression equations were estimated using cross sections of data for individual months. This has the disadvantage of focusing on a more limited set of information, but nonetheless is useful to reassure the reader that the results are not dependent on the panel nature of the data set. The cross section results were largely consistent with the results using the full data set. All of the tax interaction terms are statistically significant, in the hypothesized direction, and within 50% of the magnitude of the panel estimates for these coefficients. For the export equations, 80% of the monthly coefficients are within one-third of the panel estimates; for the import equations, 80% of the monthly coefficients are within 10% of the panel estimates. Thirdly, alternative specifications were considered that only include those data that are not inputted in the analysis. This produces results that are quite similar to those found above. I have not reported any of these specifications in detail; tables are available upon request.

A final method for examining the data is to consider separate regressions for intrafirm trade and non-intrafirm trade, and subsequently examine the differences in the tax variable. Table 5 presents results considering such specifications, employing statutory tax rates

$$\begin{aligned} \ln(\text{Price}_{it}) = & \alpha + \beta_1 \ln(1 - \text{Statutory tax rate}_{ky}) \\ & + \beta_2 \ln(\text{Exchange rate index}_{kt}) + \beta_3 \ln(\text{GDP}_{ky}) \\ & + \beta_4 \ln(\text{GDP per-capita}_{ky}) + \beta_5 \text{Inpu}te_{it} + \beta_6 \text{Link}_{it} \\ & + \beta_7 \text{No dollar}_{it} + \beta_z \text{Industry dummies} + \nu_{it}. \end{aligned}$$

Table 5
Price regressions, separating intrafirm and non-intrafirm trade

Independent variables	Exports		Imports	
	Eq. (1): intrafirm	Eq. (2): non-intrafirm	Eq. (3): intrafirm	Eq. (4): non-intrafirm
1 – Statutory tax rate	−1.369 (0.2626)	0.9922 (0.1734)	1.800 (0.1527)	−4.011 (0.1071)
Exchange rate	0.2774 (0.1173)	−0.0568 (0.0605)	0.8717 (0.0609)	0.2667 (0.0256)
GDP	0.3314 (0.0159)	0.1924 (0.0099)	0.0993 (0.0103)	0.0705 (0.0069)
GDP per-capita	0.2508 (0.0199)	−0.0664 (0.0110)	0.4821 (0.0107)	0.2574 (0.0045)
Inpute	0.2247 (0.0241)	0.1598 (0.0173)	−0.0268 (0.0156)	0.0527 (0.0103)
Link	0.2137 (0.1530)	−0.0146 (0.1439)	−0.0003 (0.1267)	0.1128 (0.0971)
No dollar	0.2383 (0.0590)	−0.1645 (0.0576)	−0.0478 (0.0270)	0.2056 (0.0190)
Industry dummies (4 digit)	Yes	Yes	Yes	Yes
# of obs.	43,653	84,947	112,081	157,796
Adjusted R^2	0.565	0.557	0.519	0.547
F	310.4	496.2	618.0	848.6
Prob>F	0.000	0.000	0.000	0.000

Note: all variables except dummy variables are in natural logs. Standard errors are in parentheses.

Again, all variables except dummy variables are in natural logs; i indicates individual products, k indicates countries, t indicates months, and y indicates years. Here it is expected that the tax coefficient will be smaller (or more negative) for intrafirm exports than for non-intrafirm exports, and larger (or more positive) for intrafirm imports relative to non-intrafirm imports. The results in Table 5 confirm this expectation. Intrafirm export prices are statistically significantly lower when country tax rates are lower, whereas non-intrafirm export prices show the opposite relationship. Intrafirm import prices are statistically significantly higher when tax rates are lower, whereas non-intrafirm import prices show the opposite relationship. These regressions also include GDP and GDP per-capita terms, which again confound the interpretation of the exchange rate variables; regressions without these variables show exchange rate results similar to those in similar regressions above. Results including effective tax rates rather than statutory tax rates show similar relative magnitudes for the tax coefficients in the intrafirm and non-intrafirm specifications.

4. Conclusions

This paper has analyzed monthly data on US international trade prices between 1997 and 1999 in order to investigate the behavior of intrafirm trade prices. Results find direct evidence indicating that intrafirm trade prices are likely influenced by the tax-minimization strategies of multinational firms. In particular, there is a strong and statistically significant relationship between a country's tax rate and the prices of intrafirm imports and exports traded with that country. The estimates in Table 4 indicate that a tax rate 1% lower in the country of destination/origin is associated with intrafirm export prices that are 1.8% lower and intrafirm import prices that are 2.0% higher, relative to non-intrafirm goods. Estimates that employ effective tax rates find smaller but still important tax effects. This evidence is particularly noteworthy in the context of a large empirical literature on tax-motivated transfer pricing that has relied almost entirely on indirect evidence.

This research suggests an agenda for further work. For instance, further research can use these results as a starting point to estimate the impact of this tax motivated transfer-pricing on US federal government tax revenues. For instance, to what extent does tax-motivated transfer pricing shift income away from the United States? Is income also shifted toward the United States, away from high-tax countries? What are the consequences for the magnitude of US corporate income tax revenue collections?

There are also interesting questions outside the scope of public finance. Intrafirm trade has been found to respond differently to tax and exchange rate variables. Such findings have important implications for those interested in understanding the determinants of international trade patterns.

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