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The determinants of intra-firm trade: in search for export-import magnification effects

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Abstract:

This paper studies the determinants of Austrian bilateral intra-firm trade in a panel of industry-level intra-firm goods trade flows. Economic size, unit labor costs and the magnification effects originating from multiple border crossing of sequentially finished products are found to be the most important determinants of trade within multinational firms. Especially, our evidence lends support to multiple border crossing of sequentially finished products, an argument that recently has been put forward in the outsourcing literature.

Keywords:

JEL-Classification:

Non Technical Summary

Intra-firm trade is an important component of international goods trade flows. For example, intra-firm exports of the U.S. now amount to almost 30% of the total U.S. export volume.

Falling trade costs and technological progress enable multinational firms (MNEs) to fragment production internationally within the firm according to the law of comparative advantage. Further, the decline in foreign investment costs and the growth of markets have fostered the activity of multinational firms and are candidates to explain the magnitude of intra-firm trade. This paper investigates the main determinants of intra-firm exports and imports empirically. For this, we adopt an eclectic approach and specify bilateral intra-firm trade equations at the industry level that account for variables that are motivated by three different branches of research on this issue.

Our estimation results for 12 Austrian manufacturing industries with intra-firm exports to and imports from five country groups underpin the direct relevance of market size, unit labor costs and, specifically, of the magnification effect associated with two-way trade in components as pointed out by Yi (2003). This holds true for the structural form estimation results, i.e., the direct effect. Due to the magnification effect, intra-firm exports and imports are non-trivially determined in equilibrium because of important indirect effects. It turns out that through mutual dependence between exports and imports the combined direct and indirect effects are such that intra-firm exports are mainly determined by market size, unit labor costs and affiliate characteristics (the share of greenfield investments, the number of affiliates, and affiliate sales per employee). In contrast, intermediate goods imports seem mainly driven by Austrian trade policy and affiliate characteristics (the number of affiliates, and affiliate sales per employee) but not by market size or costs.

Nicht technische Zusammenfassung

Der Intrafirmenhandel ist eine wichtige Komponente der internationalen Warenhandelsströme. So beläuft sich beispielsweise in den Vereinigten Staaten der Warenhandel zwischen Muttergesellschaften und ihren Auslandstöchtern auf fast 30 % des gesamten US-amerikanischen Ausfuhrvolumens.

Sinkende Handelskosten und der technische Fortschritt ermöglichen es multinationalen Unternehmen (MNU), die Produktion innerhalb des Unternehmens nach dem Gesetz des komparativen Vorteils auf verschiedene Länder zu verteilen. Zudem fördern der Kostenrückgang bei Auslandsinvestitionen und das Wachstum der Märkte die Aktivitäten multinationaler Unternehmen und könnten ein Faktor zur Erklärung der Größenordnung des Intrafirmenhandels sein. In diesem Diskussionspapier werden die wichtigsten Bestimmungsgründe der Intrafirmenexporte und –importe empirisch untersucht. Hierfür verwenden wir einen eklektischen Ansatz und legen Gleichungen für den bilateralen Intrafirmenhandel auf Branchenebene fest, die Variablen enthalten, wie sie sich aus drei verschiedenen Forschungsansätzen zu diesem Thema ergeben.

Unsere Schätzergebnisse für zwölf österreichische Branchen des verarbeitenden Gewerbes mit Intrafirmenausfuhren in und –einfuhren aus fünf Ländergruppen untermauern die unmittelbare Relevanz von Marktgröße, Lohnstückkosten und insbesondere des mit dem wechselseitigen Komponentenhandel verbundenen „Verstärkungseffekts", auf den Yi (2003) hingewiesen hat. Dies gilt für die Schätzergebnisse zur strukturellen Form, d. h. den direkten Effekt. Bedingt durch den „Verstärkungseffekt" sind Intrafirmenexporte und –importe aufgrund wichtiger indirekter Effekte im Gleichgewicht nicht trivial determiniert. Es zeigt sich, dass durch die gegenseitige Abhängigkeit zwischen Exporten und Importen die direkten und indirekten Wirkungen zusammengenommen dazu führen, dass die Intrafirmenausfuhren hauptsächlich durch Marktgröße, Lohnstückkosten und Merkmale der Schwestergesellschaften (Anteil der Neugründungen, Anzahl der Schwestergesellschaften und Umsatz der Schwestergesellschaften je Mitarbeiter) bestimmt werden. Dagegen scheinen die Einfuhren von Vorleistungsgütern hauptsächlich von der österreichischen Handelspolitik und den Merkmalen der

Schwestergesellschaften abzuhängen (Anzahl der Schwestergesellschaften und ihr Umsatz je Mitarbeiter), nicht aber von der Marktgröße oder den Kosten.

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1 Introduction[1]

Intra-firm trade is an important component of international goods trade flows. For example, intra-firm exports of the U.S. now amount to almost 30% of the total U.S. export volume (see Zeile, 1997, Rangan, 2001). Falling trade costs and technological progress enable multinational firms (MNEs) to fragment production internationally within the firm according to the law of comparative advantage. Further, the decline in foreign investment costs and the growth of markets have fostered the activity of multinational firms (see Carr, Markusen and Maskus, 2001, Markusen and Maskus, 2002) and are candidates to explain the magnitude of intra-firm trade. This paper investigates the main determinants of intra-firm exports and imports empirically. For this, we adopt an eclectic approach and specify bilateral intra-firm trade equations at the industry level that account for variables that are motivated by three different branches of research on this issue.

We introduce the determinants identified in the general equilibrium model of trade and MNEs (Markusen, 2002, Grossman, Helpman, and Szeidl, 2003), namely exporter and importer market size and their unit labor costs (as a measure of endowments and productivity). These models of vertical MNEs explain one-way trade in components. However, Feinberg and Keane (2003) report that for U.S.-Canadian intra-firm trade only 31% is one-way. Hummels, Rapoport, and Yi (1998), Hummels, Ishii, and Yi (2001), and Yi (2003) illustrate that fragmentation of production leads to multiple border-crossings of intermediate goods. We argue that this is relevant also for intra-firm trade due to fragmentation of production within the network of multinational +firms. Therefore, we take a systems view to account for the mutual interdependence of

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[1] Comments of the participants at the workshop "Multinationals and International Integration", held at the Kiel Institute for World Economics in October 2004, are gratefully acknowledged. Especially, we have benefited from the discussion by Thierry Mayer.

goods intra-firm exports and imports. Lastly, we include variables such as the share of greenfield investments that are motivated from an industrial economics perspective.

Our estimation results for 12 Austrian manufacturing industries with intra-firm exports to and imports from five country groups underpin the direct relevance of market size, unit labor costs and, specifically, of the magnification effect associated with two-way trade in components as pointed out by Yi (2003). This holds true for the structural form estimation results, i.e., the direct effect. Due to the magnification effect, intra-firm exports and imports are non-trivially determined in equilibrium because of important indirect effects. It turns out that through mutual dependence between exports and imports the combined direct and indirect effects are such that intra-firm exports are mainly determined by market size, unit labor costs and affiliate characteristics (the share of greenfield investments, the number of affiliates, and affiliate sales per employee). In contrast, intermediate goods imports seem mainly driven by Austrian trade policy and affiliate characteristics (the number of affiliates, and affiliate sales per employee) but not by market size or costs.

The next section provides a brief overview on the literature which motivates our econometric model. Section 3 describes the data base and the econometric approach and discusses the estimation results, while Section 4 provides some sensitivity analysis. In the last section we summarize our main conclusions.

2 Theoretical hypotheses

We adopt an eclectic approach to specify our empirical model of intra-firm trade. Three lines of theoretical research motivate determinants of trade within a MNE. First, general equilibrium models of trade and vertical multinationals make the case for trade in components between the headquarters and their foreign affiliate(s) on the one hand, and imports of finished products on the other hand. Second, the recent literature on the role of vertical specialization for the growth of world trade motivates a magnification effect of trade in components due to multiple border-crossing of sequentially finished products. Third, the industrial economics literature on intra-firm trade summarizes potentially important determinants associated with the characteristics of foreign affiliates and the structure of the markets they operate in. As emphasized by all these

approaches, firm specific assets are a plausible reason for trade in components occurring within the network of a multinational firm and not at arms length.

The relevant general equilibrium models of trade and multinationals are part of the family of "knowledge-capital" models (Carr, Markusen and Maskus, 2001, Markusen, 2002). MNEs are distinguished from national exporters by multi-plant economies of scale, associated with firm-specific assets. In general, vertical multinationals (Helpman, 1984) or horizontal ones (Markusen, 1984) may endogenously arise in these models. The available knowledge-capital models with intra-firm trade in intermediate and final goods focus on vertically organized MNEs with cross-border intra-firm trade in components.

Helpman (1985), Zhang and Markusen (1999) and Markusen (2002) discuss a model of vertical MNEs, where the skill intensive intermediate goods can be produced only in the parent country, whereas labor-intensive assembly of the final good is possible in either country.[2] Vertical MNEs with headquarters and intermediate goods production in the parent country ship the intermediate product to their affiliate abroad for final assembly. The final good is then sold locally but also reimported. This occurs at sufficient differences in relative endowments. Markusen (2002, p. 206) illustrates that the volume of intra-firm exports in goods declines (rises) with parent (host) country market size. Further, intra-firm exports increase (decrease) with the parent (host) country's capital-labor ratio. The latter indicates that trade in intermediate goods declines in the unit production costs of components.

Grossman, Helpman, and Szeidl (2003) provide a related model of three countries (two northern ones and one southern economy) assuming productivity differences among locations. Under "partial globalization" and the reference case of zero transport costs, intermediate goods are either produced in the parent country with assembly in the South or vice versa. Intermediate goods production in the (high-wage) parent country, intra-firm exports of components, and FDI in assembly in the South occur because firms can spare on unit production costs by doing assembly in the South at additional fixed costs. FDI in intermediate goods production in, i.e., component imports from, the (low-wage) South takes place, because of lower unit production costs of components there at

additional plant fixed costs. In other words, the volume of trade in components increases in international factor endowment differences, hence, per-unit variable cost differences. Concerning the impact of country size, the conclusions are similar to Markusen (2002).

Recent research on the international organization of production in multiple sequential stages puts emphasis on a trade magnification effect (Hummels, Rapoport, and Yi, 1998, Hummels, Ishii, and Yi, 2001, Yi, 2003). In a dynamic Ricardian trade model, Yi (2003) demonstrates that a deeper fragmented production does not only lead to increased intermediate goods trade per se, but to multiple border-crossings of sequentially finished goods with incremental value added at each production stage. In turn, the share of final goods trade in overall trade gets smaller as the international fragmentation of production rises. This literature is less explicit about whether this type of trade occurs within or across firms (at arm's length). However, the arguments are valid for intra-firm trade in components as well. Accordingly, intra-firm imports should stimulate intra-firm exports and vice versa due to this magnification effect. This motivates the specification of a two-equation system with intra-firm goods exports and imports as the endogenous variables.

Finally, the industrial economics branch of research on the determinants of intra-firm trade underpins the relevance of greenfield versus acquisition FDI for intra-firm trade (in text-book knowledge capital models of MNEs summarized above, all investments are greenfield). In this regard, Zejan (1989) finds a negative impact of acquisitions on intra-firm trade of Swedish MNEs. Andersson and Fredriksson (2000) estimate a negative effect of similar size for both imports of final goods and of intermediates of Swedish MNEs. They argue that greenfield investments are positively correlated with intra-firm exports from the headquarters due to the reliance on firm-specific technology.

3 Specification and data base

Part of the theoretical models summarized in section 2 suggests specifying intra-firm trade as a system of two equations with intra-firm exports and imports as

[2] In Markusen's model, skilled labor and unskilled labor are the primary production factors. For the ease

endogenous variables. Below, subscript *i* always refers to the host, in our case Austria. The index *j* refers to one out of five host regions[3], *k* indexes the NACE industry[4], and *t=1989,...,2001*. As motivated above, both intra-firm exports and imports are a function of market size and per-unit production costs in both the parent (*i*) and the host country (*j*). We approximate parent and host market size by apparent consumption (S_{ikt}, S_{jkt}) at the industry level (k) in each year (*t*). Apparent consumption is defined as gross production minus exports plus imports in each year, all measured in nominal terms. Parent country and host country unit labor costs (c_{ikt}, c_{jkt}) serve as a measure of per-unit production costs, and they are defined as labor compensation divided by value added.[5] Further, impediments to exports (imports) for intra-firm exports (imports), negatively affect intra-firm exports of goods. As a measure of these trade impediments, we use the industry-level overall export openness of the parent measured by exports over gross production (x_{ikt}) and the overall import openness of the host measured by imports over gross production (m_{jkt}) in the intra-firm exports equation. Similarly, we include the overall export openness of the host (x_{jkt}) and overall import openness of the parent (m_{ikt}) in the intra-firm import equation. Following Andersson and Fredriksson (2000), the bilateral share of Austria's greenfield investments in the country's total outward investments in a given host at the industry-level is included (g_{ijkt}) in both equations. Further, we presume that intra-firm exports rise with the depth of international fragmentation of production. For instance, if affiliates are specialized in different production stages as in Grossman, Helpman and Szeidl (2003), there is a positive nexus between the number of plants and the scope of intra-firm trade. To capture this effect, we include the average number of plants per MNE in a given host at the industry-level (N_{ijkt}). Finally, we control for plant-specific productivity and argue that intermediate import demand of the parent country rises with the productivity of the foreign subsidiaries. This is to account for the potential difference in technologies between foreign subsidiaries and foreign local firms. We measure the average productivity of

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of presentation, we refer to capital and labor in the summary of the theoretical hypotheses, instead.

[3] Host countries with available explanatory variables are aggregated into the following regions by the Austrian National Bank: Germany, EU13 (i.e., EU15 as of 1995 but without Austria and Germany), USA and Canada, Hungary, Czech Republic and Slovak Republic.

[4] The industries are aggregates of two-digit ones. They are listed in Table A2 in the Appendix.

[5] One would usually use real value added in the denominator. However, in our case this would lead to a loss of the majority of observations due to missing industry level price indices. Therefore, we stick to

foreign affiliates by sales per worker in a given host and industry (p_{ijkt}). To ensure that the explanatory variables such as country size or unit labor costs do not pick up effects that are common to all observations, we include fixed time effects to control for, e.g., the common business cycle in Austrian outward FDI. Finally, we include host-country-industry fixed effects in both the export and the import equation (μ_{ijk}, ξ_{ijk}) to guard against the bias from omitted time-invariant variables (geographical ones such as distance or common borders and cultural ones such as common language).

Formally, the specifications of intra-firm exports (X) and imports (M) read:

$$ln\, X_{ijkt} = \alpha_0 + \alpha_1\, ln\, M_{ijkt} + \alpha_2\, ln\, S_{ikt} + \alpha_3\, ln\, S_{jkt} + \alpha_4\, ln\, c_{ikt} + \alpha_5\, ln\, c_{jkt} + \alpha_6\, x_{ikt} + \alpha_7\, m_{jkt} + \alpha_8\, g_{ijkt} + \alpha_9\, N_{ijkt} + \alpha_{11}\, p_{ijkt} + lambda_t + mu_{ijk} + \varepsilon_{ijt}$$

$$ln\, M_{ijkt} = \beta_0 + \beta_1\, ln\, X_{ijkt} + \beta_2\, ln\, S_{ikt} + \beta_3\, ln\, S_{jkt} + \beta_4\, ln\, c_{ikt} + \beta_5\, ln\, c_{jkt} + \beta_6\, x_{jkt} + \beta_7\, m_{ikt} + \beta_8\, g_{ijkt} + \nu_t + \xi_{ijk} + \eta_{ijt}$$

where ε_{ijt} and η_{ijt} are the respective, possibly correlated remainder error terms.

Bilateral industry data for intra-firm trade in goods and components (X_{ijkt}, M_{ijkt}) and the other industry-level information on affiliates such as the share of greenfield investments (g_{ijkt}), the number of affiliates per MNE (N_{ijkt}), and affiliate sales per employee (p_{ijkt}) were kindly provided by the Austrian National Bank. The data set comprises only the Mining and quarrying and the Manufacturing subsectors. Hence, we do not consider trade between the parent and affiliates that are specialized in the distribution of goods. Accordingly, it is reasonable to assume that our intra-firm trade data mainly reflect trade in components. Intra-firm trade in services is also excluded. The other explanatory variables (S_{ikt}, S_{jkt}, c_{ikt}, c_{jkt}) are from the OECD STAN-database. Tables A1 and A2 in the Appendix summarize the descriptive statistics for both the dependent and the independent variables.

nominal rather than real data for value added and apparent consumption. However, we control for overall inflation by time dummies.

4 Econometric issues and empirical results

The magnification effect due to multiple border-crossing intra-firm trade in components à la Yi (2003) implies that intra-firm exports boost intra-firm imports and vice versa. Therefore, $ln\ M_{ijkt}$ is endogenous in the first equation and $ln\ X_{ijkt}$ is endogenous in the second one. Accordingly, one can expect $\alpha_1>0$, $\beta_1>0$. In this case, simple OLS-estimates of the parameters are biased. To obtain consistent parameter estimates, we apply instrumental variable (IV) methods and estimate the two equations by two-stage least-squares (2SLS) as well as by three stage least squares (3SLS). As formulated, the two equation system is over-identified. In the first equation, all exogenous determinants exclusively used in the second equation are valid instruments, and vice versa for the second equation. In our case, this means that at least two instruments are available in each equation: x_{jkt} and m_{ikt} for $ln\ M_{ijkt}$ in the intra-firm exports equation; x_{ikt}, m_{jkt}, N_{ijkt}, and p_{ijkt} for $ln\ X_{ijkt}$ in the intra-firm imports equation. There are two prerequisites for consistent and efficient parameter estimation. The instruments must jointly contribute significantly to the explanatory power of the respective first-stage regression, and they have to pass the over-identification test. The first one guarantees that IV does not invoke a serious loss in precision, which is especially important in small samples. The second one ensures that the instruments themselves are not omitted relevant regressors in the second-stage regression. Further efficiency gains can be achieved by considering both equations as a system. Especially, if the correlation between ε_{ijt} and η_{ijt} is high, three-stage least-squares (3SLS) systems estimates will exhibit smaller standard errors on average (see Greene, 2003).[6]

[6] Further efficiency gains can be achieved by adopting an iterated 3SLS approach instead of one-step estimation.

Table 1: The Determinants of Austrian Intra-Firm Trade

Explanatory variables	2SLS models		Lterated 3SLS model	
	Log exports	Log imports	Log exports	Log imports
Austrian intra-firm exports of goods to host: ln X_{ijkt}	-	1,579***	-	1,746***
	-	3,54	-	3,78
Austrian intra-firm imports of goods from host: ln M_{ijkt}	0,395	-	0,382**	-
	1,60	-	1,97	-
Austrian apparent consumption: ln S_{ikt}	-3,375***	4,905**	-3,485***	6,069***
	-4,23	2,24	-4,45	2,74
Host's apparent consumption: ln S_{jkt}	0,387	-0,359	0,497*	-0,662
	1,30	-0,63	1,84	-1,14
Austrian unit labor costs: ln c_{ikt}	-5,406***	8,383***	-5,315***	9,601***
	-4,55	2,80	-4,57	3,11
Host's unit labor costs: ln c_{jkt}	-1,461*	2,895**	-1,341*	2,756**
	-1,95	2,25	-1,88	2,03
Austrian export openness: x_{ikt}	1,959	-	0,488	-
	1,46	-	0,84	-
Host's export openness: x_{jkt}	-	1,192	-	-0,588
	-	0,98	-	-0,74
Austrian import openness: m_{ikt}	-	-3,595**	-	-1,516
	-	-2,09	-	-1,09
Host's import openness: m_{jkt}	-0,635	-	0,352	-
	-0,89	-	0,71	-

Table 1: (continued): The Determinants of Austrian Intra-Firm Trade

Explanatory variables	2SLS models		Lterated 3SLS model		
	Log exports	Log imports	Log exports	Log imports	
Share of Austrian greenfield investments in host: g_{ijkt}	-0,313**	0,474	-0,320**		0,539
	-2,07	1,47	-2,14		1,59
Number of Austrian foreign affiliates in host: N_{ijkt}	0,018	-	0,020		-
	0,55	-	1,05		-
Sales per employee of Austrian foreign affiliates in host: p_{ijkt}	-0,006	-	-0,007		-
	-0,32	-	-0,96		-
Number of observations	301	301	301		301
Number of host-industry pairs	37	37	37		37
R^2	0,884	0,644	0,884		0,602
Root mean square error	0,707	1,346	0,704		1,422
Time effects (p-value of F-statistic)	0,000***	0,059*	0,000***		0,056*
Host-industry effects (p-value of F-statistic)	0,000***	0,000***	0,000***		0,000***
Instrument relevance (p-value of F-statistic)	0,100*	0,001	-		
Over-identification (p-value of Sargan χ^2-statistic)	0,786	0,767		0,309	-

Notes: Figures below coefficients are t-statistics. *** significant at 1%; ** significant at 5%; * significant at 10%. The H0 of a zero correlation of the two equations in the iterated 3SLS regression is rejected at the 1% level according to the Honda-test with a test-statistic of 17.149 that is distributed as N(0,1).

Table 1 summarizes the 2SLS estimation results of both the exports and imports specification and also the iterated 3SLS system estimates. In all reported models, the instruments are jointly relevant and they pass Sargan's over-identification test.[7] Both the time effects and the industry-host-country effects contribute significantly and the R^2 in both the intra-firm exports and the intra-firm imports equation is relatively high. Because of the associated gain in efficiency, indicated by the high and negative correlation of the residuals across equations, we focus on the discussion of the iterated 3SLS results in the table.

Under iterated 3SLS, the coefficients of the endogenous intra-firm trade variables in both equations can be estimated significantly. This is a strong indication for Yi (2003) type trade in components and the induced magnification effects. Intra-firm exports and imports re-enforce each other and, hence, are complementary rather than substitutive. This finding lends support on the importance of multi-stage international fragmentation of production.

The point estimates for the size and cost variables ($ln\ S_{ikt}$, $ln\ S_{jkt}$, $ln\ c_{ikt}$, $ln\ c_{jkt}$) exhibit the opposite signs in the exports and imports equations. The finding of a negative (positive) impact of parent (host) size for intra-firm exports lends support to Markusen's (2002) hypothesis. The result that larger markets tend to import from their affiliates in small hosts is difficult to explain from this model of one-way intra-firm trade in goods. However, it implicitly indicates that at least part of the production is organized internationally in sequential stages, as hypothesized by Yi (2003).

It does not come as a surprise that higher unit labor costs abroad or at home impede intra-firm trade. Higher unit labor costs in the parent make exports to affiliates from there less profitable. Higher unit labor costs in the host market render the host's location less attractive for exports back home and to third markets (via national firms or export-platform MNEs). The former unit labor cost effect again lends support to Markusen's (2002) model. Similarly, the model of Grossman, Helpman and Szeidl

[7] For the iterated 3SLS model, the corresponding likelihood-ratio over-identification test-statistic is computed as $LR=n\{ln\ [det(W_R)]\ -\ ln\ [det(W_U)]\}$, see Greene (2003). There, n denotes the number of observations, $W_R = (R'R)/n$ with R as the $n \times 2$ matrix of iterated 3SLS residuals for both equations, and $WU = (U'U)/n$ with U as the $n \times 2$ matrix of reduced form iterated SURE residuals. The test statistic is distributed as $\chi^2(o)$, where o is the number of over-identifying restrictions in the system (in our case, $o = 5$).

(2003) suggests that intra-firm exports decline in $ln\ c_{jkt}$ - $ln\ c_{ikt}$. The reason is that component exports from the parent with assembly in the host are motivated by production cost savings in this model. This model also implies that intra-firm imports decline in $ln\ c_{jkt}$ - $ln\ c_{ikt}$, being at odds with our findings. Both an increase in Austrian and the hosts' unit production costs reduce the competitiveness of Austrian MNEs. From this perspective, it is not surprising that intra-firm imports rise in Austrian unit labor costs. However, it is difficult to explain our finding of a positive impact of host country unit labor costs for intra-firm imports from there. This result might reflect the low direct substitutability of affiliate locations and imports from there. Another reason might be found in the low level but high growth of unit labor costs in Central and Eastern Europe. Obviously, these countries are still on their transition path and MNEs do not have an incentive to relocate plants despite the rising costs there.

For intra-firm goods transactions, trade impediments seem less important than for overall goods trade, according to the structural form estimates in Table 1. This can be seen from the insignificant export and import openness coefficients in both equations. The low sensitivity of intra-firm trade with respect to trade openness could also indicate the prevalence of transfer-pricing to avoid tariffs or that tariff levels in manufacturing are already low in general. A higher share of greenfield investments is associated with less intra-firm exports but more intra-firm imports by the parent. The corresponding parameter in the imports equation is only marginally significant. This finding is partly at odds with that of Andersson and Fredriksson (2000). They find a negative impact for both intra-firm exports and imports in a sample of Swedish MNEs (note that they use the share of acquisitions rather than that of greenfield investments in total investments). Our result may indicate that newly established plants abroad are mainly low-cost seeking, producing the intermediates locally at lower costs. The other explanatory variables are obviously of minor importance.

Table 2: Wald Tests on Joint Contribution of Variables (Based on the Iterated 3SLS in Table 1)

Blocks of variables	Degr. of freedom	χ^2-statistic	P-value
Endogenous variables (ln X_{ijkt}, ln M_{ijkt})	2	31,62	0,000
Apparent consumption (ln S_{ikt}, ln S_{jkt})	4	22,23	0,000
Unit labor costs (ln c_{ikt}, ln c_{jkt})	4	27,88	0,000
Trade openness (x_{ikt}, x_{jkt}, m_{ikt}, m_{jkt})	4	1,57	0,815
Other continuous variables (g_{ijkt}, N_{ijkt}, p_{ijkt})	4	5,54	0,237

According to the Wald-tests in Table 2, the major contribution under iterated 3SLS comes from three blocks of variables: the endogenous ones suggested by Yi (2003), and the size and cost variables motivated by the models of Markusen (2002) and Grossman, Helpman and Szeidl (2003). The other variables are of less importance.[8] The tests in Table 2 refer to the structural model estimated in Table 1. However, these tests only give an insight into the immediate consequence of a shock in, e.g., unit labor costs, on intra-firm exports and imports. The fact that intra-firm exports and imports are strongly interdependent leads to the question of the overall (direct and indirect) consequences of a change in one of the exogenous determinants. Define the matrix of the two endogenous variables' parameters as

$$\mathbf{B} = \begin{pmatrix} 0 & \alpha_1 \\ \beta_1 & 0 \end{pmatrix}$$

and let

$$\mathbf{D} = (\mathbf{I} - \mathbf{B})^{-1} = \begin{pmatrix} d_{11} & d_{12} \\ d_{21} & d_{22} \end{pmatrix}$$

denote the multiplier matrix, capturing the magnification effects associated with Yi (2003) type trade. In our case, all elements in ***D*** are positive and real. The total effect on intra-firm exports of a shock in, say, Austrian apparent consumption $ln\ S_{ikt}$ (a variable that directly affects both intra-firm exports and imports) is $(d_{11}\alpha_2 + d_{12}\beta_2)\cdot\Delta ln\ S_{ikt}$. The corresponding total effect on intra-firm imports is $(d_{21}\alpha_2 + d_{22}\beta_2)\cdot\Delta ln\ S_{ikt}$. The impact on intra-firm exports of a determinant such as Austrian export openness x_{ikt} that exhibits no direct effect on intra-firm imports is $d_{11}\alpha_6\cdot\Delta x_{ikt}$. However, there is also an indirect effect on intra-firm imports of $d_{21}\alpha_6\cdot\Delta x_{ikt}$.

We report the total effect of all explanatory variables in Table 3. Additionally, we compute the importance of the direct effect relative to the total impact. Since all elements in $\boldsymbol{D}$ are positive and the parameters of variables like $ln\ S_{ikt}$ exhibit the opposite sign in the export and import equation, their total effect on either type of intra-firm trade is not clear-cut, if their sign differs in the two equations. For all variables that enter in both the export and import equation, the total (direct plus indirect) effect deviates considerably from its direct counterpart. The point estimates of apparent consumption ($ln\ S_{ikt}$, $ln\ S_{jkt}$) and unit labor costs ($ln\ c_{ikt}$, $ln\ c_{jkt}$) enter at least marginally significantly in the export equation. They only play a minor role for Austrian intra-firm imports. However, the point estimates for $ln\ S_{ikt}$ and $ln\ S_{jkt}$ in the import equation support the arguments put forward in Grossman, Helpman and Szeidl (2003), but they are insignificant.

Austrian trade policy is proxied by the import openness at the industry level. We associate lower tariffs and trade costs with a higher level of overall import openness. The results in Table 3 point to a pronounced negative impact of increased industry-level openness in Austria on its intra-firm trade in general. Again, this could indicate the prevalence of transfer pricing practices by MNEs. If tariffs and transport costs get lower, competition for MNEs gets harder, because it then pays off also for national firms to serve foreign markets via exports. Similar to its direct impact, a higher share of greenfield investments leads to less intra-firm trade.

Despite their insignificant direct effects, higher numbers of foreign affiliates per headquarters are associated with more intra-firm trade. A higher level of foreign affiliate sales per employee tends to reduce intra-firm trade. The latter can be interpreted as a negative association of pricing of the affiliate, i.e., its productivity or costs, with intra-firm trade, given the average costs and productivity at the industry level. It is noteworthy that intra-firm imports are mainly determined by variables that could not be precisely estimated in the structural form equations of Table 2. This underpins the non-

[8] Nevertheless, they serve as relevant and valid instruments in one or both of the equations as indicated in Table 1.

Table 3: Total Marginal Effect of Exogenous Variables (Based on the Iterated 3SLS Parameters in Table 1)

Exogenous determinant	Log exports		Log imports	
	Total effect	% of which is direct	Total effect	% of which is direct
Austrian apparent consumption: ln S_{ikt}	-3,503***	99	-0,047	-12847
	0,000		0,969	
Host's apparent consumption: ln S_{jkt}	0,733***	68	0,619 #	-107
	0,001		0,103	
Austrian unit labor costs: ln c_{ikt}	-4,949***	107	0,960	1001
	0,000		0,569	
Host's unit labor costs: ln c_{jkt}	-0,867 #	155	1,242	222
	0,143		0,200	
Austrian export openness: x_{ikt}	1,463	33	2,555	0
	0,474		0,422	
Host's export openness: x_{jkt}	-0,672	0	-1,760	33
	0,413		0,314	
Austrian import openness: m_{ikt}	-1,733 #	0	-4,542**	33
	0,130		0,011	
Host's import openness: m_{jkt}	1,056	33	1,843	0
	0,206		0,245	
Share of Austrian greenfield investments in host: g_{ijkt}	-0,343***	93	-0,060	-893
	0,010		0,782	
Number of Austrian foreign affiliates in host: N_{ijkt}	0,060***	33	0,105***	0
	0,000		0,000	
Sales per employee of Austrian foreign affiliates in host: p_{ijkt}	-0,021**	33	-0,036**	0
	0,028		0,033	

Notes: Figures below coefficients are p-values. *** significant at 1%; ** significant at 5%; * significant at 10%; # significant at 15%.

trivial impact of mutual interdependence of exports and imports and the importance of our exercise to compute the total effects. Further, the major determinants of intra-firm imports are only weakly supported by the text-book models of trade and multinationals, motivating further theoretical research on intra-firm trade in general equilibrium models of MNEs. Specifically, distinguishing between greenfield investment and mergers and acquisitions could provide important new insights into the determinants of intra-firm trade.

5 Sensitivity analysis

Regarding the above estimation results, several issues concerning their robustness need to be addressed. First, one could argue that the findings might be sensitive to the use of apparent consumption as a measure of economic size at the industry level. In particular, since we focus on intra-firm trade that to an important extent should be in intermediate goods, gross production might be seen as a reasonable alternative measure of industry-level economic size. We summarize the results of the iterated 3SLS regression to the left in Table 4, using industry gross production available from the OECD STAN-database instead of apparent consumption.[9] However, our findings for the relative magnitude of the coefficients and their signs seem insensitive with respect to this choice. Moreover, the explanatory power of this model is inferior as compared to the original one summarized in Table 1.

[9] For convenience, we use gross production as a measure of size throughout in Table 4.

Table 4: Sensitivity Analysis of the Iterated 3SLS Model

Explanatory variables	Gross production instead of apparent consumption		Exclude Post-Ratification of Europe Agreements (after 1994 for Hungary and after 1995 for Czech Republic and Slovak Republic)		Include Iceberg trade costs	
	Log exports	Log imports	Log exports	Log imports	Log exports	Log imports
Austrian intra-firm exports of goods to host: ln X_{ijkt}	-	1,191***	-	1,304***	-	1,154***
	-	3,58	-	3,60	-	3,75
Austrian intra-firm imports of goods from host: ln M_{ijkt}	0,696**	-	0,518	-	0,826***	-
	2,38	-	1,37	-	2,69	-
Austrian gross production instead of apparent consumption: ln S_{ikt}	-2,946***	3,493**	-3,802***	5,305***	-2,525**	2,887**
	-3,19	2,46	-2,88	2,74	-2,52	2,02
Host's gross production instead of apparent consumption: ln S_{jkt}	0,421	-0,472	0,461	-1,012	0,271	-0,297
	1,01	-0,82	0,57	-1,15	0,56	-0,53
Austrian unit labor costs: ln c_{ikt}	-5,264***	6,455***	-6,131***	8,756***	-5,515***	6,395***
	-3,40	2,88	-3,27	3,13	-3,31	2,93
Host's unit labor costs: ln c_{jkt}	-1,744*	2,235*	-2,144*	3,004	-1,884*	2,211**
	-1,85	1,95	-1,79	1,60	-1,85	1,97
Austrian export openness: x_{ikt}	0,669	-	1,461	-	0,202	-
	0,57	-	1,22	-	0,17	
Host's export openness: x_{jkt}	-	-0,401	-	-1,074	-	-0,124
	-	-0,62	-	-0,50	-	-0,19

Table 4 (continued): Sensitivity Analysis of the Iterated 3SLS Mode

Austrian import openness: m_{ikt}	-	-0,952	-	-1,643	-	-0,252
	-	-0,83	-	-1,19	-	-0,23
Host's import openness: m_{jkt}	0,298	-	0,023	-	0,100	-
	0,42	-	0,04	-	0,12	-
Iceberg trade costs for Austrian exports: τ_{ijkt}	-	-	-	-	-0,021	-
	-	-	-	-	-0,14	-
Iceberg trade costs for Austrian imports: τ_{jikt}	-	-	-	-	-	-0,005
	-	-	-	-	-	-0,10
Share of Austrian greenfield investments in host: g_{ijkt}	-0,294	0,346	-0,544**	0,672	-0,272	0,310
	-1,53	1,25	-2,32	1,58	-1,27	1,15
Number of Austrian foreign affiliates in host: N_{ijkt}	0,013	-	0,025	-	0,004	-
	0,51	-	0,64	-	0,16	-
Sales per employee of Austrian foreign affiliates in host: p_{ijkt}	-0,004	-	-0,008	-	-0,001	-
	-0,45	-	-0,52	-	-0,14	-
Number of observations	301	301	234	234	291	291
Number of host-industry pairs	37	37	25	25	35	35
R^2	0,808	0,710	0,844	0,703	0,767	0,719
Root mean square error	0,907	1,214	0,817	1,307	0,998	1,189
Time effects (p-value of F-statistic)	0,001***	0,039**	0,000***	0,037**	0,071*	0,203
Host-industry effects (p-value of F-statistic)	0,000***	0,000***	0,000***	0,000***	0,000***	0,000***
Over-identification (p-value of Sargan χ^2-statistic)	0,627	0,217		0,677		

Notes: Figures below coefficients are t-statistics. *** significant at 1%; ** significant at 5%; * significant at 10%. The H0 of a zero correlation of the two equations is rejected at the 1% level according to the Honda-test with in each of the estimated models. The corresponding test-statistics are 17.304, 15.127, and 17.056, respectively. These statistics are distributed as N(0,1).

Further, Yi's (2003) model provides a hypothesis which we did not test for so far. Namely, the sensitivity of trade with respect to trade liberalization should rise with the relative importance of intermediate goods trade. However, with our small dataset this is difficult to infer for two reasons. First, most of the bilateral intra-firm trade relations in our sample are not impeded by tariffs. Specifically, this holds true for Austria's trade with Germany and the EU13 economies; additionally, tariffs were successively eliminated for trade with Hungary, Czech Republic and Slovak Republic. Second, it is difficult to collect data on tariff measures for all involved countries and years. Therefore, we address this issue indirectly and exclude the intra-firm trade observations after the establishment of the Europe Agreements with Hungary, Czech Republic, and Slovak Republic. The second bloc of results in Table 4 summarizes our findings (again, we use gross production as the measure of size). In this sub-sample of observations, the interconnectedness of intra-firm exports and imports is higher.[10] According to Yi, we would expect trade to react more sensitively to trade liberalization in this case. We should emphasize that we focus on intra-firm trade only and the corresponding (trade openness) parameters are not significant in Table 4. However, the direction of change in the point estimates of the corresponding parameters seems consistent with Yi's hypothesis.

Finally, one could argue that the used measures of trade openness do not only reflect tariff-type trade costs but, at the very least, also iceberg type impediments to trade. Again, we need to mention that tariff measures of trade for the whole sample of countries, industries and years are not available. However, we can compute cost-insurance-freight over free-on-board (c.i.f./f.o.b.) measures of overall goods trade between Austria and the 5 blocks of economies. For this, we use the U.N. World Trade Database and Haveman's correspondence tables to derive bilateral trade figures at both c.i.f. and f.o.b. for both Austrian exports and Austrian imports (i.e., exports of the relevant partner economies). To include these iceberg measures of trade costs means narrowing the scope of the included openness measures. After controlling for iceberg

[10] Note that we observe a small annual decline of intra-firm trade in our data base according to the descriptive statistics. The elimination of post-Europe-Agreement observations means to focus on

trade costs, the openness variables should be more directly associated with policy impediments to trade such as tariffs.[11] In our dataset, it turns out that industry-level bilateral iceberg trade costs do not enter significantly in the regressions. Accordingly, the point estimates of the other variables are affected only to a minor extent as compared to the original ones in Table 1 or those in the first block of results reported in Table 4.

6 Conclusions

Intra-firm trade has emerged to an important component of international trade flows in the recent decade. Based on hypotheses derived from general equilibrium models of trade and multinationals, we analyze the determinants of Austrian intra-firm trade in goods and components. Thereby, we concentrate on the five most important host country groups including relatively rich ones like Germany, the U.S. and Canada but also low-wage transition countries (Hungary, Czech Republic, and Slovak Republic) and analyze the corresponding intra-firm trade flows at the industry level over the period 1989-2001.

Following Yi (2003), we pay specific attention to the magnification effect. With deeper international fragmentation of production components are shipped back and force, crossing borders several times. This requires modeling intra-firm exports and imports in a simultaneous equation framework. Our estimates provide strong support for the magnification effect. Market size and unit labor costs are important determinants of intra-firm exports, grossly supporting the general equilibrium models of Markusen (2002) and Grossman, Helpman and Szeidl (2003). In contrast, intra-firm imports are mainly driven by Austria's openness to trade, the relative importance of greenfield foreign direct investment, and the average number of affiliates per headquarters in a given host.

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earlier years on average. In these years, the average annual change in intra-firm trade in the sample is also higher.

[11] We are well aware of the criticism with respect to c.i.f./f.o.b. trade costs (see Hummels and Lugovskyy, 2004, for a survey). One way to overcome the measurement error in c.i.f./f.o.b. data, would be to use instrumental variables. Limao and Venables (200?) suggest using infrastructure variables among others. However, at the industry level such variables are not available. Also, in our case this would increase the number of simultaneous equations, potentially leading to convergence problems with the iterations.

References

Andersson Thomas and Torbjörn Fredriksson, 2000. Distinction between intermediate and finished products in intra-firm trade, International Journal of Industrial Organization 18 (5), 773-792.

Carr David, Markusen, James R., and Keith E. Maskus, 2001. Estimating the knowledge-capital model of the multinational enterprise. American Economic Review 91, 693-708.

Feinberg, Susan E. and Michael P. Keane, 2003. Accounting for the growth of MNC-based trade using a structural model of U.S. MNCs, unpublished manuscript, Yale University.

Greene, William H., 2003. Econometric Analysis, 5th edition, Prentice Hall, New York.

Grossman, Gene M.,Helpman, Elhanan, and Adam Szeidl, 2003. Optimal integration strategies for the multinational firm, NBER Working paper 10186.

Hausman, Jerry A., 1978. Specification tests in econometrics. Econometrica 46, 1251-1271.

Helpman, Elhanan, 1985. Multinational corporations and trade structure. Review of Economic Studies 52, 443-458.

Helpman Elhanan, 1984. A simple theory of international trade with multinational corporations. Journal of Political Economy 92, 451-472.

Helpman Elhanan and Paul R. Krugman, 1985. Market Structure and Foreign Trade. MIT Press, Cambridge, Mass.

Hummels , David, Ishii, Jun, and Kei-Mu Yi, 2001. The nature and growth of vertical specialization in world trade. Journal of International Economics 54, 75-96.

Hummels, David and Volodymyr Lugovskyy (2004), Usable data? Matched partner trade statistics as a measure of international transportation costs, Review of International Economics, forthcoming.

Hummels, David, Rapoport, Dana, and Kei-Mu Yi, 1998. Vertical specialization and the changing nature of world trade. Federal Reserve Bank New York Econonomic Policy Review 4, 79-99.

Limao, Nuno and Anthony J. Venables (2001), Infrastructure, deographical disadvantage, transport costs and trade, World Bank Economic Review 15(3) pp.451-479.

Markusen, James R., 1984. Multinationals, multi-plant economies, and the gains from trade. Journal of International Economics 16, 205-226.

Markusen, James R. and Keith E. Maskus, 2002. Discriminating among alternative theories of the multinational enterprise. Review of International Economics 10, 694-707.

Markusen, James R. and Anthony J. Venables, 2000. The theory of endowment, intra-industry, and multinational trade. Journal of International Economics 52, 209-234.

Rangan, Subramamian, 2001. Explaining the tranquility in the midst of turbulence: U.S. multinationals' intrafirm trade, 1966-1997. BLS Working Papers No. 336.

Yi, Kei-Mu, 2003. Can vertical specialization explain the growth of world trade? Journal of Political Economy 111, 52-102.

Zeile, William, 1997. U.S. intrafirm trade in goods. Survey of Current Business 77, 23-38.

Zejan, M.C., 1989. Intra-firm trade and Swedish multinationals. Weltirtschaftliches Archiv 125, 814-833.

Appendix

Table A1: Descriptive Statistic

Variables	Mean	Std. dev.	Minimum	Maximum
Austrian intra-firm exports of goods to host: ln X_{ijkt}	4,690	2,074	-3,124	8,337
Austrian intra-firm imports of goods from host: ln M_{ijkt}	2,783	2,257	-4,200	7,840
Austrian apparent consumption: ln S_{ikt}	9,174	0,699	8,006	10,828
Host's apparent consumption: ln S_{jkt}	12,515	1,241	9,889	15,212
Austrian unit labor costs: ln c_{ikt}	-0,433	0,114	-0,851	-0,266
Host's unit labor costs: ln c_{jkt}	-0,432	0,183	-1,235	0,042
Austrian export openness: x_{ikt}	0,566	0,222	0,076	0,928
Host's export openness: x_{jkt}	0,397	0,204	0,058	1,330
Austrian import openness: m_{ikt}	0,636	0,313	0,118	1,249
Host's import openness: m_{jkt}	0,406	0,278	0,058	1,802
Share of Austrian greenfield investments in host: g_{ijkt}	0,432	0,403	-0,811	3,126
Number of Austrian foreign affiliates in host: N_{ijkt}	11,847	7,947	1,000	40,000
Sales per employee of Austrian foreign affiliates in host: p_{ijkt}	2,859	4,275	0,012	49,423

Note: 301 observations.

Table A2: Average Annual Log Change in Austrian Intra-Firm Trade 1989-2001

Industry	Germany	EU 13	USA and Canada	Hungary	Czech Republic and Slovak Republic
			Exports		
Mining and quarrying	-	-	-	0,10	-0,63
Food products; beverages and tobacco	0,12	0,18		0,00	-0,43
Textiles and textile products	-0,13	-0,15	0,20	0,20	0,07
Wood and wood products	-0,22	-0,02	-	-0,21	0,08
Pulp, paper & paper products; publishing & printing	0,14	-	-0,07	-0,15	-1,43
Chemicals, chemical products and man-made fibres	-0,29	-0,19	-0,10	0,48	0,03
Other non-metallic mineral products	-0,22	-0,29	-0,23	-0,03	-0,01
Basic metals and fabricated metal products	-0,05	-0,26	0,07	-0,12	0,05
Machinery and equipment n.e.c.	-0,21	-0,09	-0,17	-0,02	0,17
Electrical and optical equipment	-0,14	-0,10	-0,11	-0,17	0,05
Transport equipment	-	-	-	-0,22	-
Manufacturing n.e.c.	-0,13	-0,19	0,00	-1,41	-0,21
Total	-0,11	-0,12	-0,05	-0,13	-0,20
			Imports		
Mining and quarrying	-	-	-	1,10	0,12
Food products; beverages and tobacco	0,08	0,21	-	-0,01	-0,07
Textiles and textile products	-0,23	-0,44	-0,11	0,14	0,25
Wood and wood products	-0,22	1,21	-	-0,37	-0,07
Pulp, paper & paper products; publishing & printing	-0,28	-	-0,07	-0,25	0,26
Chemicals, chemical products and man-made fibres	-0,08	-0,56	-0,31	0,10	0,13
Other non-metallic mineral products	-0,21	-0,27	-0,64	0,08	0,13
Basic metals and fabricated metal products	-0,15	-0,32	-0,82	0,02	-0,07
Machinery and equipment n.e.c.	-0,11	0,25	-0,16	0,34	0,13
Electrical and optical equipment	0,08	-0,39	-0,10	0,38	-0,02
Transport equipment	-	-	-	-0,75	-
Manufacturing n.e.c.	-0,49	-0,40	0,68	-1,73	-0,07
Total	-0,16	-0,08	-0,19	-0,08	0,06

Note: EU13 is defined as EU15 as of 1995, but excluding Austria and Germany.

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