THE INTERNATIONAL TRADE OF MULTINATIONAL FIRMS: THE EMPIRICAL BEHAVIOUR OF INTRAFIRM TRADE IN A GRAVITY EQUATION MODEL

KIMBERLY A. CLAUSING

I. Introduction

Multinational firms are an increasingly important part of international economic integration. In recent years, foreign direct investment has been increasing at a rate that exceeds both the rate of growth of international trade and that of income. For many countries, the sales of affiliates of multinational firms have long dwarfed the value of trade. For example, in 1997, European Union country firms exported $283 billion in products to the United States. In the same year, affiliates of E.U.-based multinational firms sold $816 billion worth of products in the United States, almost three times the value of exports.

Further, multinational firms play an important role in international trade. Intrafirm trade is international trade that occurs between different affiliates of the same multinational firm. Consider figure 1. For the United States, intrafirm trade is approximately 40% of all international trade. In addition, multinational firms also do a great deal of arms-length trade; for the U.S., this accounts for an additional 37% of all international trade. Trade that has nothing whatsoever to do with multinational firms is a mere 23% of the total. Understanding the role of multinational firms in an environment of increasing international economic integration is therefore essential for policy-makers.

As can be seen in figure 2, for bilateral trade between the United States and European Union countries, intrafirm trade is approximately 45% of all international trade. As shown in this figure, this average masks important differences between countries within the European Union. Countries like Greece and Portugal have very little intrafirm trade with the United States; for Italy 22% of trade is intrafirm; for France, Germany, the Netherlands, Sweden, and Luxembourg, over 50% of trade with the United States is intrafirm.[1] Figure 3 indicates that the importance of intrafirm trade is increasing somewhat over this time period (1982-1997), particularly during the early 1990s. In the earlier years, the share of intrafirm trade hovered close to 43% ; in the most recent year available, the share was 49%.

What is the significance of intrafirm trade? There are several issues, which may be of importance. First, the behaviour of intrafirm trade is empirically different from trade between unaffiliated entities. As demonstrated below, in common empirical models of trade, intrafirm trade behaves quite differently with respect to key economic variables such as income, income per-capita, exchange rates, and the distance between trading partners. In addition, variation in intrafirm trade is harder to account for in the models that are typically used in empirical studies of international trade. Given these

---

[1] Note: Data on Luxembourg is not included in figure 1 due to data inconsistencies but intrafirm trade is known to be far greater than 50% of the total.

behavioural differences, it may be difficult for policy makers and forecasters to predict how intrafirm trade will respond to changes in the economic or policy environment.

Second, intrafirm trade may be influenced by tax considerations. For instance, multinational firms have an incentive to locate in low-tax countries, and this foreign investment acts to stimulate intrafirm trade to a greater extent than non-intrafirm trade. Further, firms acting to minimise their worldwide tax burden have an incentive to alter prices and quantities of intrafirm trade in order to shift income to more lightly-taxed locations. There is evidence that U.S. intrafirm trade balances have been affected by such considerations; Clausing (1998) finds that the U.S. tends to have less favourable intrafirm trade balances with low tax countries. This finding is congruent with tax minimisation incentives. Also, Clausing (2000b) finds that intrafirm export prices are lower for low tax countries, while intrafirm import prices are higher, a finding that is also consistent with tax-minimising behaviour.

Such findings may be particularly important for European Union countries. As European Union countries have completely liberalised trade between members without the harmonisation of corporate tax rates or systems, opportunities for multinational firms to minimise tax burdens through their intrafirm trade transactions are plentiful. This tax minimising behaviour would have important consequences both for the revenues of the individual E.U. member countries, and for the nature of trade amongst the E.U. members. If intrafirm trade transactions were utilised to shift income to low tax countries, this would result in lost revenue to those countries that retain higher tax rates. In addition, intrafirm trade that is influenced by tax considerations may no longer be efficient. In particular, it is certainly possible that true comparative advantage could be clouded by tax considerations such that exports need not originate in the lowest cost country.

Third, intrafirm trade may respond differently to changes in exchange rates. The theoretical literature, however, is ambiguous regarding the nature of this difference. Some work argues that multinational firms should be *more* responsive to exchange rate changes due to their superior international networks that allow them informational advantages. Other work argues that multinationals may be slower to respond to exchange rate changes. Clausing (2000b) finds equivocal evidence that intrafirm trade is more responsive to exchange rate variables. Since intrafirm trade is a large percentage of total trade, its responsiveness to exchange rate changes will substantially influence the overall speed of economic adjustment.

In addition, there may be political economy considerations. As multinational firms operate in several countries, they are able to alter sourcing and pricing decisions in response to exchange rate changes, insulating themselves from dramatic swings in exchange rates. In fact, recent research (Rangan and Lawrence, 1999) has confirmed that U.S. multinational firms' sourcing decisions are indeed quite responsive to changes in exchange rates. Cross-border investments and production facilities are therefore likely to make fluctuations in exchange rates more tolerable for firms.

This paper undertakes an empirical investigation of how intrafirm trade may differ from trade conducted at arm's length, employing a gravity equation model. The gravity equation is arguably the most empirically successful approach to estimating the magnitude of international trade between countries. In the framework of a gravity equation, trade is hypothesised to depend positively on the trading partners' economic size and negatively on the distance between them. Such equations have been successfully employed to study international trade patterns, the effects of regional trade

agreements, and the role of geography in international trade. In this paper, I estimate a gravity equation model of international trade for the United States, estimating separate equations for the two types of trade in order to allow intrafirm trade to differ from conventional trade conducted at arms-length. I find that the gravity equation model performs quite differently with respect to intrafirm trade and arms-length trade. In particular, almost all of the estimated coefficients in the model are statistically different for the two types of trade, and the model as a whole has far less explanatory power with respect to intrafirm trade. Such results lead one to the conclusion that intrafirm trade is, in fact, different.

II. Background

This paper will estimate a gravity equation model of international trade. The basic estimating equation is as follows.

$$\ln(\text{Trade}_{ij}) = \alpha + \beta_1 \ln(\text{GDP}_i * \text{GDP}_j) + \beta_2 \ln(\text{GDPper capita}_i * \text{GDPper capita}_j) + \beta_3 \ln(\text{distance}_{ij}) + \beta_4 Z + \upsilon_{ij} \qquad \textbf{(1)}$$

This is a very typical specification, similar to those employed in many previous empirical studies of international trade, among them Frankel (1997), Rauch (1996), Helliwell (1998), Head and Reis (1998), McCallum (1995), and Sapir (1997).

There is now a substantial body of literature, including work by Andersson (1979), Bergstrand (1985, 1989, and 1990), and Markusen (1986), that justifies the use of gravity equations theoretically. Bergstrand (1985), for instance, utilises consumer and producer maximisation to generate a gravity equation where the trade flows between two countries depend on country incomes, distance, and price and exchange rate variables. Further, this model can be expanded (see Bergstrand (1989)) to incorporate relative factor endowment differences and non-homothetic preferences. More recently, Deardorff (1998) has found that it is possible to derive a gravity equation from straightforward Heckscher-Ohlin foundations as well as models that rely on differentiated products. This is perhaps not terribly surprising, given the intuitively reasonable nature of the variables that are included in the equation. As Deardorff (1998) notes, "I suspect that just about any plausible model of trade would yield something very like the gravity equation, whose empirical success is therefore not evidence of anything, but just a fact of life".

The individual variables included in the specifications and their empirical interpretation will be discussed in greater detail below. However, some preliminary discussion is warranted. Trade is hypothesised to depend positively on the economic size of the trading partners, and negatively on the distance between them. Economic size is measured in two ways, by the GDPs of the countries as well as by their GDPs per-capita. This is mathematically equivalent to including the variables GDP and population instead, although the interpretation of the variables would likely differ. Several rationales for including GDP per-capita (or population) have been offered in the literature, including the observation that more populous countries tend to be less open to trade, and that countries tend to trade more as their stage of development (captured by GDP per-capita) increases. Deardorff (1998) has argued that if preferences are not homothetic such that high-income consumers consume capital intensive products in disproportionate amounts, then we would expect to find these countries trading more

than average with each other and less than average with low-income, labour-abundant countries.[2]

Any model with transportation costs could generate a role for distance in the equation. Still, distance may capture other factors in addition to transportation costs, such as cultural familiarity or the ease of provision of services that accompany trade in goods. An excellent discussion of the role of distance in trade is provided in Frankel (1997), chapter 3.

While the gravity equation can be derived from the major theories of international trade, and has been quite successful empirically, the question of concern here is whether one should question its applicability to intrafirm trade. Are there theoretical reasons to suspect that intrafirm trade would respond differently to the economic variables that are included in the gravity equation? Are there other considerations that may be important for determining intrafirm trade that are left out of the gravity model?

Intrafirm trade may behave differently for at least three reasons. First, it may be more sensitive to tax influences. Second, it may be more or less responsive to changes in economic variables such as exchange rates or incomes. Third, the composition of intrafirm trade could differ from that of conventional trade in ways that would affect its behaviour. Intrafirm trade may be more likely to be trade in intermediate products, for instance. Given these considerations, would one then expect the gravity model to be as empirically successful with respect to intrafirm trade? That remains an open question, and the main question of this paper.

III. Data and Results

This paper estimates a gravity equation model of international trade. The baseline specifications follow.

$$\ln(Trade_{ijt}) = \alpha + \beta_1 \ln(GDP_{it} * GDP_{jt}) + \beta_2 \ln(GDPper\text{-}capita_{it} * GDPper\text{-}capita_{jt}) + \beta_3 \ln(distance_{ij}) + \beta_4 Z + \upsilon_{ijt} \tag{2}$$

$$\ln(Intrafirm\ Trade_{ijt}) = \alpha + \beta_1 \ln(GDP_{it} * GDP_{jt}) + \beta_2 \ln(GDPper\text{-}capita_{it} * GDPper\text{-}capita_{jt}) + \beta_3 \ln(distance_{ij}) + \beta_4 Z + \upsilon_{ij} \tag{3}$$

$$\ln(Non\text{-}Intrafirm\ Trade_{ijt}) = \alpha + \beta_1 \ln(GDP_{it} * GDP_{jt}) + \beta_2 \ln(GDPper\text{-}capita_{it} * GDP\ per\text{-}capita_{jt}) + \beta_3 \ln(distance_{ij}) + \beta_4 Z + \upsilon_{ij} \tag{4}$$

In these equations, the subscript i indicates the United States while subscript j indicates a trading partner; 54 partner countries are included in the data set.[3] The time period studied is from 1982 to 1997.[4] These equations are estimated using U.S. data on trade

---

[2] Frankel (1997, p.59) has a particularly nice illustration for why including GDP per-capita may be important: "China and Japan have roughly the same aggregate outputs. Yet China trades less with its partners than does Japan. This is what the equation would lead us to expect, because China's large output derives primarily from its large population, while Japan's derives from its high level of GNP *per capita*."

[3] Since I am using data on intrafirm trade, I am constrained in my choice of country-pairs to those that have the appropriate intrafirm data which (for now at least) limits the sample to pairs that include the United States. The partner countries included are all of those for which the Bureau of Economic Analysis (BEA) consistently provides detailed data.

[4] These are the years for which the Bureau of Economic Analysis has published comparable data on intrafirm trade.

from the U.S. International Trade Commission, data on GDP and GDP per-capita from the International Monetary Fund's *International Financial Statistics* yearbooks[5], and data on intrafirm trade from the U.S. Bureau of Economic Analysis (BEA). Distance is calculated between major cities in the U.S. and the partner country.[6] All time varying variables are adjusted to reflect real values. GDP and GDP per-capita are in constant 1990 U.S. dollars. Trade values are also adjusted to 1990 U.S. dollars using U.S. import and export price indexes. Summary statistics for the data set are given in table 1.

In addition to the income and distance variables, various dummy variables (Z) are included to capture countries with which the U.S. has a special trading relationship. Dummy variables are used for Israel in the years post-1984 when the U.S.-Israel Free Trade Agreement was in effect, for Canada starting in 1989 (for the Canada-United States Free Trade Agreement), and for Mexico and Canada starting in 1994 (for NAFTA). It is common in gravity equation specifications to include such dummy variables to capture the effects of free trade agreements. In this case, one is also capturing to some extent the effects of adjacency since (in two of the three cases) the countries with special trading relationships with the United States are also those that border the United States.

The specification given in equation (2) above is the most common gravity equation estimated in empirical studies of international trade. Equations (3) and (4) differ only in that they allow intrafirm trade to be estimated separately from non-intrafirm trade. For most specifications discussed in this paper, I have defined intrafirm trade to include trade between U.S. parent firms and their affiliates in foreign countries. This includes both U.S. exports from parent firms to their affiliates abroad as well as U.S. imports from U.S. affiliate firms abroad to their parent firms at home. Non-intrafirm trade is defined to be trade between unaffiliated entities, and total trade is then the sum of intrafirm trade and non-intrafirm trade. Trade that is excluded from the initial analysis, but considered further below, is intrafirm trade between foreign parent multinational firms and their affiliates in the United States. For now, I focus solely on U.S. multinational intrafirm trade.

The first results are shown in Table 2. In this table, the three equations are estimated together as a system. Although estimating the equations together does not substantively change the estimates (since the same right-hand side variables are included in each equation), this is still a useful procedure since it allows one to perform joint tests. Consider first column 1. This equation comes closest to the conventional gravity equation studies of trade; one important difference should be noted, however. This equation is estimated using only data on bilateral trade between the United States and other countries; most gravity equation studies use data on many more country pairs that would not include the United States, such as Germany-France, Japan-Thailand, etc. This consideration alone implies that the coefficient estimates in equation 1 are different from those commonly estimated in gravity equation studies. Several differences stand out.[7]

---

[5] The IMF's International Financial Statistics are also the source for other macroeconomic variables employed in later specifications, including the real exchange rate index, which is calculated from the nominal exchange rate and price indexes in the two countries.

[6] The U.S. reference city is Chicago. Foreign cities are major trading cities in the foreign country, usually the largest city. A list of city pairs and distances is available upon request.

[7] The following generalization are based on a comparison with results presented in Frankel (1997). To my knowledge, Frankel's study is the most exhaustive and rigorous empirical study of international trade that employs the gravity model.

First, the GDP coefficient is somewhat smaller than those commonly estimated, which tend to be closer to .8. Second, the GDP per-capita coefficient is negative, whereas in other studies it is often positive, although the coefficient estimates for this term have been declining in value over the previous three decades from around 0.3 to 0.1. Third, the distance coefficient is smaller than those commonly found, which hover near -0.6.

Most of these differences likely result from the use of U.S. data alone. The omission of other country pairs leaves off much of international trade that is commonly included, most importantly large amounts of (technically) international trade that occurs within Europe. This later omission likely accounts for at least some portion of the differing GDP per-capita and distance coefficients. In particular, very large quantities of intra-European trade occur between rich countries that are close together. Omitting this trade will likely make the (positive) effects of GDP per-capita and the (negative) effects of distance seem less important.

Although a U.S. focus can be limiting in terms of comparisons with previous results, it does have the essential advantage of allowing an investigation of the main question at hand. In particular, turning to equations 2 and 3 of Table 1, one can examine the differences in coefficient estimates for equations explaining intrafirm and non-intrafirm trade. The final column of this table reports a χ^2 test that the coefficients in the equations (2) and (3) are equal. One can easily reject the hypothesis that the whole set of estimates is identical, and in most individual cases, the individual coefficients are also statistically different in the two equations. First, the GDP coefficient is slightly larger in the non-intrafirm trade equation. Second, and more noteworthy, the GDP per-capita coefficient is dramatically different in the two equations, positive and statistically significant with a point estimate of 0.17 in the intrafirm specification, and negative and statistically significant with a point estimate of -0.23 in the non-intrafirm specification. Third, distance appears to have a larger negative impact on intrafirm trade than on non-intrafirm trade, although this can only be stated with an 88% level of confidence. Fourth, the two North American trade agreements have a larger positive effect on intrafirm trade than on trade conducted at arms-length. Fifth, the U.S. - Israel free trade agreement does not have a statistically distinguishable effect on intrafirm trade, while it is positively associated with non-intrafirm trade. Finally, the explanatory power of the gravity equation regression model as a whole is much higher for non-intrafirm trade than for intrafirm trade, as can be seen by comparing the R^2 statistics.

How should these findings be interpreted? The first lesson is immediately obvious. Intrafirm trade is, simply put, different. The gravity equation model has been one of the most empirically successful models for explaining the volume of international trade between countries. However, as seen by these results, it is less successful at accounting for variation in volumes of intrafirm trade. Further, the impact of the individual factors that are included in the gravity equation models varies substantially depending on whether one is considering intrafirm trade or conventional, arms-length, trade. For the six explanatory variables that are included in the model, four of the coefficients are statistically different with greater than 95% confidence, and all six are different with greater than 88% confidence. Some of the coefficients (most notably the GDP per-capita term coefficient) change sign.

Further insights from these results are more subject to individual interpretation. I will confine myself to some limited observations. First, the coefficient on the GDP per-capita term is positive for intrafirm trade and negative for non-intrafirm trade. As discussed in the previous section of the paper, this variable can be interpreted in many

ways: as capturing how a country's openness to trade is likely to change with its development, or in terms of capturing changes in preferences or trading patterns as countries become richer. From these results, I would simply conclude that the United States tends to exchange greater volumes of intrafirm trade with countries that have high per-capita incomes, and to exchange greater volumes of arms-length trade with countries with lower per-capita incomes. This observation fits the market-access based theories of foreign direct investment that emphasise a desire by multinational firms to invest in other countries that have (rich) customers for its products; such investment would also generate greater volumes of intrafirm trade, as intrafirm trade is a complement to foreign direct investment.[8] On the other hand, this finding would be less supportive of theories of foreign direct investment based on factor price differential motivations for investment, in which multinational firms from high-wage countries like the United States would be more likely to invest in low-wage (and hence low GDP per-capita) countries, and hence generate intrafirm trade with such countries. However, we do see greater levels of arms-length trade with countries with lower per-capita incomes.

Distance has a more negative impact on intrafirm trade than on non-intrafirm trade. This result could merely capture the possibility that distance discourages foreign direct investment, and thus intrafirm trade, more even than distance discourages trade conducted at arms-length. However, two other points are worth mentioning here. First, Rangan and Lawrence (1999) have argued that multinational firms have networks that enable them to better cope with imperfect information across international boundaries, and hence should be able to react more quickly to exchange rate changes. This type of reasoning could certainly imply that intrafirm trade should also be less sensitive to distance than conventional trade, since networks are already in place to alleviate problems of imperfect information that are likely to increase with distance. Second, Rauch (1996) has argued that trade in differentiated products should be more sensitive to distance than trade in more homogeneous products with less informational requirements. Again, assuming that intrafirm trade is in products for which the firm has less informational requirements, we should see intrafirm trade being *less* discouraged by distance than conventional trade, the opposite of what is indicated in Table 2. A greater discussion of the nature of products traded intrafirm follows below.

The North American trade agreements (NAFTA and the Canada-United States Free Trade Agreement) appear to have larger positive association with intrafirm trade than with arms-length trade, although both types of trade are strongly positively related to these dummy variables. The U.S.-Israel Free Trade Agreement does not appear to be associated with increased volumes of intrafirm trade, while it is positively associated with non-intrafirm trade. Perhaps these results are not too surprising when one considers that the U.S.-Israel Trade Agreement was a much narrower trade agreement than the North American agreements. In particular, it was focused primarily on trade liberalisation, whereas the other agreements contained substantial investment liberalisation measures in addition to trade liberalisation.

Taxation and Intrafirm Trade

As was discussed in the previous section, a fundamental theoretical distinction between the behaviour of intrafirm trade and arms-length trade is the potential for international taxation incentives to affect the former. However, this is complicated by the presence of three types of effects: a *price* effect, a *quantity* effect, and a *location*

---

[8] See Clausing (2000a) for one study that demonstrates this relationship.

effect. Consider first the *price* effect. Multinational firms may act to minimise their worldwide tax burdens in ways that affect their intrafirm trade transactions. For instance (see model in appendix A), there is an incentive to shift income to more lightly taxed locations by underpricing goods sold to low tax countries and overpricing goods sold to high tax countries. This would lead one to expect, *ceteris paribus*, lower (higher) amounts of intrafirm exports (imports) to (from) low tax countries. There is also a *quantity effect*, though. Since intrafirm trade can generate tax savings, it is optimal for firms to increase the volume of such trade relative to its level in the absence of such considerations (see Eden (1998, p.298)). Finally, there is a *location* effect. Low tax countries may be attractive places to locate foreign direct investment, and this should lead to more intrafirm trade in both directions (exports and imports), assuming again that foreign direct investment and intrafirm trade are complements.

Table 3 shows the same specifications as table 2, also including a variable that measures the effective tax rate in the foreign country.[9] Since this table shows total trade flows rather than trade prices, it will be unable to isolate the price effect from the quantity and location effects. The results are similar to those in Table 2 with minor exceptions. The GDP term is no longer statistically distinguishable in the two regressions that separate intrafirm and non-intrafirm trade. While the relative magnitude of the GDP per-capita coefficients is similar, the coefficient on this variable in the intrafirm trade equation is no longer estimated precisely. The effective tax rate coefficient is larger in the intrafirm regression than in the non-intrafirm regression, although it is large and statistically significant in both regressions. At the mean effective tax rate, these coefficients imply an elasticity with respect to the tax rate of –1.1 for intrafirm trade, –0.6 for non-intrafirm trade, and –0.8 with respect to all trade.[10] These results likely indicate that both types of trade are complementary to foreign direct investment, as low tax countries likely receive more foreign direct investment, and thus also engage in more trade, particularly intrafirm trade.[11] The quantity effect could also generate this result, as low tax countries encourage larger volumes of intrafirm trade to take advantage of tax savings. But this specification tells us less about the price effect, or the potential transfer price manipulation of multinational firms, since it is not possible to separate the pricing effect from the quantity and location effects.

Note that a better way to isolate the price effect would be to examine intrafirm trade balances. While the location and quantity effects should act to increase both intrafirm exports and intrafirm imports with low tax countries, such effects would have no effect on the intrafirm trade balance. The price effect, though, would be expected to worsen (improve) intrafirm trade balances to low (high) tax countries as intrafirm exports would be underpriced (overpriced) relative to intrafirm imports from such

---

[9] The effective tax rate is the foreign income tax paid by affiliates in a given country relative to their net (before-tax) income. While using marginal tax rates is a (theoretically superior) alternative, using marginal tax rates in practice is very difficult. First, it is harder to get comparable data for this sample of 54 countries and 16 years. Second, the published marginal tax rates are an imperfect proxy for the actual tax rates firms face since such rates do not account for the many subtleties (tax holidays, ad hoc arrangements, special allowances, etc.) that determine the true tax treatment of firms.

[10] Note that the coefficient reported in Table 3 indicates the elasticity with respect to *1 – Effective Tax Rate*. In the text, I calculate (at the mean effective tax rate) what the implied elasticities are with respect to the effective tax rate.

[11] Note that there is little correlation between measures of trade barriers and this effective tax rate variable for this sample of countries.

countries. Clausing (1998) follows this methodology and does find a noticeable impact of the price effect, or transfer price manipulation, on intrafirm trade flows.

Export and Import Equations

Tables 4 and 5 report separate results for exports and imports for the baseline specifications; Appendix B reports the same results including the effective tax rate variable. Estimating exports and imports together has the advantage of focusing on overall trade patterns without being unduly concerned with macroeconomic considerations that affect the relative levels of exports and imports. When one estimates exports and imports separately, it is more important to include price terms such as a real exchange rate. Still, empirical researchers have typically not found satisfying results with such variables in these types of studies. For instance, Frankel (1997) excludes exchange rate variables since he finds that they tend to fluctuate in sign and are usually statistically insignificant, and he cites other studies that have reached similar conclusions (p.142). I too began by including a real exchange rate index variable as well as its lagged terms. The later were never statistically significant but the contemporaneous exchange rate always had the predicted effect on non-intrafirm trade. A stronger dollar is associated with greater arms-length imports and lesser arms-length exports, with no discernible effects on intrafirm trade. This greater sensitivity of arms-length trade to exchange rate changes contrasts with the hypothesis of Rangan and Lawrence (1999) that intrafirm trade should respond more quickly to exchange rate changes due to the information advantages that the networks of multinational firms provide.

The bulk of the other results are similar to those found in earlier results: GDP per-capita has a negative effect on non-intrafirm trade, but not on intrafirm trade; distance and the North American free trade agreements have a greater estimated effect on intrafirm trade, although differences are not always statistically significant. A couple of differences between the export and import equations stand out, however. Distance has a larger negative effect on exports than imports. Per-capita income shows a strong positive relationship with intrafirm exports and no relationship with intrafirm imports. This result would be expected if intrafirm imports include substantial amounts of goods shipped back to the United States from affiliates in poorer countries, where foreign direct investment has been to a greater extent motivated by factor price differences.

Tables B1 and B2 show similar regressions including the effective tax rate variable. The results are quite similar to those just discussed. Coefficients on the effective tax rate variable indicate that intrafirm trade is again, as expected, more sensitive to tax influences than is arms-length trade.[12]

Other Multinational Trade

So far the analysis has focused on examining the empirical difference in the behaviour of U.S. multinational intrafirm trade and non-intrafirm trade, or trade between unaffiliated entities. There is a third category of trade that has been excluded from the analysis, intrafirm trade between foreign multinational parents and their affiliates in the United States. This exclusion has served three purposes: (1) it has enabled the use of a

---

[12] It is also interesting to compare the coefficients in the export and import equations. The price effect discussed above should increase intrafirm exports to high tax countries (as these goods are overpriced) while decreasing intrafirm imports from high tax countries (as these goods are underpriced). This implies (together with the location effect) that high taxes should have a stronger negative effect on intrafirm imports than on intrafirm exports. The point estimates of the regression coefficients corroborate this expectation, although these estimates are not statistically significantly distinguishable from one another.

much greater set of countries than is available if one focused solely on countries that have substantial investments in the United States, (2) it has enabled the use of appropriate tax variables, and (3) it has focused the analysis on the empirical behaviour of U.S. multinational trade in contrast to arms-length trade.

Still, it is useful to examine the nature of intrafirm trade between foreign parent firms and their affiliates in the United States. In Table 6, I present results that estimate a gravity equation model for this type of trade. Equation 1 is the baseline specification for total foreign intrafirm trade, while equations 2 and 3 show separate results for foreign intrafirm exports and foreign intrafirm imports. Comparing this table with previous results, a few observations are noteworthy. First, the GDP term and the distance term coefficients are larger than those in previous specifications, and are closer to estimates common in gravity equation models. Second, the GDP per-capita term continues to be positive, indicating that this type of intrafirm trade (like the other) is also positively associated with a country's per-capita income. When one examines equations 2 and 3, one finds that this relationship is entirely due to a very strong positive relationship between per-capita income and foreign intrafirm imports. It is likely that this relationship is due in large part to the large volumes of intrafirm imports of Japanese multinational affiliates in the United States.[13] Third, there appears to be no statistically discernible effects of the special trading agreements on this type of intrafirm trade. Fourth, the explanatory power of the regression as a whole is higher for this type of intrafirm trade than for U.S. multinational intrafirm trade.

Extensions of the Empirical Analysis

Several alternative specifications were tested to see if they changed the results in a meaningful fashion, particularly for the baseline specifications. First, I included country fixed effects. This did not appear to change the substantive nature of the results, nor did it improve the fit of the regression model, so these results are not presented. Second, I included time-specific fixed effects to test whether events peculiar to individual years were affecting the results; however, the coefficient estimates were almost identical to earlier specifications. Third, I tested three individual cross-sections: for 1982, for 1989, and for 1997. All produced results that were consistent with the above conclusions. Fourth, I tried testing sub-sections of the data, dividing the data into three equal time periods, and then two. In the later sub-periods, the coefficient on the distance variable was not negative. Otherwise, the results were fairly similar across sub-samples. Finally, I estimated the main specifications excluding the dummy variables for the trade agreements. The magnitudes of most coefficients were unchanged, although the distance coefficient was (predictably) larger when these dummy variables were excluded. Still, the relative magnitudes of the intrafirm and non-intrafirm coefficients for all variables (including distance) were quite similar with the dummy variables excluded.

The Composition of Intrafirm Trade

The empirical results have indicated that intrafirm trade *is* different from conventional trade conducted at arms-length. This could capture the fact that trade between different affiliates of multinational firms is motivated by different influences, such as tax minimisation strategies, or it could capture the fact that multinational firms respond differently to key economic variables due to their special characteristics. On the other hand, it could merely capture the fact that the product composition of intrafirm

---

[13] Japanese affiliate intrafirm imports were 50% of all such foreign intrafirm imports in 1997.

trade is different from arms-length trade. Unfortunately, when limited to data at this level of aggregation, it is more straightforward to document the way in which intrafirm trade is different from arms-length trade than it is to understand the causes of these differences.

Product composition could be an important consideration.[14] For instance, as Rauch (1996) has demonstrated empirically, proximity is more important for trade in differentiated products than for trade in more homogeneous products. Rauch attributes his finding to a "network/search" view of trade in differentiated products, which holds that information is more important as well as more difficult to obtain for differentiated products than for more homogeneous goods. [15] Such considerations, however, might lead us to expect that the coefficient on distance should be smaller for intrafirm trade (if it is the case that such trade is likely to involve more homogeneous products) than for arms-length trade; a finding opposite to the above empirical results.

IV. Conclusions

This paper has considered how intrafirm trade, or trade between two affiliates of the same multinational firm, may behave differently from traditional trade conducted between unaffiliated firms at arms' length. A gravity equation model of international trade was estimated for each type of trade for the United States and 54 trading partners between 1982 and 1997. The results of the analysis indicate that intrafirm trade is different from arms-length trade. First, the gravity equation model, long the most empirically successful model of international trade flows, has far greater explanatory power with respect to arms-length trade than with respect to intrafirm trade. Second, most of the individual coefficients in the model are substantially different with respect to the two types of trade. GDP per-capita typically has a positive effect on intrafirm trade, and a negative effect on arms-length trade. Distance, the North American free trade agreements, and the tax variable all appear to have larger effects on intrafirm trade than arms-length trade. Exchange rates, on the other hand, appear to have a larger influence on arms-length trade.

A priori, there are several reasons to suspect that intrafirm trade may differ from trade conducted at arms-length. Intrafirm trade is more likely to be affected by international tax incentives, intrafirm trade may be different due to the special nature of multinational firms, and the product composition of intrafirm trade may differ from that of arms-length trade. The above empirical results indicate several specific ways in which intrafirm trade behaves differently within a gravity equation model of international

---

[14] One way to separate the effects of the composition of trade from the fact that trade is intrafirm would be to employ more detailed data. At this point, the options are limited, but the Bureau of Economic Analysis does report some data on intrafirm exports that is broken down by intended use: goods for resale and goods for further manufacture. However, these data are only provided for exports, and for years when a benchmark survey is done: 1982, 1989, and 1994. One can do an analysis similar to the equations presented in Tables 4 and B1, further dividing intrafirm exports into those for further manufacture and those for resale. In general, the trade in goods for resale behaves much closer to non-intrafirm trade than does trade in goods for further manufacture. However, the coefficients on several of the variables are less precisely estimated than those in the specifications that make use of the full data set. Tables of results are available upon request.

[15] Rangan and Lawrence (1999) have argued that multinational firms will be better able to overcome these network/search problems. However, if multinationals primarily trade in input products, which are in turn more homogeneous than average, than it may be difficult to separate these two considerations.

trade. One area for future research is to examine how much of these differences are due to the fact that such trade occurs within the firm, and how much of the differences are due to the product composition of intrafirm trade. While the results above do not conform with what one would expect due to the product composition of intrafirm trade, more research is required to carefully separate these effects.

Most previous empirical studies of international trade have not considered the potential differences in the behaviour of intrafirm and non-intrafirm trade. However, understanding these differences allows an improved understanding of the determinants of international trade, the effects of trade agreements and policies, and the role of geography in trade. This paper has documented noteworthy differences between the empirical behaviour of intrafirm trade and that of arms-length trade. While further investigation into the causes of these differences is important, it is hoped that this research will contribute to an improved understanding of international trade patterns.

References

Anderson, James S. 1979. "A Theoretical Foundation for the Gravity Equation." *American Economic Review*. March. 106-115.

Bergstrand, Jeffrey H. 1985. "The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence." *Review of Economics and Statistics*. August. 481-8.

Bergstrand, Jeffrey H. 1989. "The Generalized Gravity Equation, Monopolistic Competition, and the Factor Proportions Theory in International Trade." *Review of Economics and Statistics*. February. 143-53.

Bergstrand, Jeffrey H. 1990. "The Heckscher-Ohlin-Samuelson Model, the Linder Hypothesis, and the Determinants of Bilateral Intra-Industry Trade." *The Economic Journal*. December. 1216-29.

Braunerhjelm, Pontus. 1998. "Organization of the Firm, Foreign Production, and Trade." In Braunerhjelm and Ekholm, eds. *The Geography of Multinational Firms*. Boston: Kluwer Academic Publishers.

Bureau of Economic Analysis. *U.S. Direct Investment Abroad: Operations of U.S. Parent Companies and Their Foreign Affiliates*. Various years.

Caves, Richard E. 1996. *Multinational Enterprise and Economic Analysis*. 2nd edition. New York: Cambridge U P.

Clausing, Kimberly A. 1998. "The Impact of Transfer Pricing on Intrafirm Trade." *NBER Working Paper no.6688* , forthcoming within U of Chicago Press volume.

Clausing, Kimberly A. 2000a. "Does Multinational Activity Displace Trade?" *Economic Inquiry*. April. 190-205.

Clausing, Kimberly A. 2000b. "The Behaviour of Intrafirm Trade Prices in U.S. International Price Data." photocopy. June.

Deardorff, Alan V. 1998. "Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World?" in Frankel, Jeffrey A., ed. *The Regionalization of the World Economy*. Chicago: U of Chicago Press.

Eden, Lorraine. 1998. *Taxing Multinationals: Transfer Pricing and Corporate Income Taxation in North America*. Toronto: U of Toronto Press.

Encarnation, Dennis. 1992. *Rivals Beyond Trade: American versus Japan in Global Competition.* Ithaca: Cornell U Press.

Encarnation, Dennis. 1994. "Intra-firm Trade in North America and the European Community." In Eden, Lorraine, ed. *Multinationals in North America*. Calgary: U of Calgary P. 309-334.

Frankel, Jeffrey. 1997. *Regional Trading Blocs in the World Economic System.* Washington: Institute for International Economics.

Goldsbrough, David J. 1981. "International Trade of Multinational Corporations and Its Responsiveness to Changes in Aggregate Demand and Relative Prices." *International Monetary Fund Staff Papers*. 28(3). 573-99.

Head, Keith and Reis, John. 1998. "Immigration and Trade Creation: Econometric Evidence from Canada." *Canadian Journal of Economics*. 31(1). February. 47-62.

Helliwell, John. 1998. *How Much do National Borders Matter?* Washington: Brookings Institution Press.

Horst, Thomas. 1971. The Theory of the Multinational Firm: Optimal Behaviour Under Different Tariff and Tax Rates." *Journal of Political Economy*. 79(5). 1059-72.

International Monetary Fund. *International Financial Statistics Yearbook*. Various issues.

Kant, Chander. 1995. "Minority Ownership, Deferral, Perverse Intrafirm Trade and Tariffs." *International Economic Journal*. 9(1). 19-37.

Kant, Chander. 1990. "Multinational Firms and Government Revenue." *Journal of Public Economics*. 42(2). 135-147.

Knetter, Michael M. 1993. "International Comparisons of Pricing-to-Market Behaviour." *American Economic Review*. 83(3). 473-86.

Lipsey, Robert E. and Kravis, Irving B. 1986. "The Competitiveness and Comparative Advantage of U.S. Multinationals, 1957-1983." *National Bureau of Economic Research Working Paper no. 3051*. October.

Little, Jane Sneddon. 1986. "Intra-firm Trade and U.S. Protectionism: Thoughts Based on a Small Survey." *New England Economic Review*. Jan/Feb. 46-51.

Markusen, James R. 1986. "Explaining the Volume of Trade: An Eclectic Approach." *American Economic Review*. December. 1002-11.

McCallum, John. 1995. "National Borders Matter: Canada-U.S. Regional Trade Patterns." *American Economic Review*. 85. June. 615-23.

Rangan, Subramanian, and Robert Z. Lawrence. 1999. *A Prism on Globalization: Corporate Responses to the Dollar*. Washington: Brookings Institution Press.

Rauch, James E. 1996. "Networks versus Markets in International Trade." *NBER Working Paper no. 5617*. June.

Sapir, Andre. 1997. "Domino Effects in Western European Trade, 1960-1992." *Centre for Economic Policy Research Discussion Paper no. 1576*. February.

Zeile, William J. 1997. "U.S. Intrafirm Trade in Goods." *Survey of Current Business*. February. 23-38.

Figure 1: U.S. Trade with All Partners, 1994

Bar chart. Y-axis: % of total, from 0.0% to 40.0% in 5.0% increments. Legend: U.S. Exports, U.S. Imports.

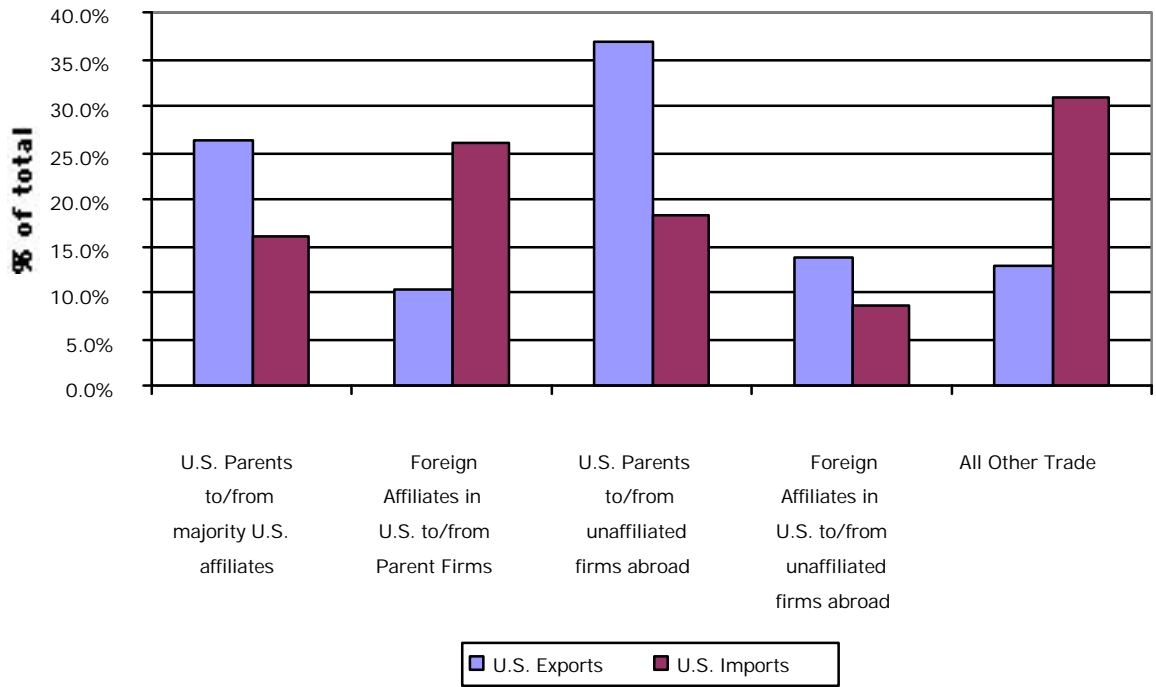| Category	U.S. Exports	U.S. Imports
U.S. Parents to/from majority U.S. affiliates	~26.5%	~16.2%
Foreign Affiliates in U.S. to/from Parent Firms	~10.5%	~26.2%
U.S. Parents to/from unaffiliated firms abroad	~37.0%	~18.5%
Foreign Affiliates in U.S. to/from unaffiliated firms abroad	~14.0%	~8.8%
All Other Trade	~13.0%	~31.0%

Figure 2: Share of U.S. - E.U. Trade that is Intrafirm, (1982-1997 average)
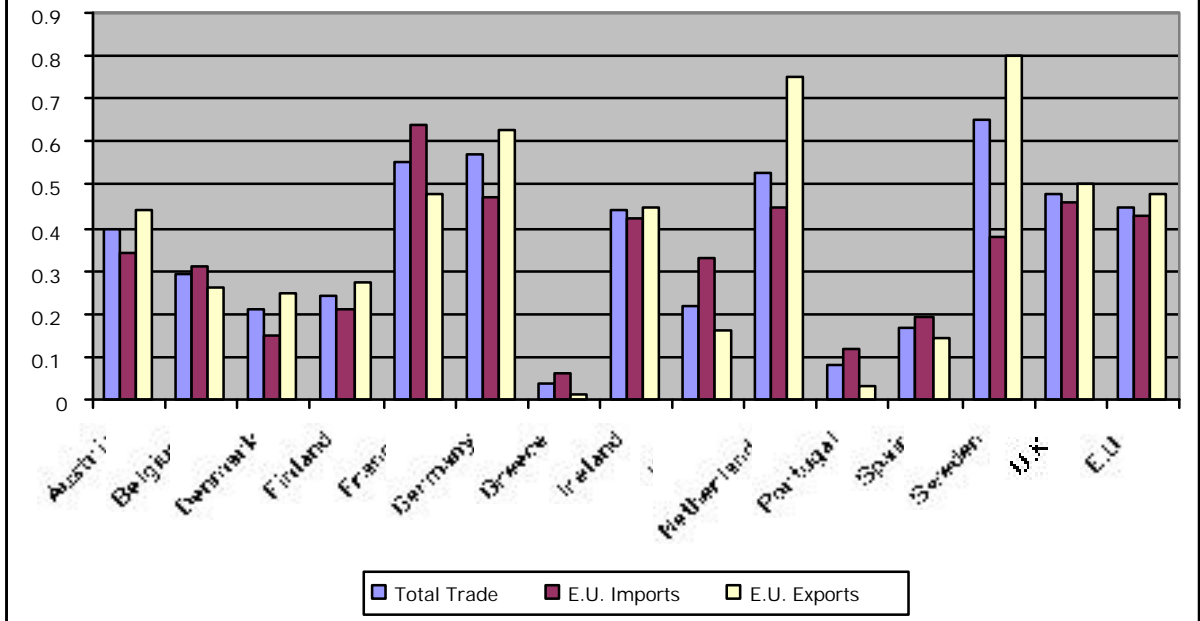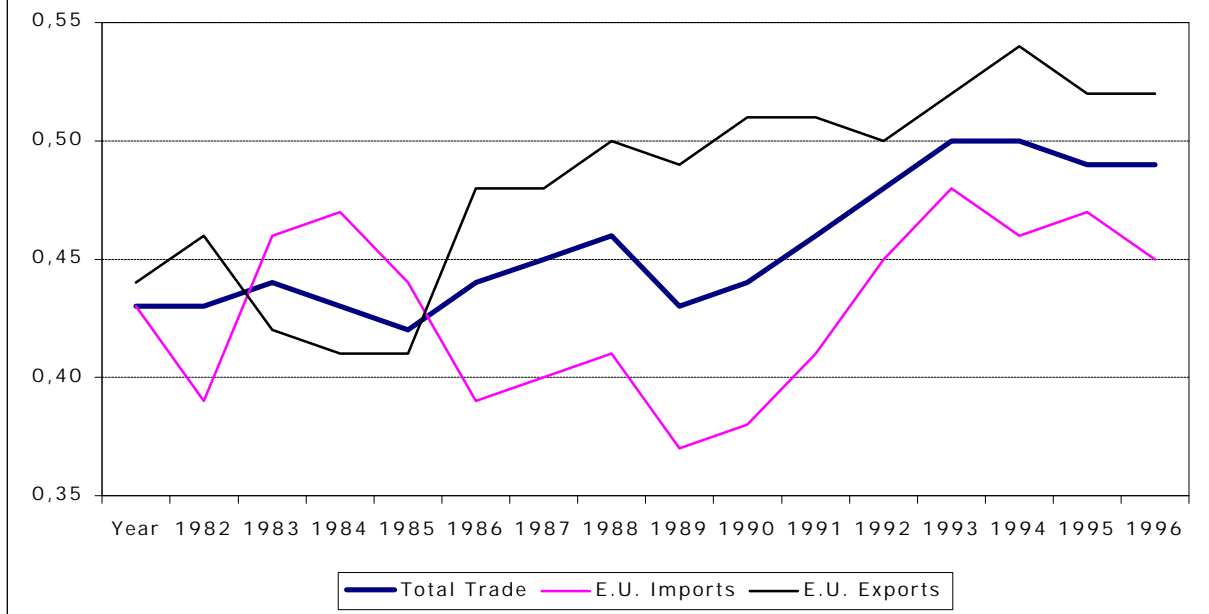
Figure 3. Share of US - EU Trade that is Intrafirm

17

Table 1. Summary Statistics

Variable	Obs.	Mean	St. Dev.
Exports$_{ijt}$, in million U.S. $	864	6,385	13,261
Imports$_{ijt}$, in million U.S. $	858	8,907	19,392
Intrafirm Exports$_{ijt}$, in mil. $	807	1,845	5,164
Intrafirm Imports$_{ijt}$, in mil. $	692	1,738	5,761
GDP$_{jt}$, in bil. 1990 U.S. $	854	251.6	473.3
GDP per-capita$_{jt}$, in 1990 U.S. $	854	9,710	9,912
Effective Tax Rate$_{jt}$	757	.341	.202
Real Exchange Rate Index, 1980=100	860	115.0	37.11
Distance$_{ij}$, in miles	864	4,907	2,320

Notes: The subscript i indicates the United States, subscript j indicates a trading partner; and t indicates years. Summary statistics are given where data are available for the period between 1982 and 1997 for 54 trading partners. All trade data are in millions of (current) U.S. dollars; in the following specifications, these data are indexed to constant 1990 dollars using U.S. export and import price indexes. GDP and GDP per-capita are in constant 1990 U.S. dollars. The effective tax rate is defined as the taxes paid by affiliates in a given country relative to their net, before-tax, income. The real exchange rate index is calculated from the nominal exchange rate and price indexes in the two countries. Distance is calculated between major cities in the U.S. and the partner country, using Chicago as the U.S. reference city.

Sources: Export and import data come from the U.S. International Trade Commission; data on intrafirm trade, taxes, and net incomes are from the U.S. Bureau of Economic Analysis (BEA). Data on GDP, GDP per-capita, and all other macroeconomic variables are from the International Monetary Fund's *International Financial Statistics* yearbooks.

Table 2. Gravity Equation Regressions Estimating US Trade Flows, 1982-97

Independent Variables:	**(1)** Total Trade	**(2)** Intrafirm Trade	**(3)** Non- Intrafirm Trade	Test that Intrafirm Coefficient = Non-If. Coef.
GDP Term	.5798 (.0252)	.5076 (.0397)	.5990 (.0244)	$\chi^2 = 8.04$ Prob = 0.005
GDP Per- Capita Term	-.1572 (.0286)	.1688 (.0450)	-.2294 (.0277)	$\chi^2 = 118.3$ Prob = 0.000
Distance	-.1553 (.0654)	-.2844 (.1029)	-.1511 (.0634)	$\chi^2 = 2.54$ Prob = 0.111
CUSFTA	2.289 (.3029)	2.800 (.4771)	2.086 (.2939)	$\chi^2 = 3.38$ Prob = 0.066
NAFTA	1.937 (.4089)	2.861 (.6440)	1.755 (.3967)	$\chi^2 = 4.46$ Prob = 0.035
Israel FTA	.6458 (.2864)	-.4419 (.4511)	.8838 (.2779)	$\chi^2 = 13.07$ Prob = 0.000
Number Obs.	667	667	667	
R^2	.560	.424	.567	

Notes: Variables are defined as in equation (2) of the text. Summary statistics and data sources are given in Table 1 above. All variables that are not dummy variables are in logs. Standard errors are in parentheses.

Table 3. Gravity Equation Regressions Estimating U.S. Trade Flows, 1982-97
(with Effective Tax Rate included as an explanatory variable)

Independent Variables:	(1) Total Trade	(2) Intrafirm Trade	(3) Non-Intrafirm Trade	Test that Intrafirm Coefficient = Non-If. Coef.
GDP Term	.6780 (.0275)	.6546 (.0433)	.6775 (.0271)	$\chi^2 = 0.40$ Prob = 0.526
GDP Per- Capita Term	-.2826 (.0319)	-.0312 (.0503)	-.3274 (.0315)	$\chi^2 = 49.89$ Prob = 0.000
Distance	-.1558 (.0645)	-.2670 (.1019)	-.1490 (.0637)	$\chi^2 = 1.93$ Prob = 0.165
CUSFTA	2.323 (.2921)	2.875 (.4610)	2.119 (.2885)	$\chi^2 = 3.86$ Prob = 0.049
NAFTA	1.743 (.3936)	2.559 (.6212)	1.607 (.388)	$\chi^2 = 3.38$ Prob = 0.066
Israel FTA	.4941 (.2755)	-.6633 (.4348)	.7669 (.2721)	$\chi^2 = 15.55$ Prob = 0.000
1-Effective Tax Rate	1.517 (.1845)	2.137 (.2912)	1.195 (.1822)	$\chi^2 = 15.04$ Prob = 0.000
Number Obs.	628	628	628	
R^2	.599	.461	.592	

Notes: Variables are defined as in equation (2) of the text. Summary statistics and data sources are given in Table 1 above. All variables that are not dummy variables are in logs. Standard errors are in parentheses.

Table 4. Gravity Equation Regressions Estimating U.S. Exports, 1982-97

Independent Variables:	(1) Total Exports	(2) Intrafirm Exports	(3) Non-Intrafirm Exports	Test that Intrafirm Coefficient = Non-If. Coef.
GDP Term	.5839 (.0217)	.6010 (.0350)	.5826 (.0226)	$\chi^2 = 0.37$ Prob = 0.543
GDP Per- Capita Term	-.1097 (.0252)	.3441 (.0407)	-.2103 (.0262)	$\chi^2 = 251.1$ Prob = 0.000
Distance	-.3396 (.0628)	-.5857 (.1015)	-.3286 (.0653)	$\chi^2 = 8.71$ Prob = 0.003
CUSFTA	1.883 (.3031)	1.884 (.4900)	1.779 (.3155)	$\chi^2 = 0.06$ Prob = 0.804
NAFTA	1.778 (.4114)	2.555 (.6653)	1.646 (.4284)	$\chi^2 = 2.53$ Prob = 0.112
Israel FTA	.5833 (.2290)	-1.646 (.3703)	.8943 (.2384)	$\chi^2 = 63.79$ Prob = 0.000
Real Exchange Rate Index	-.2167 (.0970)	-.1235 (.1569)	-.2393 (.1010)	$\chi^2 = 0.74$ Prob = 0.390
Number Obs.	790	790	790	
R^2	.580	.514	.538	

Notes: Variables are defined as in equation (2) of the text. Summary statistics and data sources are given in Table 1 above. All variables that are not dummy variables are in logs. Standard errors are in parentheses.

Table 5. Gravity Equation Regressions Estimating US Imports, 1982-97

Independent Variables:	**(1)** Total Imports	**(2)** Intrafirm Imports	**(3)** Non-Intrafirm Imports	Test that Intrafirm Coefficient = Non-If. Coef.
GDP Term	.6191 (.0296)	.5565 (.0680)	.6559 (.0288)	$\chi^2 = 2.83$ Prob = 0.093
GDP Per- Capita Term	-.2123 (.0344)	.0658 (.0792)	-.2651 (.0335)	$\chi^2 = 23.15$ Prob = 0.000
Distance	-.1128 (.0780)	-.4721 (.1792)	-.1342 (.0758)	$\chi^2 = 4.71$ Prob = 0.030
CUSFTA	2.568 (.3614)	3.340 (.8307)	2.229 (.3511)	$\chi^2 = 2.37$ Prob = 0.124
NAFTA	2.098 (.4879)	3.475 (1.122)	1.831 (.4740)	$\chi^2 = 2.85$ Prob = 0.091
Israel FTA	.9571 (.3437)	1.025 (.7900)	1.114 (.3339)	$\chi^2 = 0.02$ Prob = 0.897
Real Exchange Rate Index	.4129 (.1227)	.0380 (.2819)	.4060 (.1192)	$\chi^2 = 2.26$ Prob = 0.133
Number Obs.	665	665	665	
R^2	.503	.211	.525	

Notes: Variables are defined as in equation (2) of the text. Summary statistics and data sources are given in Table 1 above. All variables that are not dummy variables are in logs. Standard errors are in parentheses.

Table 6. Gravity Equation Regressions Estimating Foreign Intrafirm Trade, 1982-97

Independent Variables:	**(1)** Foreign Intrafirm Trade	**(2)** Foreign Intrafirm Exports	**(3)** Foreign Intrafirm Imports
GDP Term	.7885 (.0425)	.8254 (.0585)	.8361 (.0469)
GDP Per- Capita Term	.3358 (.0817)	-.0730 (.1008)	.6868 (.0734)
Distance	-.4590 (.1358)	-.2495 (.1444)	-.6516 (.1444)
CUSFTA	.1040 (.4743)	-.2058 (.4206)	-.1350 (.5385)
NAFTA	-.0377 (.6022)	-1.249 (.5110)	.6077 (.7022)
Israel FTA	-.3486 (.4157)	-.3983 (.5473)	.4769 (.5572)
Number Obs.	383	218	431
Adjusted R^2	.546	.547	.592

Notes: Foreign Intrafirm Trade is trade between foreign parent firms and their affiliates in the United States. Foreign Intrafirm Exports are U.S. exports sent by foreign affiliates in the U.S. to their foreign based parents; Foreign Intrafirm Imports are U.S. imports destined for affiliates in the United States from their foreign based parents. Other variables are defined as in equation (2) of the text. Data sources are given in Table 1 above. All variables that are not dummy variables are in logs. Standard errors are in parentheses.

Appendix A
A Model of Transfer Pricing and Intrafirm Trade

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 minimisation 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).[16] For now, assume that the affiliate is fully owned.[17]

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

$$\eth_1 = R_1(s_1) - C_1(s_1 + m) + pm \qquad (1)$$

$$\eth_2 = R_2(s_2) - C_2(s_2 - m) - pm \qquad (2)$$

$\eth_1$ 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:

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

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

$$\eth = (1-t_1) \eth_1 + (1-t_2^e) \eth_2 \qquad (4)$$

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.

$$\eth_p = (1-t_1) m - (1-t_2^e) m \qquad (5)$$

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

$$\eth_p = -(t_1-t_2)(1-f) m \qquad (6)$$

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

---

[16]It 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.

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

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 $t_2 > t_1$.[18][19]

---

[18]Note 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.

[19] As 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. Second, 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.

Appendix B: Export and Import Regressions including the Effective Tax Rate

Table B1: Gravity Equation Regressions Estimating U.S. Exports, 1982-1997
(with Effective Tax Rate included as an explanatory variable)

Independent Variables:	(1) Total Exports	(2) Intrafirm Exports	(3) Non-Intrafirm Exports	Test that Intrafirm Coefficient = Non-If. Coef.
GDP Term	.6721 (.0228)	.7169 (.0367)	.6634 (.0243)	$\chi^2 = 2.68$ Prob = 0.102
GDP Per- Capita Term	-.2255 (.0269)	.1661 (.0432)	-.3132 (.0287)	$\chi^2 = 154.9$ Prob = 0.000
Distance	-.3413 (.0611)	-.5522 (.0983)	-.3310 (.0652)	$\chi^2 = 6.39$ Prob = 0.012
CUSFTA	1.895 (.2869)	1.964 (.4617)	1.789 (.3061)	$\chi^2 = 0.18$ Prob = 0.671
NAFTA	1.566 (.3883)	2.251 (.6250)	1.459 (.4144)	$\chi^2 = 2.03$ Prob = 0.155
Israel FTA	.4952 (.2163)	-1.842 (.3482)	.8265 (.2308)	$\chi^2 = 74.1$ Prob = 0.000
Real Exchange Rate Index	-.2150 (.1011)	-.1835 (.1628)	-.2338 (.1079)	$\chi^2 = 0.12$ Prob = 0.729
1- Effective Tax Rate	1.724 (.1578)	2.532 (.2539)	1.506 (.1684)	$\chi^2 = 20.6$ Prob = 0.000
Number Obs.	729	729	729	
R^2	.629	.564	.575	

Note: Variables are defined as in equation (2) of the text. Summary statistics and data sources are given in Table 1 above. All variables that are not dummy variables are in logs. Standard errors are in parentheses.

Table B2: Gravity Equation Regressions Estimating U.S. Imports, 1982-1997
(with Effective Tax Rate included as an explanatory variable)

Independent Variables:	(1) Total Imports	(2) Intrafirm Imports	(3) Non-Intrafirm Imports	Test that Intrafirm Coefficient = Non-If. Coef.
GDP Term	.7105 (.0322)	.7721 (.0734)	.7281 (.0316)	$\chi^2 = 0.47$ Prob = 0.494
GDP Per- Capita Term	-.3477 (.0383)	-.2636 (.0874)	-.3720 (.0377)	$\chi^2 = 2.00$ Prob = 0.157
Distance	-.0904 (.0769)	-.4061 (.1755)	-.1066 (.0756)	$\chi^2 = 3.79$ Prob = 0.052
CUSFTA	2.646 (.3478)	3.504 (.7932)	2.310 (.3419)	$\chi^2 = 2.95$ Prob = 0.086
NAFTA	1.911 (.4688)	3.004 (1.069)	1.694 (.4608)	$\chi^2 = 1.95$ Prob = 0.162
Israel FTA	.7840 (.3303)	.6295 (.7534)	.9772 (.3247)	$\chi^2 = 0.28$ Prob = 0.599
Real Exchange Rate Index	.3426 (.1293)	-.2292 (.2948)	.3386 (.1271)	$\chi^2 = 4.82$ Prob = 0.028
Effective Tax Rate	1.421 (.2206)	2.957 (.5032)	1.094 (.2169)	$\chi^2 = 17.8$ Prob = 0.000
Number Obs.	626	626	626	
R^2	.540	.256	.552	

Note: Variables are defined as in equation (2) of the text. Summary statistics and data sources are given in Table 1 above. All variables that are not dummy variables are in logs. Standard errors are in parentheses.