Wheels of Change:
Tax Policy Effects on U.S.-Japan Automobile Trade

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While several theoretical works point out inefficiency of tax competition, few attempts have been made at quantitative analysis. Using a case study based on the U.S.-Japan automobile trade, we measure the degree to which independent tax systems create efficiency losses in the global market. A simulation reveals that, once the governance of the interrelated markets is coordinated between two countries, the potential for social welfare improvement is significant. The result illustrates the necessity for an integrated tax authority with supra-national legislative and tax-raising powers.

Key Words:
Intra-firm Trade; Multinational Companies; Tax Competition

JEL Classification:
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Market integration movements are putting increasing pressure on policy makers to adjust national tax structures. Growing multinational business challenges independent tax legislation in many countries since cross-border transactions among related parties increase the scope for tax avoidance. Governments have recognized the need to regulate, and try to prevent, tax evasion, yet are fearful of the impediments that tax regulations may cause to global trading. This trade and public finance issue, inextricably linked with globalization, is one of the major policy debates the OECD and WTO are facing.

We study efficiency losses caused by independent tax systems. Several theoretical works point out inefficiency of tax competition (see the survey by Wilson [1999]). However, few attempts have been made at quantitative analysis (Mendoza and Tesar, 2003; Sorensen, 2003). This paper relates the inefficiency issues to the growing concern of the trade of intermediate goods (Hummels et al., 2001; Hanson et al., 2003; Yi, 2003). We measure the efficiency losses caused by independent tax systems via tax-induced trade distortions using a case study based on the U.S.-Japan automobile trade.

Automobile trade is one of the best examples for understanding this topic's political importance. The rivalry between the U.S. and Japanese car industries often goes beyond private sector market competition, extending to political disputes between the two governments. The voluntary export restraint (VER) during the 1980s and the transfer pricing issues of the late 1980s and early 1990s are examples of government market intervention.

The model introduces the internal organization of a firm into the models of source-based capital tax competition found in the public finance literature (Wilson, 1986; Zodrow and Mieszkowski, 1986; Mieszkowski and Zodrow, 1989). We relate this to the analysis in the literature on transfer pricing of multinational companies (Horst, 1971; Copithorne, 1971; Eden, 1985; Kant, 1990; Prusa, 1990; Gresik and Nelson, 1994; Stoughton and Talmor, 1994; Bond and Gresik, 1996; Elitzur and Mintz, 1996). Specifically, we construct a model incorporating recent tax regulations such as the Bilateral Advanced Pricing Agreement (BAPA).[1] Tomohara (2004) shows that independent domestic tax policies under the BAPA system cause efficiency losses. A centrally integrated tax system

can overcome the inefficiency. We numerically measure the possible gains from tax coordination after estimating the market demand and industry cost. We refer to the trade literature on the voluntary export restraint (VER) in the process (Dixit, 1988; Berry et al., 1995; Feenstra and Levinsohn, 1995; Goldberg, 1995).

A simulation reveals that some tax policies benefit both governments and companies, but not consumers. A large increase in tax revenue can be achieved in conjunction with increased profits for both Japanese and U.S. companies, yet the size of the market shrinks. Japanese companies increase profits by reducing the supply of cars via increased price. U.S. companies increase their profits by replacing part of the market for Japanese cars. The increase in sales of U.S. cars is not large enough to compensate for a decrease of Japanese cars, hence the market size gets smaller. Increased profits lead to larger joint tax revenues for the two governments.

One may see this as being analogous to the case of VER by Japanese car companies supplying the U.S. market during the 1980s. A quota for Japanese cars benefited both Japanese and U.S. companies at the expense of U.S. consumers. VER policies create monopoly rents for both Japanese and U.S. companies. However, the degree to which tax coordination affects consumers is different from VERs. The literature on VERs estimates huge losses to consumers. The impact of tax coordination on the size of the market is trivial when compared to the changes in tax revenues and profits levels. Gains to the governments and companies are so large that social welfare improves in our analysis.

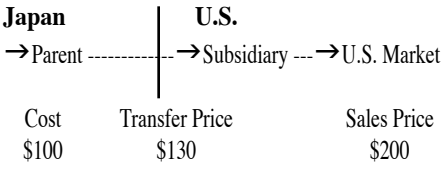
Given social welfare improvements, tax coordination is suggested. However, tax coordination may involve transfer payments between two governments in the event of increased tax revenues. The analysis suggests an integrated tax authority with supra-national legislative and tax-raising authority is necessary. Given that transfer payments are not general practice under the current tax system, the tax system should be reconstructed to integrate tax administration across countries. Similar policy implications will be of relevance for other industries engaged in global trading.

Background

This section briefly reviews the history of tax war and the literature on inter-government fiscal relations. This includes transfer pricing cases among Japanese companies and U.S. and Japanese governments. Reviewing recent U.S.-Japan Business-Government relations will give us a better understanding of the political importance of the topic.

Institution

As multinational business expanded in the 1970s, governments grew aware of eroding tax bases via tax evasion by multinational companies. Since tax systems differ across countries, multinational companies can reduce their tax burden by shifting profits to countries with relatively low tax rates. Transfer pricing is one method of evasion. Multinational companies manipulate a transfer price so that income is allocated to the country with a lower tax rate. The following example illustrates the mechanism of transfer pricing.



The figure shows intra-firm trade of a Japanese multinational company. A parent company in Japan produces and exports intermediate goods. These goods are further assembled or manufactured by a subsidiary in the U.S. The cost of producing intermediate goods is $100. The parent sells the intermediate goods to the subsidiary at the transfer price of $130. Final goods are sold for $200 in the U.S. markets. Suppose the Japanese corporate tax rate is 50 percent and the U.S. tax rate is 40 percent. The company's after-tax profits are $57 (= (1-0.5)(130-100)+(1-0.4)(200-130)). Next, suppose the company misreports the transfer price to the IRS as $110, instead of $130. This allocates less profit to Japan, where tax rates are higher. The company's after-tax profits increase to $59 (= (1-0.5)(110-100)+(1-0.4)(200-110)). The transfer pricing benefits the company with increased profit, however, the Japanese government suffers a $10 decrease in tax revenue, from $15 to $5.

Such tax avoidance has also been brought to public attention as an equity issue. Domestic companies are subject to higher effective corporate tax rates when compared to multinational companies. Domestic companies are not able to manipulate their profits, as multinational companies do, for tax saving purposes. The last thirty years have been an era of trial and error for governments attempting to regulate transfer pricing among related parties across country borders.

Current corporate tax laws intend to regulate any illegitimate income allocation among related affiliates of multinational companies. For example, the Internal Revenue Code § 482 regulates the transaction:

> In any case of two or more organizations, trade, or businesses ... owned or controlled directly or indirectly by the same interests, the Secretary may distribute, apportion, or allocate gross income, deductions, credits, or allowances between or among such organizations, trades, or business, if he determines that such distribution, apportionment, or allocation is necessary in order to prevent evasion of taxes ...

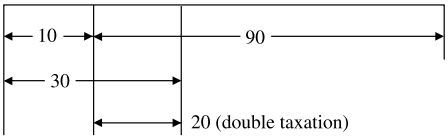
Most countries employ similar regulations on the same type of transactions among multinational affiliates.

The Internal Revenue Service (IRS) needed to develop a new understanding of the importance of private information when implementing the code. The IRS was frustrated with auditing restrictions that did not allow access to information related to intra-firm transactions of multinational affiliates. The IRS did not have the right to investigate multinational parents and/or affiliates outside the United States. Because of the lack of information, the IRS had a difficult time in courts when they tightened tax audits of transfer pricing on foreign-affiliated subsidiaries in the United States from the 1980s to the 1990s. Since the audit reinforcement was motivated by huge budget deficits and the strong performance of foreign affiliated multinational companies operating in the U.S. market, many multinational companies protested this arbitrary change of administration and disagreed with the "notice of correction" from the IRS. As the result of

this, the number of appeals to tax courts increased drastically upon the audit reinforcement. The appeals often resulted in favor of multinational companies because of insufficient evidence of tax manipulation.

In 1991, the Advanced Pricing Agreement (APA) was introduced to resolve disputes associated with determining a legitimate transfer price (the so called "arm's length price"). The arm's length price is a fictitious transfer price constructed for the purpose of filing a tax return. The price is defined as the transfer price that would have been used if the intra-firm transaction took place between non-associated parties in the market. The purpose of the APA is to reach a consensus on the arm's length price between a taxpayer and a tax authority before taxpayers file a tax return. Once companies apply for the APA, the procedure requires them to submit certain information, including an organization chart, the nature of the transaction, and the relationship among affiliates. The IRS can then decide the appropriateness of the arm's length price used in the intra-firm transaction. Since the tax authorities have not usually audited multinational firms after the agreement, the consensus on the transfer price has helped companies eliminate the risk of tax penalties and save on the cost of lawsuits and tax audits. Despite the costs of documentation, multinational companies welcomed and frequently utilized the system. In most developed countries, a similar system is functioning as a precautionary device to avoid disputes on transfer pricing.

The APA has been extended to the Bilateral Advanced Pricing Agreement (BAPA), which aims to coordinate the confirmation of the arm's length price between two countries. The necessity of coordination results from an effort to eliminate international double taxation, which will occur if tax authorities in each jurisdiction apply a different arm's length price. The following example clarifies the mechanism of double taxation. Suppose both U.S. and Japanese tax authorities use the same arm's length price of $110. We use the same information as in the previous example, except for a transfer price. The before-tax profits of the company are $100 (=200-100). The profits are sum of the profit earned in Japan, $10 (=110-100), and the profit earned in the U.S., $90 (=200-110). However, suppose the Japanese IRS claims a different price, $130, while the U.S. IRS still uses the arm's length price of $110. The tax base in Japan increases to $30 (=130-100). As a result, the tax payment in Japan increases to $15 (=30*0.5) and the company's after-tax profits are reduced to $49 (=100-15-36). The decreased profits are due to double taxation on the profit equivalent to $20 (i.e., the difference of the arm's length price between the two countries).



Once double taxation is observed, either tax authority is supposed to reallocate the income in a way to reduce their tax base and refund the corresponding tax overpayment to companies in their country. In this example, the Japanese IRS (the U.S. IRS) will refund $10 ($8) to the company, if the two tax authorities and the company agree that the arm's length price is $110 ($130). The BAPA not only reduces the government administrative costs of political bargaining, but also lowers risk in the consequent income adjustment.

The Literature

Over the past few decades, tax legislation for multinational businesses initiated numerous studies while becoming one of the critical policy issues posed by economic globalization. The earlier literature tries to provide a theoretical framework for multinational companies' decision- making under different tax systems across countries. The literature shows that multinational companies can increase global income by shifting their profits to lower-taxed jurisdictions via transfer price manipulation in intra-firm transactions (Horst, 1971; Copithorne, 1971; Eden, 1985; Kant, 1990). While it is clear that the mechanism of transfer pricing can serve as an arbitrage device to reduce the tax burden of companies, these works treat tax policies as exogenous. More recent works study policy planning for a less-informed government regulating tax evasion. Transfer pricing is a company's private information that is often beyond governments' control. The literature proposes an analysis of mechanism design by using a principal-agent model. The question is how to implement tax policies so as to induce an appropriate transfer price from multinational companies (Prusa, 1990; Gresik and Nelson, 1994; Stoughton and Talmor, 1994; Bond and Gresik, 1996). The policy concern turned toward an efficiency loss rather than information constraints after the introduction of the APA/BAPA. Elitzur and Mintz (1996) show the inefficiency of tax competition under the APA case. Tomohara (2004) shows efficiency losses caused by the BAPA case. The loss of efficiency arises because multinational companies, while integrated under common control, cannot internalize the costs of intra-firm transactions under the BAPA system. The BAPA segregates the profits earned by two different affiliates within the same company for the purpose of imposing taxes independently. Corporate profits (and tax revenue) will consequently be lower. The inefficiency will be overcome once tax coordination eliminates the segmentation between two or more affiliates within the same company.

U.S.-Japan tax war

International tax war debates date back to the voluntary export restraint (VER) placed on Japanese automobile manufacturers supplying the U.S. market. The VER was instituted at the request of the U.S. government, as an attempt to protect the domestic car industry. Increasing demand for fuel-efficient Japanese cars following the 1973 and 1980 oil-crises eroded market share of U.S. companies. During the 1980s Japanese automobile exports to the U.S. were limited via a quota, which was allocated by the Japanese government to various companies.

In response to the quota (and sales expansion), the Japanese automobile industry gradually began to shift production from Japan to the U.S. by establishing manufacturing subsidiaries in the U.S. A typical process involved parent companies in Japan producing intermediate goods, which were then assembled or manufactured by subsidiaries in the U.S. The volume of such intra-firm trade grew drastically: "Parts from Japan, imports of which burgeoned to supply the growing number of U.S.-produced Japanese

vehicles, have accounted for the most of the U.S. trade deficit since the mid-1980s" (Slater, 1997, p.37).

The expansion of Japanese automobile parts trade (and increasing market share), however, created another problem: suspicion of dumping.[2] An investigation of Japanese-controlled subsidiaries by the Treasury Department showed that Japanese subsidiaries were, in fact, purchasing interim products at higher prices from their parent companies. This discovery brought to light a new problem, transfer-pricing issues. Japanese subsidiaries were shifting their profits illegitimately to Japan to avoid tax payments in the U.S. As a result, the Japanese automobile industry was plagued with extensive IRS tax audits. The cases of Nissan and Toyota are notable. Large amounts of tax correction and prolonged negotiations required a political settlement between the Japanese and U.S. governments. After twelve years of strife, the IRS succeeded in receiving about 640 million dollars in additional tax revenue (464 million from Nissan and 176 million from Toyota, in 1987 and 1988, respectively). The corporate tax revenues in Japan were correspondingly reduced. Nissan had to pay another 160 million dollars to the IRS in 1993.

Other Japanese multinational companies operating in the United States suffered similarly during the 1980s and early 1990s (Table 1). The Japanese government reacted by using similar policy toward U.S. companies operating in Japan. Subsidiaries of the American International Underwriters (AIU) and Coca-Cola were two of those hit, early on, with tax penalties in Japan. Complaints from businesses were an inevitable consequence. Tax authorities have responded to the criticism by allocating the profits to each country (where global trading is occurring) through the APA and its successor, the BAPA.
The issues concerning governments reflect on whether it is possible to protect or broaden the tax bases without harming business incentives of multinational companies. Governments have attempted to coordinate tax policies (e.g., BAPA). However, the current system may not be the best method for increasing tax revenues or benefiting the overall operation of multinational companies.

TABLE 1
Tax Dispute Settlement: Japanese Companies and the IRS

Settlement Years	Taxpayers	Settled Amount
1987	Nissan	570
	Toyota	270
1988	Nissan	40
	Toyota	140
1991	Matsushita (Panasonic)	5.8
1992	Matsushita (Panasonic)	18
	Suzuki	7
	Kawasaki Heavy	24
1993	Nissan	240
	Matsushita (Panasonic)	6
1994	Yamaha	55
	Hitachi, Ltd.	2.5
	Hitachi Denshi	1

(Unit: $ million)

Source: KPMG (1998)

Data

This paper measures the degree to which the current tax system causes efficiency losses using a case study based on Japanese automobile companies supplying the U.S. market. We employ a theoretical model developed by Tomohara (2004). Introducing recent tax regulation in this area, his model characterizes the welfare consequences of different tax policies using market demand and industry cost. Below is an overview of demand and cost parameters used for the following numerical simulation. For the model's theoretical derivation, please refer to Appendix 1.

We determine parameters in indirect demand functions using two elasticity concepts: the price elasticity of market demand and the elasticity of substitution. This follows the literature. For this purpose, we collected twenty-four annual observations in the period from 1975-98. The observed variables are income, sales, prices, gasoline prices, interest rates, and automobile stocks. This period is chosen since the U.S. automobile market experienced structural changes after the 1973 oil crisis. The Japanese car industry occupied a stable (but gradually increasing) market share after that period. Major Japanese cars such as the Honda Civic and Toyota Corolla have been prominent in the U.S. market since the oil crisis. Our estimation uses the data from the following U.S. and Japanese companies operating in the U.S: Honda, Isuzu, Mazda, Mitsubishi, Nissan, Subaru, Suzuki and Toyota. The data source is Ward's automotive yearbook. Gasoline prices and disposable personal income are obtained from the U.S. Department of Commerce, Bureau of Economic Analysis. All monetary measures are deflated with the Consumer Price Index (CPI) to 1996 dollars. The CPI is available from the U.S. Department of Labor, Bureau of Labor Statistics.

The stock adjustment model is used to estimate the price elasticity of market demand. The model explains annual purchases of durable goods as consumer's decision to reconcile the difference between desired stock and current stock. Desired stock is the ownership level in a long-run equilibrium. Desired stock is determined by the price p_t real disposable income y_t the interest rate i_t and random factor u_t. Let q_t be the quantity of new cars purchased in year t, d_t be the desired stock at the end of year t and s_{t-1} be total stock at the end of year $t-1$. The market demand for cars is characterized as an increasing function of the desired-current stock ratio,
$q_t = q_t(d_t(p_t, y_t, i_t, u_t) / s_{t-1})$.
Assuming a multiplicative functional form, the demand can be estimated using the following log-linear form:

$$\ln q_t = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln p_t + \beta_3 \ln i_t + \beta_4 \ln s_{t-1} + \beta_5 T + \varepsilon_t$$

We include a variable, T, to adjust for any time trends. The trend variable is a discrete number, which starts at one and increases by one in each successive year. The price elasticity of market demand (or the coefficient of interest, β_2) is estimated as -0.51. The value is slightly lower, but almost similar to, the findings in previous work (e.g., McCarthy, 1996). The elasticity of substitution is the effect of a change in the ratio of Japanese to U.S. car prices, (p_J/p_A), on the ratio of Japanese to U.S. car sales, (q_J/q_A):
$d \log (q_J/q_A) / d \log (p_J/p_A)$.

Consumers are modeled as buying either a Japanese or U.S. car using the price, income, and gas prices to make the decision. Gas price takes into account consumers' preferences for fuel-efficient cars. The elasticity of substitution is estimated using a log-linear form: $\log (q_J/q_A)_t = \gamma_0 + \gamma_1 \log (p_J/p_A)_t + \gamma_2 \log y_t + \gamma_3 \log f_t + \varepsilon_t$, where f is the gas price in year t. The regression estimates the elasticity of substitution (or $\hat{\gamma}_1$) as -1.1. This analysis leads to the following conclusion: An increase in U.S. price relative to Japanese price induces consumers to substitute Japanese cars for U.S. cars.

The two elasticities, along with actual prices and quantities, determine the parameters of the demand functions. This derivation requires a little knowledge of mathematics. A detailed derivation is provided in Appendix 2 for interested readers. Table 2 summarizes the values of the derived parameters.

We now turn to cost parameters. For marginal cost, we refer to previous studies of the automobile industry. The literature finds that the average mark-up lies in the 10-30% range (23.9% in Berry et al. (1995), 10% in Bresnahan (1981), 15% in Dixit (1988), 27% in Feenstra and Levinsohn (1995), and 38% (to wholesale price) in Goldberg (1995)). These figures imply that about 70-90% of an automobile's retail price is attributable to marginal costs.[3] Our simulation uses Berry et al.'s estimate, which seems to be the most cited figure in the literature.

Fixed costs are seldom estimated in the literature despite their relevance for tax base calculations. We use a company's annual reports and financial statements given to financial authorities (i.e., *Yukashoken-hokokusho* for Japanese companies and Forms 10K/10Q for U.S. companies). The classification, *Selling, General and Administrative Expenses*, in financial statements, is used to approximate fixed costs. This item includes expenses such as land rents, which do not rise in proportion to sales.

Our simulation requires identifying how the (marginal and fixed) costs are attributed to either Japanese or U.S. affiliates within the same Japanese company. We refer to the JETRO survey, which polled the business activities of U.S.-based Japanese manufacturers. The survey reports that, in 1997, 63% of production costs in the vehicle industry applied to U.S. affiliates and 37% of costs applied to Japanese affiliates. Finished cars imported from Japan consist of 29% of Japanese car sales in the U.S. market. We calculate the costs attributed to the U.S. affiliates as a weighted-average of domestically processed cars and imported finished cars. The 45% of costs is allocated to U.S. affiliates and the remaining 55% is to Japanese affiliates. Marginal (fixed) costs of Japanese affiliates are \$8,370 (\$7.45 billion) and the costs of U.S. affiliates are \$6,582 (\$6.09 billion).

Unlike the other parameters, a mark-up ratio for intra-firm trade is indeterminate a priori. As the IRS claims, a mark-up ratio should vary depending on the fiscal year's economic environment (Compaq Computer Corp. v. Commissioner, No.24238-96, T.C.). The ratio tends to be larger in times of prosperity than during a recession, reflecting stronger demand in a prosperious market. It is not easy to estimate the ratio using publicly available data. Tax authorities often use private data to calculate the mark-up ratio, however, they do not disclose this information. Confidentiality provisions prohibit the disclosure of taxpayer information obtained in the line of duty. We use mark-up ratios in the neighborhood of 27%. The ratios allocate positive profits of Japanese companies to each country, as the current system expects. Both the U.S. and Japanese governments would agree to use the mark-up for profit allocation.

We introduce an index for the number of firms operating in the U.S. market. Our model of a representative firm implicitly assumes that companies of the same nationality are identical in their operation, despite this not being the case in reality. We should adjust for these differences. The analysis uses the Cournot-equivalent number: the number of companies that would attain the actual market equilibrium if the companies behaved in a Cournot manner.[4] To examine the relevance of the assumption, the actual number of firms is calculated by the number equivalent HHI, $1/HHI$, where HHI_i is the Herfindahl index within the same nationality, i. The Cournot-equivalent number appropriately approximates the market, though the actual market is slightly more competitive than Cournot conduct for both the Japanese and U.S. industries.

TABLE 2
Demand and Cost Parameters

Variables

1. Demand Parameters	
a_J	59201.47
a_A	51261.56
b_J	0.00672
b_A	0.00267
g	0.00141

3. Mark-up ratio	
k	0.27

4. Cournot-equivalent number	
n_J^*	5.522
n_A^*	6.995

2. Industry Costs	
Japanese Industry	
c_h	\$8,370
c_f	\$6,582
F_h	\$7.45 billion
F_f	\$6.09 billion
$\bar{\theta}$	\$10,629
U.S. Industry	
c_A	\$13,176
F_A	\$18.34 billion

Numerical Analysis

The characteristics of market equilibrium become clearer once we substitute the parameters derived in the previous section (Table 2) into our

theoretical model (Equations (2) and (3) in Appendix 1). The equilibrium sales are increasing for Japanese firms and decreasing for U.S. firms, in the relative tax rate ratio, $\rho = (1 - t_J) / (1 - t_A)$:

$$q_J^* = 3.3145 \times 10^6 + 3.0983 \times 10^5 \rho,$$
$$\text{and } q_A^* = 1.0951 \times 10^7 - 1.4276 \times 10^5 \rho, \quad (1)$$

where a corporate tax rate, t_r, in location $r = J$ for Japan and $r = A$ for the U.S. The opposite sign of the coefficient on ρ reflects the rivalry relation between Japanese and U.S. industries. A tax policy will increase the market share of one industry at the expense of the other. The absolute value of the coefficient is larger for the Japanese industry than the U.S. industry. Hence, if the U.S. government decreases the tax rate, sales of Japanese cars decrease. The decrease is only partially replaced by U.S. companies' sales, as the goods are imperfect substitutes. The equilibrium prices are functions of the relative tax rate ratio, as are equilibrium sales. Both prices are decreasing in this ratio.

$$p_J^* = 21514 - 1882.5 \rho$$
$$\text{and } p_A^* = 17357 - 54.512 \rho. \quad (2)$$

If the U.S. government decreases the tax rate, then the supply of Japanese cars in the market decreases, and the price of Japanese cars increases. U.S. companies can increase their price as U.S. cars replace Japanese cars in the market. The aggregate after-tax profits of Japanese and U.S. companies are expressed as

$$\Pi_J = (1 - t_A)(7.2862 \times 10^9 - 4.9471 \times 10^9 \rho + 1.1689 \times 10^8 \rho^2) \text{ and}$$

$$\Pi_A = (1 - t_A)(2.7442 \times 10^{10} - 1.1938 \times 10^9 \rho + 7.7821 \times 10^6 \rho^2). \quad (3)$$

Profits have the same functional forms and signs on coefficients. Japanese and U.S. industries will benefit (or lose) from the same tax policies. The reason is clear from the above discussion. When the U.S. tax rate decreases, Japanese companies obtain higher profits by reducing their supply and increasing the price of Japanese cars. U.S. companies gain by raising both the quantity sold and price, and are able to do so since demand for U.S. cars has increased. A similar story applies to the case where Japanese tax rates are increased.

Tax revenue for each country is expressed as

$$T_J = t_J (4.1683 \times 10^7 + 7.0014 \times 10^8 \rho) \text{ and}$$
$$T_A = t_A (7.2862 \times 10^9 - 4.9888 \times 10^9 \rho - 5.8325 \times 10^8 \rho^2). \quad (4)$$

The coefficients on ρ imply that a tax policy has opposite effects on each country's tax revenue. Jurisdictional tax policies create externalities on tax revenues in the globally interrelated market. A change of tax rate in one country influences tax revenue in the other country, even if the other country does not make policy changes. Tax-induced trade distortion plays an intermediary role in creating the externalities.

The possible gains from tax coordination are measured by simulating different tax policies. The analysis defines tax coordination as a fiscal federalism case (or an integrated tax authority). The literature suggests that inefficiency under independent tax systems will be overcome once the governance of the interrelated markets is coordinated among different countries. We use welfare indices of joint tax revenues, profits of both Japanese and U.S. industries, and consumer surplus. Each index represents benefits (or losses) for governments, companies, and consumers.

We compare welfare indices under tax coordination with indices of the initial state under current tax systems. The initial point utilizes the tax rates, 40% in the U.S. and 51.6% in Japan, from 1997 (The KPMG Corporate Tax Rate Survey, 1998). Substituting these tax rates for in equations (1), (2), (3), and (4) determines the values of initial welfare indices. These values define contour curves for each welfare index, such as iso-profit curve for Japanese industry, as a function of the two tax rates. We specify profiles of tax rates that enlarge the tax base (or before-tax profit) for both the Japanese and U.S. industries, and calculate values of welfare indices as if governments in the two countries cooperated on the tax policy. The tax base is the sum of tax revenue and after-tax profit. Thus, such tax coordination increases joint tax revenues without lowering both Japanese and U.S. companies' profits.

Table 3 summarizes these outcomes. The impact of tax coordination is significant in the levels of tax revenues and profits. In comparison, the impact on the size of the market is trivial. Joint tax revenues increase by 72.6 million (and up to 1.25 billion) dollars, which is equivalent to 5% (and up to 85%) of the original tax revenues. The after-tax profits of the Japanese industry increase by 401 million (and up to 2.58 billion) dollars. The after-tax profits of the U.S. industry increase by 799 million (and up to 3.9 billion) dollars. The increase is equivalent to 20% (and up to 128%) of the original profits for Japanese industry and to 5% (and up to 26%) of the original profits for U.S. industry. Total car sales decrease by 23,559 (and up to 111,072) units, which is equivalent to only 0.16 % (and up to 0.77%) of original consumption. Sales of Japanese cars decrease by 43,368 (and up to 205,660) units. Sales of U.S. cars increase by 19,809 (and up to 94,588) units. The changes are equivalent to 1.22 % (and up to 5.8%) of the original consumption of Japanese cars, and 0.18% (and up to 0.87%) of the original consumption of U.S. cars. Prices increase by 1.3% (and up to 6%) of the original price of Japanese cars and by 0.04% (and up to 0.2%) of the original price of U.S. cars.

Some tax policies are mutually beneficial for governments and companies, but not beneficial for consumers. These policies create monopoly rents for both Japanese and U.S. companies. With a lower relative tax rate ratio, ρ, Japanese companies obtain higher profits by reducing the supply of cars and correspondingly increasing the price. Replacing the forgone Japanese car sales brings higher profits for U.S. companies. The increase in U.S. car sales is not large enough to compensate for the decrease in Japanese cars sold. U.S. and Japanese cars are imperfect substitutes. Increases in profits leads to larger tax revenues for governments. Since both governments are receiving more in tax revenues, the benefits are shared.

The results are consistent with theoretical predictions in Tomohara (2005). He constructs a model similar to the current analysis and proves that tax coordination always increases the tax base.

TABLE 3
Welfare Consequences of Tax Coordination

Agents	Original values	Welfare indices		Changes Min.	Max.
Governments	1.47 b	Total revenues	↑	72.6 m (5%)	1.25 b (85%)
	0.31 b	J-tax revenue	↓	47.9 m (15.3%)	170 m (54.3%)
	1.15 b	US tax revenue	↑	121 m (10.5%)	1.42 b (123%)
Companies	2.02 b	J-profits	↑	401 m (20%)	2.58 b (128%)
	15.2 b	US profits	↑	799 m (5%)	3.9 b (26%)
Consumers	14.4 m	Total sales	↓	23,559 (0.16%)	111,072 (0.77%)
	3.56 m	J-car sales	↓	43,368 (1.22%)	205,660 (5.8%)
	10.8 m	US car sales	↑	19,809 (0.18%)	94,588 (0.87%)
	19,996	J-car price	↑	263 (1.3%)	1,249 (6%)
	17,314	US car price	↑	7 (0.04%)	35 (0.2%)
Total	52.4 b	Social welfare	↑	695.9 m (1.3%)	3.13 b (6%)

(Unit: U.S. dollars except sales; the unit on sales is number of cars sold;
b for billion and m for million)
Percentages in parenthesis represent changes in indices compared to the original values.

However, impacts on the markets vary, depending on two different mechanisms capable of increasing the tax base. First, there is the case where a large increase in the tax base results from selling a higher quantity at a lower price. The second is the case where a larger tax base is attained by reducing the supply of goods via increasing the price. The results of our study correspond to the latter case.

Calculating social welfare evaluates the effect of tax coordination collectively. Social welfare is defined as the weighted-sum of consumer surplus and the before-tax profits (i.e., after-tax profits plus tax revenues). We examine the trade-off between gains to governments and companies and losses to consumers. The results show that the gains to governments and companies are so large that, overall, social welfare improves. Coordinated tax policy increases social welfare by 695.9 million dollars (and up to 3.13 billion dollars), which is equivalent to a 1.3% (and up to 6%) increase in the level of social welfare. We further examine the outcome's sensitivity by calculating the welfare indices within a 10% range of the original parameter values. For example, marginal costs in this range correspond to a mark-up between 21% and 27.7%. This covers most of the range of average mark-up ratios estimated in previous studies. The numerical outcome is still robust. The welfare change of tax coordination lies in a range similar to that of the original parameters. These results support the conclusion that tax coordination improves social welfare.

Tax coordination will involve transfer payments between the two governments. An increase in total tax revenues is due to increased revenue in the U.S., which surpasses decreased revenue in Japan. The possibility that one country may lose from tax coordination also arises in different models of capital tax competition, though the mechanisms driving the results are different (Bucovetsky, 1991; Wilson 1991). In models of capital tax coordination, efficient capital allocation is attained via transfers of income between governments (Wildasin, 1989; DePater and Myers, 1994). In this case, it is natural to consider that the Japanese government is entitled to claim a portion of the increased tax revenues for its contribution to the policy coordination. Given that such transfer payments are not general practice under the current tax system (where the source of taxation rights relies on national sovereignty), the result suggests that the tax system should be integrated to accommodate flexible revenue allocation across different countries. Is such policy coordination feasible? It is not as antithetical as it sounds. Consider that the EU, which is already reallocating the member countries' tax revenues through its agricultural subsidy policy.

Tax coordination is modeled as integrated governance. One possible alternative is to consider coordination under independent tax systems. An example is a Nash bargaining solution, in which each government is constrained by the level of tax revenue under non-cooperative independent tax systems. The efficiency loss caused by independent tax policies is, however, fully understood only in the context of fiscal federalism. The Nash bargaining solution may not achieve an improvement of social welfare, when integrated governance does. Our simulation shows some cases where the Nash bargaining solution increases tax revenues for two countries, while always lowering the profits of U.S. companies and generally reducing profits of Japanese companies. The Nash bargaining solution helps to remedy coordination failure between governments but does not help to eliminate inefficiency caused by tax-induced trade distortion. This implies that policy cooperation under independent tax systems is not sufficient. Further coordination (i.e.,

integrated tax administration across different countries) is necessary.

One last remark regarding tax rates is in order. Tax rates in this analysis do not necessarily mean statutory rates. It is more appropriate to regard these as effective rates, including an adjustment for income deduction. We often observe that governments tailor income taxes to either to specific industries or to foreign companies. This is done by establishing special treatment provisions such as decelerated depreciation for certain types of investments (ITEP, 2000). For example, decelerated depreciation for plant investment will function as a tax increase for foreign companies, who are relatively new entrants to the market and need to make large fixed capital investments. Effective tax rates could vary by industry and company despite the single statutory tax rate. This argument refutes the criticism of the analysis where governments set domestic tax rates using only multinational company information.

Concluding Remarks

This paper measures the degree to which independent tax systems cause efficiency losses via tax-induced trade distortions. The analysis shows that a greater tax base would result if intergovernmental fiscal relations were restructured beyond the current bounds of national sovereignty. Domestic tax policy is a flexible strategy under the autonomy of each country. However, the results suggest that domestic tax policy and trade policy should be coordinated in the global economy. Domestic tax policy imposes externalities on the trade of multinational companies. Governments should recognize the externalities when drafting tax policies.

Tax coordination requires collaborative policy planning and implementation, along with a system for redistribution of tax revenues between governments, in order to achieve social welfare improvement. Current tax coordination under the guidance of OECD is limited. The OECD provides opportunities to discuss how to coordinate tax polices across countries. But it does not operate to redistribute tax revenues among members. Consensuses at OECD (such as the Model Tax Treaty) are not legally binding and serve only as a recommendation to member countries. The results suggest policy implication to establish a globally integrated tax authority. While this idea is not new and has been proposed by a number of practitioners, clearly, this is a politically sensitive issue and, therefore, not an easy task. Our analysis suggests that if it is feasible to establish a centrally integrated tax system compatible with an incentive for growing global business, it will attain the goal of welfare improvement.

The analytical method is applicable to other practical situations. One possible extension is to examine multi-agent regimes such as regions, nations, or government agencies. Examples include tax policies in the EU and U.S. state tax polices. Another extension is to consider tax policies in North-South relations. Governments in developing countries take a keen interest in attracting multinational companies based in developed countries. Tax incentives are a key factor in this attraction. Opponents of globalization argue that self-interested, multinational companies impair domestic market development. The current model examines the possibility that tax coordination benefits developing countries. Tomohara (2005) shows that tax coordination enhances the size of the domestic market, if the multinational company's home country, in an upstream location, overcharges the tax rate relative to the host country, in a downstream location.

This analysis provides governments with potentially useful information for tax planning. The technology structure of a firm (i.e., the cost and production functions) and consumers' preference (i.e., the demand function) characterize welfare consequences of different tax policies. We can derive specific policy implications after estimating the parameters in cost, production, and demand functions. Off course, the computational model is by no means complete. As simple functional forms of demand and cost functions are improved, more accurate policy forecasting for tax planning will be provided to governments. This exercise will provide a platform from which new political issues facing globalization can be explored.

Appendix

1. The Model

The Households

The U.S. automobile market is oligopolistic. U.S. and Japanese cars are imperfect substitutes. The discussion concentrates on the U.S.-Japan rivalry. We ignore the supply of cars from Europe and Korea because their market share is relatively small. Denote the price as p_l and the aggregate sales as $q_l = \sum_{i=1}^{n_l} q_l^i$, where l=J for Japanese and l=A for U.S. automobiles, given that n_l firms operate in the market. Let q_0 be the aggregate consumption of a numeraire good measured in real dollars. The aggregate utility function U is $U = q_0 + u(q_J, q_A)$, assuming a sub-utility for the automobile sector $u(q_J, q_A)$ is separable from q_0. The budget constraint is $q_0 + p_J q_J + p_A q_A = Y$, where Y is income. Maximization of the aggregate utility function subject to the budget constraint yields inverse demand functions. We use $u(q_J, q_A) = a_J q_J + a_A q_A - {}^1/_2 (b_J q_J^2 + b_A q_A^2 + 2g q_J q_A)$, as in Dixit (1988). The rivalry relationship between the U.S. and Japanese automobile industries is captured by the inverse demand functions of the aggregate sales of automobiles for each country:

$$p_J = a_J - b_J q_J - g q_A \text{ and } p_A = a_A - g q_J - b_A q_A,$$

where a_J, a_A, b_J, b_A, are positive and $b_J b_A - g^2 > 0$ holds.

Decision of Companies

The markets in the U.S. and Japan are interrelated through intra-firm transactions of vertically integrated Japanese car companies. Trade within a firm is modeled as a manufacturing process from a mother factory in Japan to assembly factories in the U.S. In a typical example, parent companies in Japan produce and export intermediate goods that are further assembled or manufactured by subsidiaries in the U.S. Final goods are sold in the U.S. market.

Following the vertical integration literature, the intra-firm transaction is character-

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ized as a fixed-coefficient production function (Greenhut and Ohta, 1979). Let $Q^i_J > 0$ be the quantity of intermediate goods produced by a Japanese parent company, i, and $q^i_J > 0$ be the number of automobiles manufactured by its subsidiary located in the U.S. The production function is denoted as $q^i_J = a^i Q^i_J$, where $a^i > 0$. This assumes that the amount of a local input required for the production is proportional to Q. We use $a^i = 1$, as is commonly observed in the literature (Spencer and Jones, 1991; Dasgupta and Sengupta, 1995). With the proper choice of units, one unit of the intermediate good is required to produce one unit of the final good.

Factor markets are characterized as competitive (either in the U.S. or Japan). Many local companies provide non-differentiated products. We use a cost function, $C^i_{rJ} = c^i_r q^i_J + F^i_{rJ}$, where c^i_r is a positive constant marginal cost and F^i_{rJ} is a positive constant fixed cost in location r (Spencer and Jones, 1991; Keen and Lahiri, 1993; Levinsohn and Slemrod, 1993; Dasgupta and Sengupta, 1995; Elitzur and Mintz, 1996). The location is denoted as $r = J$ for the factory in Japan and $r = A$ for the factory in the U.S. The cost function of U.S. companies is similar as $C^i_A = c^i_A q^i_A + F^i_A$, where c^i_A (or F^i_A) is a positive constant marginal (or fixed) cost.

We introduce the recent tax regulations on intra-firm trade of multinational companies (Elitzur and Mintz, 1996; Tomohara, 2004). A transfer price is set as $\bar{\theta}^i = (1 + k)c^i_J$ with a constant mark-up rate, $k > 0$.[5] Japanese companies and the Japanese and U.S. governments agree upon the mark-up in advance. The mark up rate is carefully chosen so that positive profit of Japanese companies is allocated to each country. This is the Bilateral Advanced Pricing Agreement (BAPA) case, where tax authorities in the two countries agree to use the same arm's length price to eliminate double taxation risk. This case ignores both private information and commitment issues, which are the focus of much work on transfer pricing. However, it allows us to highlight the inefficiency arising from domestic tax policies under the BAPA system. Discussion of the BAPA framework is a relevant topic, as recently there have been an increasing number of applicants to the system (Tax Management Inc., 1999, p.722).

Japanese and U.S. companies are analyzed using a Brander-Spencer game. Japanese multinational affiliates pay corporate income taxes calculated at a corporate tax rate t_r in their resident countries. In addition, Japanese multinational affiliates pay a tariff, charged by the U.S. Customs at rate τ on the import of intermediate goods. The after-tax profits of a representative Japanese firm i are the sum of profits earned in the two countries

$$\Pi^i_J = \left\{(1 - t_J)(\bar{\theta}^i - c^i_J) + (1 - t_A)\left(p_J - (1 + \tau)\ \bar{\theta}^i - c^i_A\right)\right\} q^i_J - (1 - t_J) F^i_{JJ} - (1 - t_A) F^i_{AJ}$$

The after-tax profits of a representative U.S. firm are

$$\Pi^i_A = (1 - t_A)\left((p_A - c^i_A) q^i_A - F^i_A\right)$$

The first-order condition (which is also a sufficient condition) provides the familiar, but slightly modified relationship. The after-tax marginal revenue is equated to the after-tax marginal cost:

$$(1 - t_J)\bar{\theta}^i - (1 - t_A)(p_J - b_J q^i_J) = (1 - t_J) c^i_J + (1 - t_A)\left((1 + \tau)\bar{\theta}^i + c^i_A\right) \qquad (1)$$

Aggregating the conditions over n_J (or n_A) firms provides best response functions of the Japanese (or U.S.) companies.

Market Equilibrium

Equilibrium outputs are solved as simple functions of relative tax rates in two countries:

$$q_j^* = K_1 + K_2\rho \quad (2), \text{ and } \quad q_A^* = K_3 + K_4\rho \quad (3),$$

where $\rho = (1 - t_J)/(1 - t_A)$, $K_2 = b_A(1 + n_A)\, n_J BL > 0$,

$K_1 = \left(b_A(1 + n_A)\, n_J A - n_J n_A g(a_A - c_A)\right)L$,

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Footnotes

1 The BAPA is a system in which a multinational company and tax authorities in two countries agree to use the same arm's length price for filing tax returns.

2 "Under international law, a firm is dumping if it sells its product abroad at a price below its domestic price or below its actual costs." (Carlton, D.W., and J.M. Perloff, 1994, Modern Industrial Organization, p. 758).

3 Using financial statements, we also calculate the average mark-up by dividing costs (Cost of Sales) by revenues (Net Sales). The result indicates that marginal costs account for 79% of the Japanese automobile value for the three years of 1995-97. These figures lie within the range of past estimates.

4 We derive the number of companies that satisfies equations (2) and (3) in Appendix by using the actual tax rates and the demand and cost parameters in Table 2 (see, for example, Dixit (1988) for a detailed exposition).

5 This is the cost-plus method and is used in cases involving manufacturing, assembly, or other production goods that are sold to related parties (Intercompany Transfer Pricing Regulations, §1.482-3(d)(1)). The cost-plus method is the most frequently used method according to surveys on intra-firm transfer pricing (Al-Eryani, Alam, and Akhter, 1990; Hamaekers, 1992; Ernst & Young LLP, 1997).

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$$K_3 = \left(b_J(1+n_J)\, n_A (a_A - c_A) - n_J n_A g A\right) L,\ K_4 = -\, n_J n_A g B L < 0,$$

$$L = 1/\left(b_J b_A (1+n_J)\,(1+n_A) - n_J n_A g^2\right),\ A = a_J - (1+\tau)\bar{\theta} - c_A,\ B = \bar{\theta} - c$$

$$\bar{\theta} = \tfrac{1}{nj}\sum_{i=1}^{nj} \bar{\theta}^i,\ c_J = \tfrac{1}{nj}\sum_{i=1}^{nj} c^i{}_J,\ and\ c_A = \tfrac{1}{nj}\sum_{i=1}^{nj} c^i{}_A$$

The inequalities $K_2 > 0$ and $K_4 < 0$ are obtained by the assumption $b_J b_A - g^2 > 0$. The relative tax rates play a key role in determining the market share of each (Japanese and U.S.) industry, when the markets of the two countries are interrelated through the intra-firm trade of Japanese companies.

2. Estimation of Market Conduct

Following the literature, we derive the five parameters in the indirect demand functions using two elasticity concepts (e.g., Dixit, 1988). Suppose the direct demand functions for each Japanese and U.S. industry are

$$q_J = A_J - B_J p_J + G p_A \qquad (4) \quad \text{and,} \qquad q_A = A_A + G p_J - B_A p_A\,, \qquad (5)$$

where A_J, A_A, B_J, B_A, and $G > 0$, and $B_J, B_A - G^2 > 0$.

The price elasticity of market demand is the percentage change in sales when both the U.S. and Japanese car prices change at the same proportion. Let P_{i0} be the initial price of country i's car, and P be the proportional change factor of price. Denote $p_J = P_{J0}P$ and $p_A = P_{A0}P$. We define the dual quantity index, $q = P_{J0}q_J + P_{A0}q_A$. This relates the sales and prices between the U.S. and Japanese industries. Substituting the two prices, (4) and (5) into the dual quantity index provides $q = (P_{J0}A_J + P_{A0}A_A) - (B_J P^2{}_{J0} + B_A P^2{}_{A0} - 2GP_{JO}P_{AO})P$. The price elasticity of market demand, ε, is the elasticity of q with respect to P, evaluated at the initial point $P = 1$. The estimated price elasticity of market demand, $\hat{\varepsilon}$, is expressed as

$$\hat{\varepsilon} = \frac{-(B_J P^2{}_{J0} + B_A P^2{}_{A0} - 2GP_{J0}P_{A0})}{P_{J0}A_J + P_{A0}A_A - (B_J P^2{}_{J0} + B_A P^2{}_{A0} - 2GP_{J0}P_{A0})} \qquad (6)$$

The elasticity of substitution is the effect of a change in the ratio of Japanese to U.S. car prices on the ratio of Japanese to U.S. car sales: $\sigma = d\log(q_J/q_A) / d\log(p_J/p_A)$. Assuming that the sales ratio is a function of the price ratio p_J/p_A alone (at least locally), we use the condition

$$P_{J0}(A_J G + A_A B_J) = P_{A0}(A_A G + A_J B_A). \qquad (7)$$

With this assumption, the estimated elasticity of substitution, , is expressed as

$$\hat{\sigma} = \frac{-B_J\left(\frac{A_A}{P_{A0}} + G\frac{P_{J0}}{P_{A0}} - B_A\right) - G\left(\frac{A_J}{P_{A0}} - B_J\frac{P_{J0}}{P_{A0}} + G\right)\frac{P_{J0}}{P_{A0}}}{\left(\frac{A_A}{P_{A0}} + G\frac{P_{J0}}{P_{A0}} - B_A\right)^2 \frac{q_{J0}}{q_{A0}}} \qquad (8)$$

The two elasticities, along with the actual prices and quantities, determine the five parameters, A_J, A_A, B_J, B_A,and G, from equations (4), (5), (6), (7), and (8). Then, we can derive the five parameters in the inverse demand functions as (9)

$$a_J = \frac{A_J + \frac{GA_A}{B_A}}{B_J - \frac{G^2}{B_A}},\ b_J = \frac{1}{B_J - \frac{G^2}{B_A}},\ a_A = \frac{A_A + \frac{GA_J}{B_J}}{B_A - \frac{G^2}{B_J}},\ b_A = \frac{1}{B_A - \frac{G^2}{B_J}},\ \text{and}\ \ g = \frac{G}{B_J B_A - G^2}$$

Technically, we substitute $\hat{\varepsilon}$ = -0.508, $\hat{\sigma}$ = -1.1, P_{J0} = 19996, P_{A0} = 17314, q_J= 3564421, and q_A = 10836018 into equations (4), (5), (6), (7) and (8). This determines the five parameters A_J, A_A, B_J, B_A,and G. The parameters of interest are derived, as in Table 2, from (9).

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