DOI: 10.1515/ijme-2016-0010

International Journal of Management and Economics
No. 50, April–June 2016, pp. 27–48; http://www.sgh.waw.pl/ijme/

Quoc H. Tran[1]
Bridgewater State University, Bridgewater, USA

Rachel T.A. Croson[2]
University of Texas, Arlington, USA

Barry J. Seldon[3]
University of Texas, Dallas, USA

Experimental Evidence on Transfer Pricing

Abstract

We use incentivized economics experiments to test both the point predictions and comparative static predictions of optimal transfer pricing models, comparing behavior under varying conditions, including wholly versus partially-owned subsidiaries and different tariff and tax rates. As predicted, we find that transfer prices are responsive to relative tax and tariff rates as well as ownership proportions. Additionally, we examine convergence and learning in this setting. While individuals do not choose optimal transfer prices, their choices converge to optimal levels with experience. This paper thus makes two important contributions. First, by comparing behavior with theoretical predictions it provides evidence of whether (and when) individuals set transfer prices optimally. Second, by comparing behavior under conditions of full and partial ownership it provides evidence on the impact of policy interventions (like regulating ownership proportions by MNEs) on tax revenues.

Keywords: transfer pricing, economic experiments, multinational enterprise, learning
JEL: C90, C91, L11, F23, H21

Introduction

Transfer pricing has been a topic of growing academic research in economics since the pioneering works of Hirshleifer [1956, 1957], Gould [1964], and Horst [1971, 1973]. Transfer prices affect firms' after-tax profits, as well as countries' revenues [United Nations Conference on Trade and Development, 1999]. Differences between countries' tax and tariff rates create opportunities for tax arbitrage by multinational enterprises (MNEs) through the use of transfer prices for goods and services traded among subsidiaries. Recent studies suggest that a major fraction of income shifting is through the use of transfer prices, especially in MNEs with intangible property holdings [Clausing, 2003; Gruber 2003]. For example, a recent article in Forbes [2016] reported that Google has been asked to pay $ 1.8 billion in back taxes to the French government due to their transfer pricing practices.

In response, governments around the world have sought to limit profit shifting activities of MNEs by introducing tougher transfer pricing regulations [e.g. Ernst and Young, 2010; Beer, Loeprick, 2015]. In 2009, the U.S. Census Bureau reported that related-party trade accounted for over 40 percent of total goods – or over 2.5 trillion dollars – traded in markets [U.S. Census Bureau News, 2010]. Bernard et al. [2005] reported that 77 percent of imports and 93 percent of exports traded by MNEs were intra-firm trade. Tax-motivated transfer pricing practices are an important determinant of government revenues, which also makes transfer pricing a political issue. Recently, the United States has undertaken an effort to close tax loopholes, especially the practices of transfer pricing. The number of countries that impose transfer pricing rules has risen sharply, from 16 in 1995 to 59 in 2007 [Silverman et al., 2008].[4]

However, the size of the problem may be overstated for two reasons. First, early research concerning transfer pricing typically assumed that foreign subsidiaries were wholly owned by domestic MNEs and would price goods traded across tax jurisdictions to minimize their tax outlays. In practice, however, many subsidiaries are less than wholly owned. The Benchmark Survey conducted by the Bureau of Economic Analysis finds that 20% of MNEs' subsidiaries are partially owned [Mataloni, Fahim, 1996]. Under conditions of partial ownership, profit shifting to a foreign subsidiary may not be as beneficial as it would be under conditions of total ownership. Even if the foreign subsidiary faced lower corporate taxes, the MNE would only capture part of those increased profits.

The size of the problem may also be overstated for a second (behavioral) reason. We have very little data on how firms set transfer prices as compared with the profit-maximizing transfer price that could be selected. Much of the literature discusses the methods that should, in principle, be used for setting transfer prices.[5] (See Tang [1997] for a review of these methods).[6] However, we know very little about how firms actually set transfer prices, and whether tax revenue is indeed being lost at predicted levels.

In this paper we use an incentivized economics experiment to investigate how individuals set transfer prices under conditions of partially and wholly owned subsidiaries. We test both point predictions and comparative static predictions transfer pricing models. Our results are consistent with theoretical predictions that there are, indeed, conditions under which profits are not shifted to the lower-taxed jurisdiction.

This paper thus makes two important contributions. First, by comparing behavior with theoretical predictions it provides a test of whether (and when) individuals set transfer prices optimally. Second, by comparing behavior under conditions of full and partial ownership it provides evidence on the impact of policy interventions (like regulating ownership proportions by MNEs) on tax revenues overall.

Literature Review

Original models of transfer pricing calculated optimal transfer prices treating subsidiaries as if they were wholly owned by the same enterprise [e.g., Horst, 1971, 1973; Eden, 1983, 1998]. Subsequent research derived optimal transfer pricing in situations where a foreign subsidiary was not wholly owned [Kant, 1988; Gabrielsen, Schjelderup, 1999]. Optimal prices can be quite different when ownerships are not wholly-owned

Enterprise-level data are proprietary and extremely difficult to access, hence, we have limited empirical evidence about the transfer prices enterprises actually set. Although some empirical work has been done [e.g. Grubert, Mutti, 1991; Hines, Rice, 1994; Collins et al., 1998; Desai et al., 2006], most studies use aggregate, industry-level transfer prices or survey data collected by the Bureau of Economic Analysis to estimate the magnitude of income shifting to lower-tax countries. Others [e.g. Clausing, 2003; Richardson et al., 2013; Dharmapala, Riedel, 2013] use a more direct approach by constructing data on export/import prices to estimate the magnitude of tax-motivated transfer prices. Unfortunately, these analyses do not allow a comparison between decisions and theoretical predictions at the enterprise level. Furthermore, they follow Horst [1971] in assuming that the subsidiaries are wholly owned, although 20 percent of MNEs' subsidiaries are partially owned [Mataloni, 1996].

The enterprise-level data that do exist rely almost exclusively on surveys rather than observational data [e.g. Abdalla, 1989; Eden, 1998; Tang, 1994]. Surveys typically elicit the methods used by various enterprises to determine transfer prices (i.e. comparable uncontrolled prices, cost plus, retail price, and comparable profits), but do not test whether the prices set are optimal, given the ownership structure, tax and tariff rates, and other conditions.

We take a new approach by designing experiments that capture the assumptions of basic transfer pricing models motivated by Horst [1971] (complete ownership) as well as Kant [1988] (partial ownership). We examine the impact of ownership fraction of subsidiaries, relative tax rates between countries, and the tariff rate of the importing subsidiary. Our experimental design allows us to test both the point predictions and comparative statics of the models.

As far as we know this is the transfer pricing analysis that compares behavior to the prediction of wholly owned and partially owned subsidiaries as well as point predictions of optimal transfer prices. Some previous works by accountants [e.g. Avila, Ronen, 1999; Dejong et al., 1989; Chalos, Haka, 1990; Kachelmeier, Towry, 2002] deal with different issues of transfer prices, namely which method of transfer pricing measures subsidiaries' performance best (negotiated transfer price, comparable uncontrolled prices, cost plus, retail price, comparable profits, etc.). But none of these experiments allow the ownership proportion to vary and none take into consideration the impact of governmental policies in the form of varying tax rates and tariff rates. These issues are the subject of our inquiry.

Experimental Design, Parameters, and Hypotheses

In this section we describe the market conditions, parameters, and market organization used in our experimental design. In standard transfer pricing models, profit from sales in the home country is separable from profit from sales in a foreign country. We thus treat the home subsidiary's profit from domestic sales as exogenous and consider in the experimental design only the profit that the home subsidiary makes by exporting to the foreign subsidiary. We further assume a constant marginal cost in the home subsidiary's cost function equal to 25.[7] t_H, t_F, τ, R_F, and k are home tax rate, foreign tax rate, tariff rate, foreign subsidiary revenues and ownership proportion, respectively. The enterprise's problem is to choose the output of the foreign subsidiary, s_F, the export/import quantity, m, and the transfer price, θ, to maximize its profit. Then the pre-tax profit for the home subsidiary is

$$\pi_H = \theta m - 25m \tag{1}$$

Kant [1988, p. 164] points out, this problem can be considered in two stages. First, the enterprise maximizes its profit with respect to θ (the transfer price) and obtains θ as a function of s_F and m. For experimental implementation, we set the inverse demand function in the foreign country as

$$p_F = 75 - s_F \tag{2}$$

where s_F is the quantity sold by the foreign subsidiary.The total cost of the foreign subsidiary is

$$C_F = (s_F - m)^2 + (1+\tau)\theta m \tag{3}$$

The profit of the foreign subsidiary is

$$\pi_F = R_F - C_F \tag{4}$$

Then the enterprise's net global profit will be

$$\pi_E = (1 - t_H)(\pi_H + k\pi_F), \tag{5}$$

assuming that $t_H > t_F$ and the enterprise is credited with this tax by the home tax authority.

In the Horst [1971] model, if the foreign subsidiary is wholly owned ($k = 1$) and $t_H > t_F$, the MNE maximizes global net profit by setting the transfer price, θ, as low as possible; in our parameterization, the MNE sets $\theta = 25$ to be consistent with international trade law, where a price below average cost is considered dumping. On the other hand, if the subsidiary is partially owned with $0.5 < k < 1$ and $k(1+\tau) < 1$, Kant [1988] shows that the MNE should set the transfer price θ as high as possible, so that $\theta = \theta_{Max} = (R_F - s_F^2)/[(1+\tau)m]$. This effectively transfers all the profits from the subsidiary back to the parent company. In this manner, the parent company appropriates all the profit from its partially-owned subsidiary. In either case, if $t_F > t_H$ then the enterprise's net profit will be

$$\pi_E = (1 - t_H)\pi_H + (1 - t_F)\, k\pi_F \tag{6}$$

Our first experiment involves testing the predictions of transfer pricing models under conditions of whole and partial ownership. We use a 2x[2] experimental design, varying the ownership fraction (whole versus partial) and the relative tax rates ($t_H > t_F$ versus $t_H < t_F$). The design and theoretical predictions are illustrated in Table 1.

TABLE 1. First 2x2 experimental design

	$t_H > t_F$ home > foreign tax rate	$t_H < t_F$ home < foreign tax rate
$k = 1$ Wholly-owned	$\theta = 25$	$\theta = \frac{R_F - s_F^2}{[(1+\tau)m]} = 89.88$
$k = 0.6$ Partially-owned	$\theta = \frac{R_F - s_F^2}{[(1+\tau)m]} = 89.88$	$\theta = \frac{R_F - s_F^2}{[(1+\tau)m]} = 89.88$

Source: own elaboration.

Our first experiment tests point predictions in these four conditions (H1) and the extent to which individuals converge to the optimal transfer price over time. We also test the comparative statics predictions; that ownership proportion matters if the home tax rate is higher than the foreign tax rate – but not otherwise (H2) – and that the tariff rate matters if the ownership proportion is partial, but not if it is wholly owned (H3).

Our second experimental design again varies the ownership structure, but also varies the tariff rate. Optimal transfer prices for different ownership structures and tariff rates are depicted in Table 2.

TABLE 2. Second 2x2 experimental design

	$\tau = 0.05$ Tariff = 5%	$\tau = 0.40$ Tariff = 40%
$k = 1$ $t_H > t_F$	$\theta = 25$	$\theta = 25$
$k = 0.6$ $t_H < t_F$	$\theta = \frac{R_F - s_F^2}{[(1+\tau)m]} = 89.88$	$\theta = \frac{R_F - s_F^2}{[(1+\tau)m]} = 226.35$

Source: own elaboration.

We again test point predictions (H1) and convergence over time in this experimental design. In addition, we test the comparative static prediction that tariff rates matter for partially owned subsidiaries but not for wholly owned subsidiaries (H4). Our final hypothesis tests whether transfer prices are higher for partially owned subsidiaries than for fully owned subsidiaries, and whether this difference is larger for higher tariff rates (H5).

In the experiment we assume that the decision-maker chooses the profit-maximizing quantity to transfer (m) and the resulting optimal output (s_F). We thus focus on the transfer pricing decisions of the participants.

Experimental Implementation

The experiment was run at the Center for Behavioral and Experimental Economic Science laboratory at the University of Texas at Dallas. The experiment was programmed and run in z-tree. Our experimental design, described above, involves two $2x^2$ designs, yet yields only six distinct treatments (note that the first column of each table involves identical parameters and predictions). We utilized both a within- and between-subjects design in our experiments. Subjects were randomly placed in either wholly or partially owned treatment (between subject). Subjects in the wholly owned treatment experience low home tax, low tariff ($t_H < t_F$ and $\tau = 0.05$), high home tax tax, low tariff ($t_H > t_F$

and $\tau = 0.05$), and high home tax, high tariff ($t_H > t_F$ and $\tau = 0.40$) treatments in that order. Subjects in the partially owned treatment experience low home tax, low tariff ($t_H < t_F$ and $\tau = 0.05$), high home tax, low tariff ($t_H > t_F$ and $\tau = 0.05$), and low home tax, high tariff ($t_H < t_F$ and $\tau = 0.40$) treatments in that order.

The experiments were conducted over five sessions in the spring of 2010 at the CBEES lab of the University of Texas at Dallas. Participants were predominantly undergraduate students enrolled during the spring semester of 2010. For each session we recruited 12 participants, but in one session only 11 attended; thus, we had a total of 59 participants. Participants were randomly placed in the wholly or partially owned treatment. For runs with a wholly owned subsidiary there were 29 participants. For the runs with a partially-owned subsidiary, there were 30 participants.

The instructions were entirely computerized, and described the parameters of the problem including market demand, production costs, taxes, and tariffs (referred to in the instructions as a "handling cost"), and the ownership fraction of the subsidiary. Each participant made 60 pricing decisions; 20 in each of three treatments. After each decision, participants were informed of the resulting profit from each of their two subsidiaries, and in total. Participants earned an average of \$ 15, including a \$ 5 show-up fee, for a one-hour experiment.

After the participants completed the experiments they were asked to complete a survey, which elicited their attitudes about Multinational Enterprises and the U. S economy. These results were used as controls in our analysis. The survey also included measures of participants' cognitive ability, using the Cognitive Reflection Test (CRT) introduced by Frederick (2005).[8]

Table A1 in the appendix describes the demographic details of our sample. Average age was 21 and almost 70 percent of participants in both treatments were born in the U.S. There were no statistical differences in the demographics of the participants in the two treatments.

We found no significant differences in the responses to any of our survey measures or the CRT between treatments, as shown in Table A2 in the appendix.

Experimental Results

H1: Individuals choose optimal transfer prices

Our first hypothesis is that individuals will choose optimal transfer prices. Our data clearly reject the hypothesis for all six treatments; individuals do not choose optimal transfer prices in general although, as we will see, their choices do converge toward optimal as they receive feedback. Table 3 summarizes the average transfer prices chosen and the t tests comparing those prices with those predicted.

TABLE 3. Summary statistics and t-tests

	Mean price (standard error) All periods	t-statistic (vs. optimal)	Mean price (standard error) last 15 periods	t-statistic (vs. optimal) last 15 periods
Wholly-owned k = 1				
$t_H > t_F$ and $\tau = 5\%$ Optimal price = 25	31.04 (0.65)	9.30*	29.97 (0.19)	25.59*
$t_H < t_F$ and $\tau = 5\%$ Optimal price = 89.85	78.24 (2.05)	−5.66*	82.81 (0.56)	−12.54*
$t_H > t_F$ and $\tau = 40\%$ Optimal price = 25	48.70 (1.60)	14.82*	46.56 (0.79)	27.46*
Partially-owned k = 0.6				
$t_H > t_F$ and $\tau = 5\%$ Optimal price = 89.85	78.39 (1.66)	−6.90*	82.54 (0.49)	−14.96*
$t_H < t_F$ and $\tau = 5\%$ Optimal price = 89.85	79.89 (1.28)	−7.77*	82.05 (0.61)	−12.78*
$t_H < t_F$ and $\tau = 40\%$ Optimal price = 226.35	172.51 (3.66)	−14.72*	180.44 (1.52)	−30.11*

* 5% level

Source: own elaboration.

Mean transfer prices are clearly different than those predicted ($p < 0.01$ for all six treatments). The results remain robust even after dropping the first five periods, suggesting that the deviation from optimal behavior is not simply caused by initial confusion.

As shown in Table 3, in the wholly owned treatment with $t_H > t_F$ and $\tau = 0.05$ the mean transfer price chosen by participants is too high. This difference is largest with the high tariff ($\tau = 40$ percent) treatment. This error is reversed in the partially-owned treatment, where the mean transfer price is lower than the predicted one. On the other hand, in treatments where $t_H < t_F$ and $\tau = 0.05$ mean transfer prices are lower in both treatments (wholly owned and partially owned) than those predicted. These errors improve after the first five periods, but the direction of the errors does not change (i.e., either subjects continue to choose a transfer price larger or smaller than the optimal value).

A more sophisticated analysis compares outcomes and predictions while accounting for learning over time. This method, proposed by Noussair, Plott, and Riezman [1995] [9], examines whether transfer prices chosen converge (or asymptote) to the prediction. The regression model is

$$y_{it} = B_{11}D_1(1/t) + B_{12}D_2(1/t) + B_{13}D_3(1/t) + B_{1i}D_i(1/t) + \dots$$
$$B_{21}D_1(t-1)/t + B_{22}D_2(t-1)/t + B_{23}D_3(t-1)/t + B_{2i}D_i(t-1) + \dots u, \quad (7)$$

where y_{it} is the transfer price for treatment i in period t, B_{1i} is the origin of possible convergence process for the treatment i, D_i is a dummy variable that takes a value of 1 for treatment i and 0 otherwise. Thus B_{11}, B_{12}, and B_{13} refers to origin of the transfer price in treatment $t_H < t_F$ and $\tau = 0.05$, $t_H > t_F$ and $\tau = 0.05$, $t_H > t_F$ and $\tau = 0.40$ respectively for the wholly-owned treatment. B_{2i} is the asymptote of the transfer price for treatment i. Thus B_{21}, B_{22}, and B_{23} are the asymptotic transfer prices for those treatments. We estimated this equation for both treatments (wholly owned and partially owned) in our experiment. Table A3 (in the appendix) reports the estimated coefficients using all twenty periods of the treatment. Table A4 (in the appendix) reports the results after we drop the first five periods to investigate the convergence process after the participants have had some experience.

We again find that choices in each of the six treatments differ significantly from optimal, although the coefficients are relatively close. These results are robust to dropping the first five periods, as shown in Table A4, in the appendix.

This first set of tests compared behavior against theoretical predictions. The next set of tests examined the comparative static predictions resulting from the experimental design.

H2: Ownership matters if home taxes are higher than foreign taxes but not otherwise.

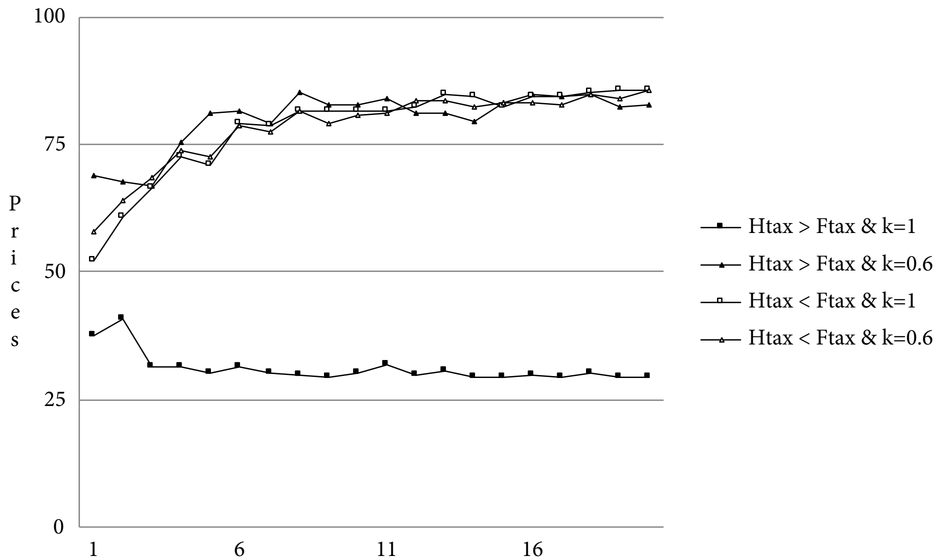
We compared transfer prices between wholly and partially owned cases, chosen by the participants in the treatments where $t_H < t_F$ and the treatments where $t_H > t_F$. Figure 1 presents the average prices in the relevant treatments, while Table 4 summarizes the relevant data and statistical tests.

As predicted, when $t_H > t_F$ average initial transfer prices are quite different between partially and wholly-owned treatments; in all periods, average transfer prices are lower in the wholly-owned treatment than in the partially-owned treatment, as predicted ($p < 0.01$, t-test), and as seen in Table 4 (the dark triangles and the dark squares in Figure 1). In contrast, when $t_H < t_F$, the transfer prices chosen initially are not different from each other as predicted (p = ns, t-test), and as seen in Table 4 (the empty triangles and the empty squares in Figure 1).

*H3***:** *Relative tax rates matter more if ownership is complete than if it is partial.*

We next tested hypothesis H3 by comparing the effects of tax rates using $t_H < t_F$ and $t_H > t_F$ treatments between wholly and partially-owned cases. Note that this is a within-subject test, since all participants did both treatments ($t_H < t_F$ and $t_H > t_F$).

FIGURE 1. Comparing wholly-owned and partially-owned treatments



Where Htax, Ftax, and k are: home tax rate, foreign tax rate, and ownership proportion.
Source: own elaboration.

TABLE 4. Wholly-owned vs. partially-owned t-tests

	Differences in transfer prices	t-statistic	p-value
H0: $\theta_{k=1} - \theta_{k=0.6} = 0$			
$t_H < t_F$ and $\tau = 5\%$.	−0.15 (0.46)	−0.33	0.75
H0: $\theta_{k=1} - \theta_{k=0.6} = 0$			
$t_H > t_F$ and $\tau = 5\%$.	−48.85** (1.83)	−26.74	< 0.01

** 1% level
Source: own elaboration.

The graph in Figure 1 confirms a tax rate effect when the subsidiary is wholly owned (dark and light squares) but not when it is partially owned (dark and light triangles). The analysis presented in Table 5 confirms that if the subsidiary is wholly owned then the mean transfer prices are significantly different from each other ($p < 0.01$, t-test). However, they are not significantly different if the subsidiary is partially owned (p = ns, t-test). This result confirms our hypothesis H3 and is consistent with the comparative static predictions of the theory.

TABLE 5. Relative tax rate and ownership

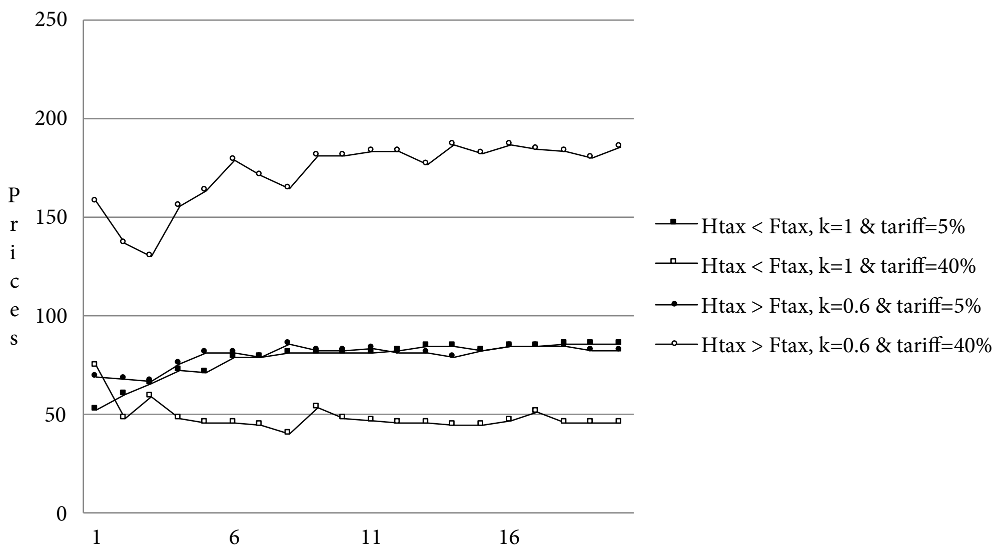
	Z-stat	p-value	Binomial test P=0.5
Wholly-owned k = 1			
H0: $\theta_1 - \theta_2 = 0$. $t_H < t_F$ vs. $t_H > t_F$, and $\tau = 5\%$.	3.92*	< 0.01	< 0.01
Partially-owned k = 0.6			
H0: $\theta_1 - \theta_2 = 0$. $t_H < t_F$ vs. $t_H > t_F$, and $\tau = 5\%$.	−1.64	.10	0.50

* 5% level

Source: own elaboration.

H4: Tariff rates affect the transfer price if the ownership proportion is partial, but not if it is complete.

FIGURE 2. Comparing tariff rates



Where Htax, Ftax, and k are: home tax rate, foreign tax rate, and ownership proportion.

Source: own elaboration.

Figure 2 depicts the average transfer prices throughout all twenty periods in the low tariff ($\tau = 5\%$) and the high tariff ($\tau = 40\%$) treatments for wholly-owned and partially-owned treatments. Table 6 reports the Z and the binomial tests for the fourth hypothesis. Since these treatments are within subject design, the binomial test is a more appropriate test than the t-test.

The statistical tests in Table 6 and graphs in Figure 2 only partially support the hypothesis. If ownership proportion is partial, the transfer prices under different tariff rates are indeed statistically different ($p < 0.01$, t-test, binomial test), as predicted. However, transfer prices also differ if ownership is complete ($p < 0.01$, t-test, binomial test), which is not consistent with the hypothesis. As can be seen in Figure 2, the differences between treatments are in the correct direction, with partial ownership (solid and empty circles) being farther apart than full ownership (solid and empty squares).

H5: Individuals learn to choose optimal transfer prices

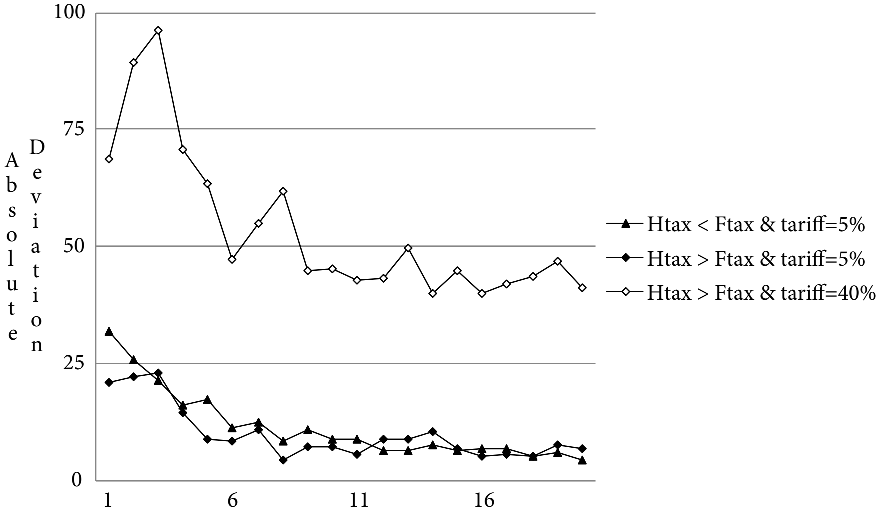
Our fifth hypothesis is that transfer prices will converge to optimal over time. The graphs in Figure 3 and Figure 4 depict the average absolute deviation of chosen transfer price from the optimal transfer price in each of the conditions. Inspection of these figures suggests that behavior does converge toward the optimum. Individuals may learn to choose optimal prices through experience; one can see that error systematically decreases over time in all treatments.

TABLE 6. Tariff rate and ownership

	Z-stat	p-value	Binomial test P=0.5
Wholly-owned k = 1			
H0: $\theta_1 - \theta_2 = 0$. $t_H < t_F$ and $\tau = 5\%$. vs. $t_H < t_F$, and $\tau = 40\%$.	3.80	< 0.01	< 0.01
Partially-owned k = 0.6			
H0: $\theta_1 - \theta_2 = 0$. $t_H > t_F$ and $\tau = 5\%$. vs. $t_H > t_F$, and $\tau = 40\%$.	–3.92	< 0.01	< 0.01

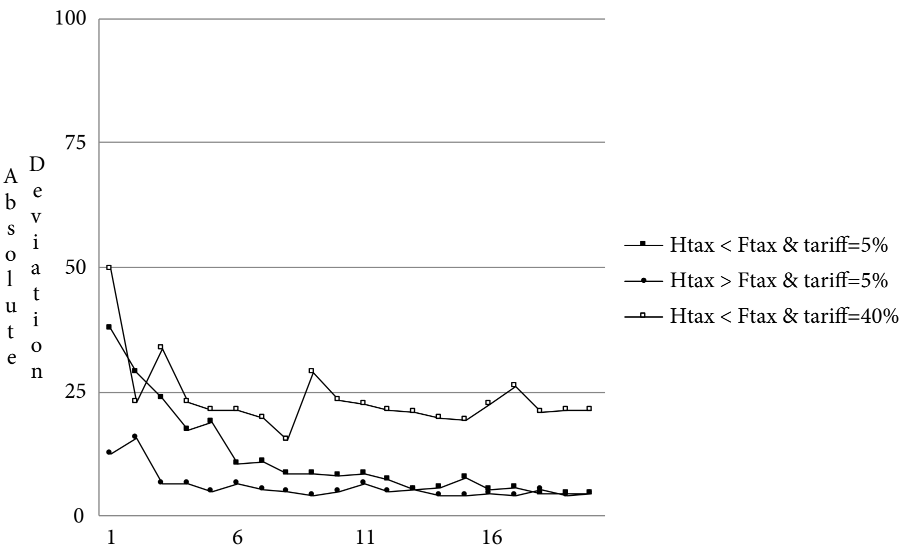
Source: own elaboration.

FIGURE 3. Absolute deviation from optimal value (partially-owned k=0.6)



Where Htax and Ftax are: home tax rate and foreign tax rate respectively.
Source: own elaboration.

FIGURE 4. Absolute deviation from optimal value (wholly-owned k=1)



Where Htax and Ftax are: home tax rate and foreign tax rate respectively.
Source: own elaboration.

TABLE 7. Regression analysis (absolute deviation from optimal price as dependent var)

	Model 1	Model 2	Model 3	Model 4	Model 5
Period	−2.55** (0.44)	−3.09** (0.43)	−3.25** (0.44)	−3.26** (0.44)	−3.41** (0.54)
Period2	0.08** (0.01)	0.10** (0.02)	0.12** (0.02)	0.12** (0.02)	0.12** (0.02)
Wholly-owned		4.30 (4.28)	−17.23** (5.97)	−21.61** (6.11)	−21.51** (6.16)
Low home tax		27.30** (3.30)	11.27** (3.47)	11.02** (3.59)	11.51** (3.73)
High tariff rate (1=40% and 0=5%)		54.79** (8.00)	40.57** (8.48)	40.32** (8.10)	40.81** (8.07)
Wholly-owned*period			0.59^ (0.31)	0.59^ (0.31)	0.69* (0.32)
Low home tax*period			−0.68** (0.16)	−0.68** (0.16)	−0.69** (0.17)
High tariff *period			−0.86^ (0.45)	−0.85^ (0.45)	−0.86^ (0.45)
Cognitive test (1 out of 3 correct)					−7.96 (8.12)
Cognitive test (2 out of 3 correct)					−17.16^ (9.13)
Cognitive test (3 out of 3 correct)					−21.18* (8.26)
Cognitive test * Period	No	No	No	No	Yes
Include Demographic	No	No	Yes	Yes	Yes
Include Survey Question	No	No	No	Yes	Yes
Log likelihood F		−16634.55 27.91	−16590.42 21.64	−16578.56 14.43	−16553.90 10.10
N	3540	3540	3540	3540	3540

** 1%, * 5%, and ^ 10% level.

Source: own elaboration.

To provide statistical support for our hypothesis, we ran a panel regression model with random effects for each participant. We pooled responses in the two treatments (wholly owned and partially owned). Table 7 reports the results of the model

$$y_{it} = \beta_i X_{it} + \gamma_i Z_{it} + \epsilon_{it}, \tag{8}$$

where y_{it} is the absolute deviation from the optimal value at time t for participant i, $t = 1,..., T$, and $i = 1,..., N$. X comprises variables of interest, i.e. treatments and cognitive ability, and Z is a vector of control variables, which includes individual demographics and survey answers. The constant term was omitted to enable us to jackknife standard errors to correct for bias due to the treatment pooling.

Over all treatments, the absolute deviation from the optimal value decreased over time but at a decreasing rate ($\beta = -3.41$, $p < 0.01$). This result is robust even after controlling for demographics and other individual-level variables. Participants in the wholly-owned treatment deviated less from the optimal than those in the partially-owned treatment ($\beta = -21.51$, $p < 0.01$). In the low tax ($t_H < t_h$ and low tariff ($\tau = 5$ percent) treatment, participants tended to learn more quickly compared to the high tax and high tariff treatments ($\beta = 40.81$, $p < 0.01$).

The interaction of period with low tax treatment was marginally significant. This means that over time, participants perform better in the low tax and/or high tariff rate treatments relative to the high tax and low tariff treatments. Additionally, participants in the wholly-owned treatment perform better relative to the partially-owned treatment ($\beta = -21.51$, $p < .01$).

One possible explanation of variation is our subjects' cognitive ability. We coded participants who correctly answered at least two out of the three questions correctly on the CRT as having high cognitive ability. While these individuals deviated less from optimal than others ($\beta = -21.18$, p< 05), these differences do not interact with period, suggesting that individuals of different cognitive abilities learn at the same rate.

Conclusion

This study provides the first controlled test of transfer pricing decisions. We find that while individuals often set transfer prices that deviate from the optimal, they learn from experience and decisions converge quite closely to optimal levels over time. Additionally, we compared behavior under conditions of full and partial ownership, varying relative tax rates, and varying tariff rates. These comparisons allow us to offer policy prescriptions informed by behavioral responses to policies, as well as by theoretical predictions.

We find that individuals are responsive to changes in tax and tariff rate, as predicted. Individuals set a low transfer price when the foreign tax rate is larger than home tax rate and the reverse is true when the home tax rate is smaller than the foreign tax rate under the wholly-owned treatment. And the transfer price does not change significantly when subsidiary ownership is partial. However, they are also responsive in settings we did not predict, such as when foreign country has a high tariff rate. Theory predicts that for wholly-owned subsidiary, transfer prices should only be responsive to the tax-tariff differential. But in our result when the tariff rate is high individuals set a high transfer price as compared to when the tariff rate is low. This suggests that tariff rates play a significant role in MNE strategy when setting transfer prices.

More generally, the results from our experiments provide additional supporting evidence to existing literature on income shifting by MNEs through the use of transfer pricing. While individuals do not choose optimal transfer prices, their choices converge close to the optimal transfer price with experience. Hence, the magnitude of income shifting estimated in our study is substantial compare to the previous literature where it was estimated to be minimal.

Given our results, anti-avoidance measures by policy makers might be desirable. If policy makers want to restrict profit shifting by MNEs then it would be helpful to pay close attention to subsidiaries' ownership structures as well as the tax and tariff rates differential.

Notes

[1] Author's e-mail address: Quoc.tran@bridgew.edu(corresponding author).
[2] Author's e-mail address: croson@uta.edu
[3] Author's e-mail address: seldon@utdallas.edu
[4] The OECD is counted as one country in these totals.
[5] Governments are interested in monitoring transfer prices to ensure that they receive tax revenues due to them under the existing tax code and may challenge transfer prices if they believe they are set in a way that allows the enterprise to evade taxes. A universal standard is that transfer prices should reflect the price that might arise if the units were independent firms; this is the so-called "arms-length standard".
[6] All of the various methods attempt to mimic the arm's-length standard as closely as possible given the characteristics of the goods, service, or intellectual property inherent in the asset being exchanged.
[7] This does not conflict with the original model in Horst [1971] and Kant [1988]. The foreign subsidiary will have increasing marginal costs.
[8] The CRT test has been used as a measurement of cognitive abilities in studies of ability and overconfidence [Moore, Healy, 2008], anomalous preferences [Benjamin, Brown, 2006], winner's curse [Casari, Ham, Kagel, 2007], and time and risk preferences [Frederick, 2005]. The CRT has been shown to be positively correlated with the Scholastic Achievement Test (SAT) and the American College Test (ACT), [Frederick, 2005].
[9] See Noussair, Plott, Riezman [1995] for a more detailed explanation of the model.

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Appendix

TABLE A1. Subject demographic statistics

Variable	Wholly owned treatment	Partially owned treatment	t-stat
Age	20.79	21.13	–0.43
Gender (Male=1)	48%	70%	–1.71
Born in the U.S (yes=1)	72%	67%	–0.47
Marital status (single=1)	100%	97%	–0.98
Student status:	1.03	1	–0.02
Freshmen	21%	3%	
Sophomore	38%	33%	
Junior	34%	34%	
Senior	7%	40%	
Job status:	1.69	2%	0.50
Not working	48%	50%	
Temporary job	34%	23%	
Full time job	18%	27%	
Ethnicity:	5.28	5.43	–0.27
African American	7%	7%	
East Asian	17%	17%	
Middle Eastern	7%	0%	
Hispanic	0%	3%	
Pacific Islander	3%	0%	
South Asian	28%	27%	
White	28%	40%	
Other	10%	7%	
N	29	30	

Source: own elaboration.

TABLE A2. Survey summary statistic

Variable	Wholly owned	Partially owned	t-stat
Should U. S companies be allowed to outsource their jobs to a foreign country? (yes=1)	0.83	0.77	0.57
Should foreigners be allowed to own a large portion of U. S companies? (yes=1)	0.62	0.77	–1.21
In your opinion what is the overall effect of globalization on the U. S economy? (1=small, 7=large)	3.69	3.80	–0.29
What is the overall effect on the U. S economy of foreign companies' activities in the U. S? (1=small 7=large)	3.86	3.53	1.04
How large is the overall effect on the U. S economy of foreign companies' activities in the U. S? (1=small 7=large)	5.28	4.97	0.93
Have you ever lived overseas? (yes=1)	0.38	0.23	1.21
Cognitive Reflection Test (0=none correct 3=all correct)	1.48	1.50	0.06
None correct	7	7	
One correct	9	8	
Two correct	5	8	
Three correct	8	7	
N	29	30	

Source: own elaboration.

TABLE A3. Transfer price convergence analysis

Wholly-owned treatment			
Coefficients		Model predictions	95% Conf. interval
B_{11}	46.32** (5.47)	89.85	35.70–57.61
B_{12}	39.83** (5.47)	25	29.10–50.56
B_{13}	70.39** (5.47)	25	59.65–81.12
B_{21}	85.21* (1.82)	89.85	81.64–88.78
B_{22}	29.11* (1.82)	25	25.54–32.68
B_{23}	43.94* (1.82)	25	40.36–47.51
R-sq = 0.74			

Partially-owned treatment			
Coefficients		Model predictions	95% Conf. interval
B_{11}	53.05* (6.89)	89.85	39.53–66.57
B_{12}	63.22* (6.89)	89.85	49.70–76.73
B_{13}	134.38* (6.89)	226.35	120.87–147.90
B_{21}	83.94* (2.29)	89.85	79.44–88.44
B_{22}	83.55* (2.29)	89.85	79.05–88.04
B_{23}	180.87* (2.29)	226.35	176.37–185.37
R-sq = 0.88			

** 1% and * 5% level

B_{11}, B_{12}, and B_{13} refers to the origin of the transfer price in treatment $t_H < t_F$, $\tau = 0.05$, $t_H > t_F$, $\tau = 0.05$, and $t_H > t_F$, $\tau = 0.40$ respectively and B_{21}, B_{22}, and B_{23} are the asymptotic transfer prices for those treatments.

Source: own elaboration.

TABLE A4. Transfer price convergence analysis (last 15 periods)

Wholly-owned treatment			
Coefficients		Model predictions	95% Conf. interval
B_{11}	30.74* (42.17)	89.85	–51.99–113.46
B_{12}	40.22* (42.17)	25	–42.51–122.94
B_{13}	36.38* (42.17)	25	–46.34–119.11
B_{21}	87.81* (4.34)	89.85	79.30–96.33
B_{22}	28.98* (4.34)	25	20.47–37.50
B_{23}	47.55* (4.34)	25	39.03–56.06
R-sq = 0.76			

Partially-owned treatment			
Coefficients		Model predictions	95% Conf. interval
B_{11}	27.74* (51.53)	89.85	–73.36–128.83
B_{12}	67.80* (51.53)	89.85	–33.29–168.89
B_{13}	88.32* (51.53)	226.35	–12.77–189.42
B_{21}	87.27* (5.31)	89.85	76.86–97.67
B_{22}	83.96* (5.31)	89.85	73.55–94.37
B_{23}	189.29* (5.31)	226.35	178.87–199.70
R-sq = 0.90			

* 5% level

B_{11}, B_{12}, and B_{13} refers to the origin of the transfer price in treatment $t_H < t_F$, $\tau = 0.05$, $t_H > t_F$, $\tau = 0.05$, and $t_H > t_F$, $\tau = 0.40$ respectively and B_{21}, B_{22}, and B_{23} are the asymptotic transfer prices for those treatments.

Source: own elaboration.