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A UNIFIED APPROACH TO INTRA-INDUSTRY TRADE AND DIRECT FOREIGN INVESTMENT

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ABSTRACT

Economic interactions among the high-income developed countries are characterized by high degrees of both intra-industry trade and intra-industry affiliate production and sales. Similar high-income countries both heavily trade with and invest into each other. The purpose of this paper is to show how the theory of direct investment can now be integrated with the theory of international trade in goods, and to show how the two combine to determine the pattern of trade and foreign affiliate production. Empirical estimation gives good support to the predictions of the theory for intra-industry affiliate sales, with somewhat weaker results for intra-industry trade. Results confirm that the intra-industry affiliate sales index rises relative to the intra-industry trade index as countries become richer and more similar in size and in relative endowments.

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1. Introduction

The theory of international trade has long been relatively disjoint from the theory of direct foreign investment, the latter traditionally viewed as part of the macroeconomic theory of capital flows. The foreign investment "regime" (e.g., restricted, liberal) could of course affect trade in this view, but only through changing the host country's capital stock. This conceptual approach to direct investment began to break down in the 1980's as researchers noted direct investment seemed more related to firm-specific assets than to measures of aggregate capital. Firms in the developed countries penetrated each other's markets with intra-industry direct investment, and the directions of investment did not seem to bear any particular relationship to interest rates or other measures of returns to capital. Other studies refined the evidence by showing that direct investment was closely related to knowledge-based and other intangible assets and not related to physical capital intensity.[1]

We have now come to appreciate direct investment as quite different from portfolio capital flows, and our theoretical understanding of FDI has become more closely related to real trade theory than to international finance. It might be best to think of a firm's decision to build or acquire a foreign factory as a "real" side decision, with the decision of where and how to raise financial capital for the factory as a separate and distinct decision. Financial capital sometimes comes from the parent country, sometimes from the host country, and sometimes it is raised on world markets in a manner that makes it difficult to define its origin.

In this paper, we will concentrate on the "real" side of direct investment; that is, decisions on the location of production and sales by firms. We will try to integrate these choices with a trade model, permitting firms to serve foreign markets by either exports or branch-plant

production, or indeed to serve the home market by exports from the foreign branch plant. This permits a much-needed integration of trade and investment theories and is particularly important in discussions of intra-industry trade and the "new trade theory" (the industrial-organization approach to trade). These two literatures have generally ignored the role of multinational firms, even though most of the industries that are widely cited as examples of the new trade theory are dominated by multinational firms.

The next section of the paper provides a few statistics on intra-industry trade and intra-industry affiliate sales (sales by the foreign affiliates of multinational firms). We use real affiliate sales rather than investment stocks or flows, because the latter are a conceptual mismatch when compared to trade flows.

Section three of the paper outlines a formal general-equilibrium model with endogenous multinational firms, and notes how Grubel-Lloyd intra-industry trade (IIT) indices and intra-industry affiliate sales (IIAS) indices depend on country characteristics and the restrictiveness of the trade and investment regimes.

The results of section three provide hypotheses for econometric testing and estimation in section four. We relate IIAS and IIT indices to their theoretical determinants, including joint market size, differences in market size, differences in skill endowments, and the costs of engaging in investment and trade. The IIAS regressions fit the theory very well. The index grows higher as two countries become more similar in size and in relative endowments. The IIT regressions fit somewhat less well, but generally support the theory. A final set of regressions use the ratio of the IIAS to the IIT index as the dependent variable. The results suggest that "balanced" (high index) affiliate activity, much more so than trade, is encouraged by higher

incomes and country similarity in terms of size and labor-force composition.

2. IIT and IIAS indices

We will use indices for trade and affiliate activity following the formula developed by Grubel and Lloyd (1975). The IIT index is defined as follows, for industry i and countries j and k. $Exports_{ijk}$ are exports from j to k and $imports_{ijk}$ are imports into j from k in industry i.

$$IIT_{ijk} \quad \left[1 \quad \frac{|\, exports_{ijk} \quad imports_{ijk} \,|}{exports_{ijk} \quad imports_{ijk}} \right] \; 100 \tag{1}$$

The IIT index ranges from a low of zero, when trade in one way only, to a value of 100 when trade is perfectly balanced. The IIAS index is similarly defined, where AS_{ijk} are industry i affiliate sales by affiliates in country k of country j parent firms

$$IIAS_{ijk} \quad \left[1 \quad \frac{|\, AS_{ijk} \quad AS_{ikj} \,|}{AS_{ijk} \quad AS_{ikj}} \right] \; 100 \tag{2}$$

Our data set covers the United States and ten countries or regions: Canada, France, Germany, Netherlands, Switzerland, the UK, Australia, Japan, Other Asia-Pacific, and Latin America. The industrial sectors are total manufacturing and seven broad sub-categories: food and kindred products (FOOD), chemicals (CHEM), primary metals (PRIM), machinery (MACH), electrical machinery (ELEC), transport equipment (TRAN), and other manufacturing (OTHE). In the econometric estimation in Section 4 we employ data for three years: 1988, 1991, and 1994. The affiliate sales data are from the United States Bureau of Economic Analysis. One

unfortunate feature of these data is that all observations are bilateral with the United States. Thus, for example, Germany-UK activity is not available and the United States is always one side of each observation.

Table 1 presents the IIAS and IIT indices for 1987 and 1997 (TMFG is total manufacturing). Because these are highly aggregated industrial sectors and the figures are averaged across all countries, the indices are quite high. For most sectors intra-industry sales ratios exceeded intra-industry trade ratios in 1987, except for machinery and transport equipment. The sales and trade indexes came closer together by 1997.

Because we are interested in the evolution of intra-industry activity, in Table 2 we present some comparative statistics. In the top panel of Table 2, we show the change in the IIAS and IIT indices between 1987 and 1997. The IIT index for total manufacturing rose more than its counterpart IIAS index and substantial variation across industries is shown.

The bottom section of Table 2 shows the percentage change in the IIAS index minus the percentage change in the IIT index between 1987 and 1997 and then shows a similar statistic for the changes in the levels of total (two-way) affiliate sales and total trade. The statistics indicate that the IIAS index grew somewhat slower than the IIT index over the period except in machinery and transport equipment. However, the right-hand numbers indicate that the level of affiliate activity grew faster than the level of trade for total manufacturing. Considering the results at the bottom of Table 2, we can say that affiliate activity grew faster than trade over the period, but trade became somewhat more balanced than affiliate activity. It is thus important to keep in mind that the indices of intra-industry activity measure proportions and say nothing about volumes. Affiliate activity in the food, electrical machinery, and transport equipment industries

grew much faster than trade, but affiliate activity became more balanced relative to trade in the machinery and transport equipment industries.

3. A General-Equilibrium Model of Trade and Affiliate Activity

Consider the two-country, two-good, two-factor general-equilibrium model developed in Markusen (1998b) as an extension of Markusen and Venables (1998, 2000). The principal features of the model are as follows. First, there are two homogeneous Goods, X and Y, two countries, h and f, and two factors, unskilled labor L and skilled labor S. Second, the Y sector is competitive, has constant returns to scale, and is L-intensive. Third, the X sector is imperfectly competitive, has increasing returns to scale, and is S-intensive overall. In this good, "headquarters and "plant" may be geographically separated. Thus, firms may have plants in one or both countries

Fourth, there are six firm types, with free entry and exit into and out of firm types. Permit *regime* to denote a set of firm types active in equilibrium.

Type m_h - horizontal multinationals that maintain plants in both countries and headquarters are located in country h.

Type m_f - horizontal multinationals that maintain plants in both countries and headquarters are located in country f.

Type n_h - national firms that maintain a single plant and headquarters in country h. Type h firms may or may not export to country f.

Type n_f - national firms that maintain a single plant and headquarters in country f. Type f firms may or may not export to country h.

Type v_h - vertical multinationals that maintain a single plant in country f and headquarters in country h. Type v_h firms may or may not export to country h.

Type v_f - vertical multinationals that maintain a single plant in country h and headquarters

in country f. Type v_f firms may or may not export to country f.

Fifth, good X is homogeneous, firms engage in Cournot competition, and the h and f markets are segmented. Sixth, a firm's markup over marginal cost is decreasing in its market share. This creates a "reciprocal dumping" motive for intra-industry trade and investment. Seventh, there are firm-level scale economies arising from the joint-input ("public good") nature of knowledge-based assets, as well as plant-level scale economies. Finally, the factor-intensity assumptions of the various activities, ranked from most skilled-labor-intensive to least skilled-labor-intensive, are:

[headquarters only] > [integrated X] > [plant only] > [Y]

The firm-level scale economies create a motive for horizontal multinationals, which spread the fixed costs of knowledge capital across multiple plants. The different factor intensities between activities combined with the different factor endowments (and prices) across countries create a motive for vertical firms. We now describe circumstances under which one firm type is encouraged relative to another in equilibrium.

National Firms

National firms wish to locate in the larger market (to save transport costs) and/or the skilled-labor abundant country (for factor-price motives). The number of firms in the two countries will be relatively balanced, and hence the IIT index higher, if the countries are relatively similar, or if the smaller country is skilled-labor abundant, and trade costs are low.

Horizontal Firms

Horizontal multinationals will be more important when trade costs are high, the countries are relatively similar in size and in relative endowments, and total income is high (for then firms

bear the fixed costs of branch plants instead of the variable costs of exports). The location of a firm's headquarters depends only on factor prices (but these are influenced by the location of production in general equilibrium). Intra-industry affiliate sales should be highest when the countries have very similar endowments (headquarters' locations are balanced) and when the countries are relatively similar in size and trade costs are high (type-m firms are important).

Vertical firms

Vertical firms will be important when the countries have very different relative endowments and trade costs are relatively low. We have included a small cost to fragmenting the headquarters and plant, so that other things equal, a type-v firm has higher costs than a type-n firm. The consequence of this is that there will never be type-v firms operating in both countries. One type-v firm from each country could be replaced by one type-n in each country, and the same output could be generated with lower costs. Combining this notion with the previous result, we do not expect intra-industry affiliate sales when the countries have quite different relative factor endowments.

What do these general results imply about the relationship of the IIT and IIAS indices to each other and to country characteristics? Clearly, if countries are quite similar and trade costs are moderate to high, then we would expect type-m firms to substitute for trade. Similarly, if countries grow in total income, we expect horizontal firms to substitute for trade (due to plant-level scale economies).

Figures 1 to 6 illustrate contours for the levels of IIT and IIAS indices over the "world" (two-country) Edgeworth box. On the horizontal axis is the total two-country endowment of unskilled labor and the vertical axis is the total two-country endowment of skilled labor. The

origin for country h is at the southwest (SW) corner of the box and the origin for country f is at the northeast (NE) corner of the box. For points along the SW-NE diagonal, the countries differ in relative size but not in relative endowments. The line of approximately equal incomes, in which countries differ in relative endowments but not in size, is steeper than the NW-SE diagonal, and runs from approximately column 9 to column 11 through the center of the box.

We simulate the model repeatedly over a grid of endowment values, solving for the equilibrium regime and trade pattern for each point in the box. Then we compute IIT and IIAS indices for each solution. These are then plotted in Figures 1-6. Four different combinations of trade and investment restrictions are considered.

1. NL involves no liberalization and includes high trade costs (20%) and a prohibition on FDI.
2. TL involves trade liberalization, adopting low trade costs (1%) and a prohibition on FDI.
3. IL involves investment liberalization, permitting FDI but maintaining high trade costs (20%).
4. FL involves both trade and investment liberalization.

Figure 1 shows the intra-industry trade index under NL (trade costs 20%, multinationals prohibited). Intra-industry trade occurs when the countries are very similar, or when the smaller country is skilled-labor abundant. Because good X has increasing returns to scale and is skilled-labor intensive, size and skilled-labor abundance are both sources of comparative advantage in that sector. These results will be used in the specification of the regression equations in the next section.

Figure 2 shows the IIT index with trade costs reduced to 1% and multinationals still prohibited. The effect of trade liberalization is to increase the areas where intra-industry trade occurs, but the same general pattern holds: the IIT index is high when countries are similar or

when the small country is skilled-labor abundant.

Figure 3 plots the IIT index under the investment liberalization (IL) experiment, retaining high trade costs. Intra-industry trade almost entirely disappears. Near the center of the box, type-n firms are replaced by type-m firms so that there is in fact no trade in good X. In the region where the small country is skilled-labor abundant, type-v firms headquartered in that country dominate. Thus, headquarters are located there and plants are located in the large, unskilled-labor-abundant country.

Figure 4 plots the IIT index under the full liberalization (FL) scenario. Due to plant-level scale economies, type-m firms are not active near the center of the box, and there is once again intra-industry competition between type-n firms located in the two countries. The other regions where the index is high are where one country is very skilled-labor abundant, and of similar size or smaller than the other country. Consider the N-NW region of Figure 4. In this region, the dominant firms are type-n_h and type-v_h. Thus all firms are headquartered in country h, but there are plants in both countries and intra-industry trade occurs while (as noted below), intra-industry affiliate activity does not.

Figure 5 show the IIAS index under investment liberalization (IL) and trade costs at 20%. Positive IIAS occurs where countries are similar in relative endowments, and not too different in size. As the countries become very different in size, type-n firms headquartered in the large country come to dominate. Figure 6 shows the effect of doubling the world factor endowment. The region of intra-industry affiliate sales stretches to include countries that are more different in size, but not more different in relative endowments.

No intra-industry affiliate sales occur under the full liberalization (FL) scenario, so we

have not shown the IIAS index under FL. There are regions in which type-v firms are dominant under FL, but they are always headquartered in the skilled-labor abundant country. Thus there are no intra-industry affiliate sales, even though the level of multinational activity is high. As noted earlier, it is important to remember that the IIAS index is a measure of the *balance* of activity, not its *level*.

What are the general conclusions from the theory? Trade liberalization can increase the IIT index for many country pairs (compare Figure 1 to Figure 2). However, investment liberalization can largely eliminate IIT if trade costs are high (compare Figure 1 to Figure 3) or reduce IIT if trade costs are low (compare Figure 2 to Figure 4). We expect IIT to be highest when, on the one hand, the countries are similar in size or the small country is skilled-labor abundant and, on the other hand, when trade costs are low and investment costs are high.

We expect the IIAS index to be higher when the countries are similar in size and in relative endowments, trade costs are high, and investment costs are low. One final hypothesis not shown in a diagram relates to total world income. As the two-country total income rises, we expect a shift from intra-industry competition by type-n firms to intra-industry affiliate sales competition by type-m firms at points near the center of the box. Thus there is a hypothesis that a growth in total world income should increase the ratio of the IIAS index to the IIT index.

4. Empirical Results

The theory suggests hypotheses about how IIT and IIAS should be related to country characteristics. Thus, in our regression equations the dependent variables are the IIT index, the IIAS index, and the ratio IIAS/IIT. The country characteristics identified by our theory include

the following. First, SUMGDP is the sum of U.S. and country j GDP. This is a measure of joint market size. Second, GDPDIFSQ is the squared difference between U.S. and country j GDP. It captures similarity in size between partners and is squared in order to capture non-linearities in the indexes as we move toward the Northeast in the endowment box.

Third, SKDIFSQ is the squared difference between the share of the labor force that is skilled in the United States and the same share in country j. Differences in skill endowments play a strong role in the theory. Fourth, GDPDIF*SKDIF is an interaction term that is important in the IIT regressions. Next, INVCJ is an index of costs of investing in country j and TCJ

is an index of the costs of overcoming trade barriers in country j.

Data for the estimation form a panel of cross-country and cross-industry observations for the years 1988, 1991, and 1994. Again, the countries and regions involved are Canada, France, Germany, Netherlands, Switzerland, the UK, Australia, Japan, Other Asia-Pacific, and Latin America. We take real sales volume of non-bank manufacturing affiliates in each country to indicate production activity. The U.S. Department of Commerce, Bureau of Economic Analysis (BEA) provides annual data on sales of foreign affiliates of American parent firms and on sales of U.S. affiliates of foreign parent firms. Because the focus of our inquiry is intra-industry sales, we use the sectoral breakdown indicated in Table 1. Clearly it would be better to investigate data with far greater industry disaggregation but when BEA data on both outward and inward sales activity are combined the resulting number of sectors and partner countries or regions becomes severely limited.

The data are bilateral with the United States, which is either the parent country or the host country in every observation. Annual sales values abroad were converted into millions of 1990

U.S. dollars using an exchange-rate adjusted local wholesale price index, with exchange rates and price indexes taken from the *International Financial Statistics* (IFS) of the International Monetary Fund.

In our theory, intra-industry trade emanates from country characteristics. Thus, the appropriate usage is bilateral trade by sector rather than intra-firm trade. For this purpose, figures on bilateral U.S. exports to each trading partner, and U.S. imports from each trading partner, were compiled from the COMTRADE database, using the Standard International Trade Classification, version 2, and were aggregated to our sectoral classification.[2] Details of this aggregation are available on request. The exports and imports data were in current U.S. dollars and we converted them into millions of 1990 U.S. dollars.

Real gross domestic product is measured in billions of 1990 U.S. dollars for each country. For this purpose, annual real GDP figures in local currencies were converted into dollars using the market exchange rate. These data are also from the IFS. Skilled labor abundance is defined as the sum of occupational categories 0/1 (professional, technical, and kindred workers) and 2 (administrative workers) in employment in each country, divided by total employment. These figures were compiled from annual surveys reported in the *Yearbook of Labor Statistics* published by the International Labor Organization. In cases where some annual figures were missing, the skilled-labor ratios were taken to equal the period averages for each country. The variable SKDIFFSQ is the squared difference between relative skill endowment of the parent country and the affiliate country.

The cost of investing in the affiliate country is a simple average of several indices of perceived impediments to investment, reported in the *World Competitiveness Report* of the

World Economic Forum. The investment barriers include restrictions on the ability to acquire control in a domestic company, limitations on the ability to employ foreign skilled labor, restraints on negotiating joint ventures, strict controls on hiring and firing practices, market dominance by a small number of enterprises, an absence of fair administration of justice, difficulties in acquiring local bank credit, restrictions on access to local and foreign capital markets, and inadequate protection of intellectual property. The resulting indices are computed on a scale from zero to 100, with a higher number indicating higher investment costs.

A trade cost index was taken from the same source and is defined as a measure of national protectionism, or efforts to prevent importation of competitive products. It also runs from zero to 100, with 100 being the highest trade costs. All of these indices are based on extensive surveys of multinational enterprises. It should be noted that both the investment-cost and trade-cost indices are ordinal and qualitative in nature. Thus, regression coefficients represent the partial effects of a change in the average perceived costs of investing and trading.

The variables suggested above form the basic specifications we estimate. However, there is likely to be heterogeneity in effects across sectors and investment partners. Thus, we add industry effects in a second specification and industry effects and dummies for Japan and Canada in a third specification. Finally, due to the bilateral nature of the data the United States is one partner in each observation. Thus, the U.S. values of INVC and TC are constant for all observations and cannot provide independent information. Accordingly, impacts of the U.S. trade and investment costs are subsumed into the constant term.

In the IIT and IIAS regressions the dependent variable is limited in range from 0 to 100. Accordingly, ordinarily least squares is an inappropriate estimation technique. For this reason we

employ the standard logit approach for those equations. However, the equations involving the ratio IIAS/IIT are not so constrained in principle and we use OLS.

Table 3 shows the results for the regressions with intra-industry affiliate sales as the dependent variable. There were a number of industry-country cells for which data were suppressed, leaving a sample size of 181. For the IIAS regressions, the hypothesized sign on SUMGDP is positive following Figure 6. The hypothesized signs on GDPDIFSQ and SKDIFSQ are negative from the results in Figures 5 and 6. INVCJ should have a negative sign if two-way affiliate sales are relatively balanced at low investment costs. TCJ should have a positive sign, as type-m firms should substitute for type-n firms as trade costs in the host country rise.

In Table 3 there are six regressions listed. The first is the basic model without investment costs, trade costs, or industry and country effects. The second adds industry dummies and the third adds dummy variables for Japan and Canada. The final three regressions repeat this structure but include INVCJ and TCJ.

The results in Table 3 give good support to the theory, both in terms of correct signs and statistical significance, with coefficients that achieve at least 90 percent confidence shown in boldface. It is evident that market size, as captured by SUMGDP, exerts a positive and significant impact on IIAS. Thus, increases in size raise the ratio of two-way affiliate sales to total affiliate sales. In virtually all specifications GDPDIFSQ has a significantly negative effect on IIAS, as anticipated. Thus, the greater the dissimilarity in sizes the smaller the share of intra-industry sales. In the regressions without cost variables, SKDIFSQ also has a significant and negative effect on IIAS, consistent with the theory. The signs and significance of the central variables SUMGDP, GDPDIFSQ, SKDIFSQ are robust to the inclusion or exclusion of the

industry dummies and Japan and Canada dummies. We should note that the coefficient on the Japan dummy is always negative and usually significant, while that on the Canada dummy is always positive and significant. Industry fixed effects are also typically significant.

When the trade and investment cost variables are added, the results on SUMGDP and GDPDIFSQ remain intact. SKDIFSQ retains its appropriate sign but loses its statistical significance. Skill differences are positively correlated in our data with investment costs, which are higher in the developing countries. This collinearity explains the reduction in magnitude and significance of SKDIFSQ. As for INVCJ and TCJ themselves, their coefficients generally have the right signs. Investment costs clearly reduce incentives to engage in intra-industry affiliate activity. Overall, these results are very positive for the theory.

The IIT regressions in Table 4 have 264 observations because there are no missing observations in the trade data and we include total bilateral trade in addition to the sectoral flows. The results are less supportive of the theory. In principle, SUMGDP should have a negative sign as type-m firms replace type-n firms when total two-country income grows, and this holds in four of the six regressions. GDPDIFSQ and SKDIFSQ each should have negative signs. However, GDPDIFSQ comes out positive in four specifications. Note that it takes on the correct sign when idiosyncracies in the IIT flows with Japan and Canada are controlled with country dummies. As is well known, Japan displayed markedly low IIT ratios in its trade with the United States during our estimation period. Controlling for this unusual case we find that differences in GDP negatively affect intra-industry trade. Skill differences have consistently negative signs but do not achieve statistical significance in the explanation of IIT.

The interaction term GDPDIFF*SKDIFF should be negative. Figures 1, 2 and 4 suggest

that IIT should be high when one country is small and skilled-labor abundant, implying that IIT should be large when GDPDIFF*SKDIFF is negative. The interaction term always has the right sign and achieves statistical significance in three cases. Note that this variable performs better when investment and trade costs are included.

The INVCJ variables should be positive and the TCJ variable negative, and these hypotheses are generally confirmed in the data. Without controlling for Japan and Canada, we find that an increase in host-country investment costs significantly expands intra-industry trade. Again, however, Japanese history suggests an anomaly: it is costly to invest in Japan but there is relatively little IIT between the United States and that country.

In Table 5, the ratio IIAS/IIT is the dependent variable and there are 181 observations. Again, these are OLS regressions because the dependent variable may range without limit. Joint market size, or SUMGDP, should be positive as type-m firms displace type-n firms. This result is robust and powerful in the econometric estimates. The diagrams discussed above suggest that the impacts of SKDIFSQ should be negative, as they are. Thus, intra-industry sales rise in comparison with intra-industry trade as countries grow richer and are more similar in size.

However, the theory does not suggest a very sharp hypothesis with respect to GDPDIFSQ. An increase in the size difference should lower the ratio when countries have similar endowments (the numerator falls, the denominator is constant) but raise the ratio when the countries have different relative endowments (the numerator is constant, the denominator falls). Yet in spite of some theoretical ambiguity, the signs are consistently negative, even if significance levels are low. Thus, the IIAS index seems to grow relative to the IIT index as countries become more similar in relative endowments.

A puzzle is why the trade and investment cost variables have the wrong signs in Table 5 (although they always have very large standard errors) since they do well in the IIAS and IIT regressions and have opposite signs in those regressions. The results in tables 3 and 4 lead us to expect that the coefficients on INVCJ should be negative, and those on TCJ should be positive, in Table 5. Why they are not is unclear to us at this point.

5. Summary and Conclusions

The purpose of this paper is to present a unified model of intra-industry trade and intra-industry affiliate production and sales where the pattern of firm location, production, and trade are simultaneously and endogenously determined. This model is then used to generate predictions about how IIT and IIAS indices should be related to country characteristics and to trade and investment costs. The principal conclusions of the paper are as follows.

The IIAS regressions fit the theory very well. The index is higher as the two countries are richer and more similar in size and in relative endowments.

The IIT regressions fit less well. The sign on GDPDIFSQ is inconsistent, though it works as hypothesized when trade with Japan is controlled for. The interaction term between differences in country size and differences in relative endowments always has the correct sign is generally statistically significant.

While the theory regarding the ratio IIAS/IIT does not always give sharp predictions, the positive sign on the SUMGDP coefficient is robust. The ratio regressions suggest that balanced direct investment, much more than trade, is encouraged by higher incomes and country similarity in terms of size and labor-force composition. Note that skill differences could be considered also

a proxy for per capita income. This last result complements earlier findings in Carr, Markusen and Maskus (2001) and Markusen and Maskus (2001) that the *level* of affiliate sales rises with country incomes and with their similarity in size and in relative endowments. Combining the findings of those papers with the current analysis, we conclude that increased incomes and increased similarity in size and in relative endowments increases both the level of affiliate activity and the balance of affiliate activity between country pairs.

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ENDNOTES

[1]For recent surveys which provide many references to empirical findings, see Markusen (1995, 1998a) and Caves (1996).

[2] I am grateful to Frances Ng of the World Bank for providing these data.

Table 1. Grubel-Lloyd Indices

AFFILIATE SALES 1987		TOTAL TRADE 1987	
TMFG	73.4	TMFG	69.4
FOOD	71.3	FOOD	66.6
CHEM	97.4	CHEM	80.4
PRIM	82.3	PRIM	39.8
MACH	32.6	MACH	93.9
ELEC	93.6	ELEC	75.5
TRAN	17.2	TRAN	66.9
OTHE	93.0	OTHE	41.4

AFFILIATE SALES		TOTAL TRADE 1997	
TMFG	82.9	TMFG	84.4
FOOD	73.5	FOOD	86.1
CHEM	86.8	CHEM	86.5
PRIM	71.5	PRIM	68.5
MACH	52.3	MACH	93.2
ELEC	98.4	ELEC	90.9
TRAN	52.6	TRAN	86.9
OTHE	81.6	OTHE	63.0

Table 2. Changes in Grubel-Lloyd Indices for Affiliate Sales and Total Trade, 1987-97

	AFFILIATE SALES INDEX		TOTAL TRADE INDEX
TMFG	9.5	TMFG	14.9
FOOD	2.1	FOOD	19.6
CHEM	-10.7	CHEM	6.1
PRIM	-10.7	PRIM	28.6
MACH	19.7	MACH	-0.7
ELEC	4.8	ELEC	15.5
TRAN	35.4	TRAN	20.0
OTHE	-11.4	OTHE	21.6

	_____ΔIIAS/IIAS -		___ΔAS/AS - ΔT/T
TMFG	-5.4	TMFG	16.7
FOOD	-17.4	FOOD	69.8
CHEM	-16.7	CHEM	-60.4
PRIM	-39.4	PRIM	-6.3
MACH	20.4	MACH	-24.5
ELEC	-10.7	ELEC	52.3
TRAN	15.4	TRAN	98.3
OTHE	-33.0	OTHE	-29.0

Table 3. Intra-Industry Affiliate Sales Logit Regressions

RHS Variable	Basic (1)	Basic Ind. Dum. (2)	Basic Ind. Dum. J, C Dum. (3)	Basic INVC, TC (4)	Basic INVC, TC Ind. Dum. (5)	Basic INVC, TC Ind. Dum. J, C Dum. (6)
Constant	**48.9** (4.54)	**86.3** (14.8)	**86.1** (14.1)	**125.4** (12.2)	**112.8** (13.5)	**120.2** (14.3)
SUMGDP	**0.007** (3.71)	**0.004** (4.24)	**0.005** (4.26)	**0.006** (4.87)	**0.005** (4.92)	**0.007** (6.34)
GDPDIFSQ	-8.3e-7 (-1.28)	**-6.2e-7** (-1.90)	**-8.6e-7** (-2.07)	**-9.6e-7** (-2.25)	**-8.1e-7** (-2.56)	**-16.7e-7** (-4.28)
SKDIFSQ	**-2574** (-5.11)	**-1009** (-3.46)	**-867** (-3.01)	-178 (-0.50)	-429 (-1.50)	-172 (-0.61)
INVCJ				**-3.15** (-10.3)	**-1.05** (-3.53)	**-1.34** (-4.20)
TCJ				**0.64** (1.81)	-0.07 (0.82)	0.08 (0.25)
No. of Obs.	181	181	181	181	181	181
Adj. R^2	0.62	0.91	0.91	0.85	0.92	0.93

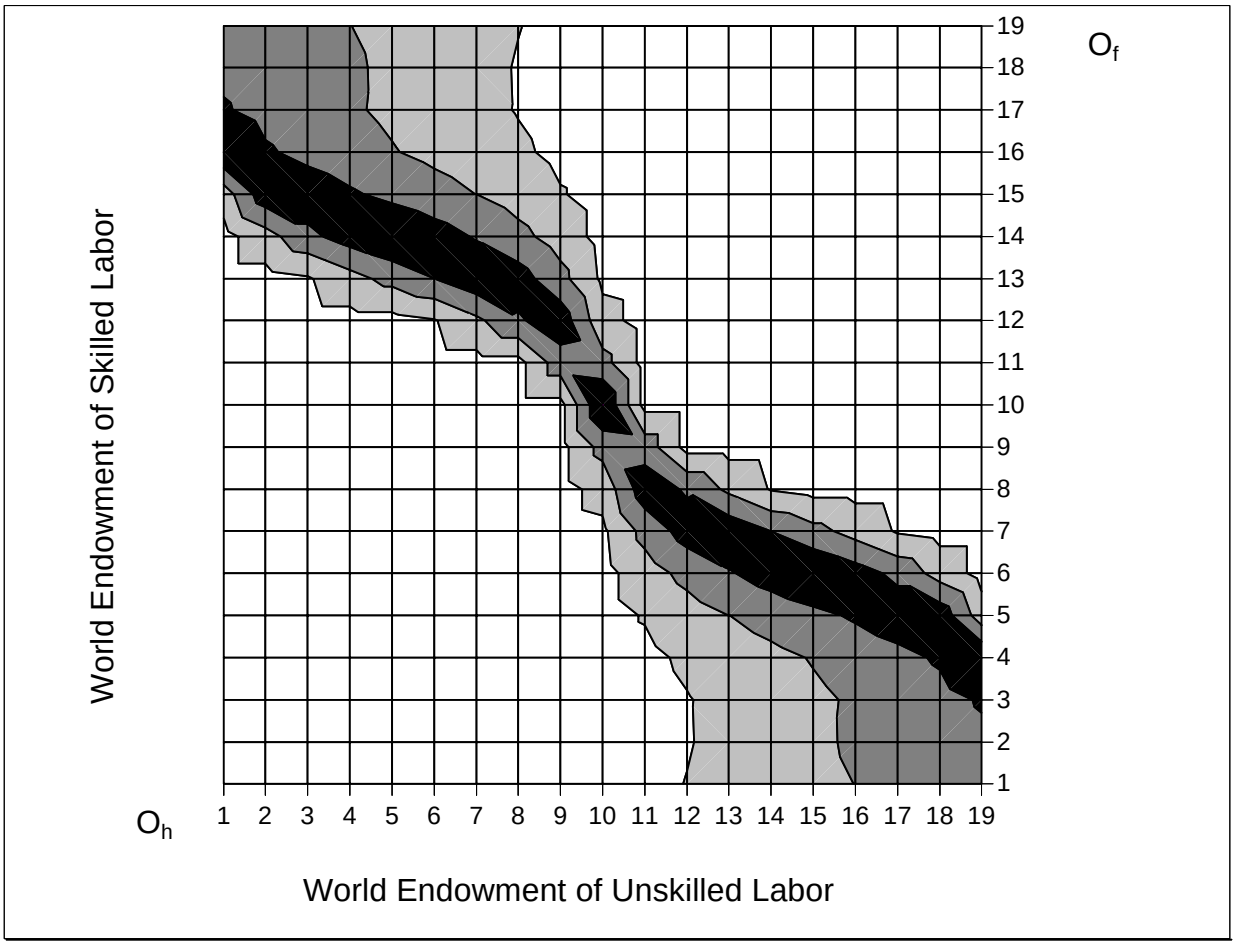
Table 4. Intra-Industry Trade Logit Regressions

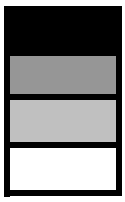
RHS Variable	Basic (1)	Basic Ind. Dum. (2)	Basic Ind. Dum. J, C Dum. (3)	Basic INVC, TC (4)	Basic INVC, TC Ind. Dum. (5)	Basic INVC, TC Ind. Dum. J, C Dum. (6)
Constant	**89.2** (14.0)	**91.8** (13.5)	**91.5** (12.7)	**83.4** (9.91)	**86.9** (9.82)	**91.2** (10.1)
SUMGDP	**-0.002** (-2.09)	-0.001 (-1.46)	**0.002** (2.39)	**-0.003** (-2.86)	**-0.002** (-2.29)	**0.002** (1.74)
GDPDIFSQ	**4.3e-7** (2.00)	**4.0e-7** (1.87)	**-7.7e-7** (-2.84)	**3.8e-7** (1.72)	**3.6e-7** (1.66)	**-7.4e-7** (-2.65)
SKDIFSQ	-198 (-0.73)	-225 (-0.84)	-339 (-1.34)	-98.4 (-0.36)	-120 (-0.44)	-274 (-1.05)
GDPDIFF*SKDIFF	**-0.01** (-1.68)	-0.01 (-0.84)	-0.001 (-0.07)	**-0.02** (-2.77)	**-0.02** (-2.45)	-0.006 (-0.67)
INVCJ				**0.84** (2.81)	**0.84** (2.81)	0.35 (1.22)
TCJ				**-0.43** (-1.96)	**-0.44** (-1.96)	-0.25 (-1.16)
No. of Obs.	264	264	264	264	264	264
Adj. R^2	0.87	0.88	0.90	0.87	0.88	0.90

Table 5. Ratio of Intra-Industry Affiliate Sales to Intra-Industry Trade Logit Regressions

RHS Variable	Basic (1)	Basic Ind. Dum. (2)	Basic Ind. Dum. J, C Dum. (3)	Basic INVC, TC (4)	Basic INVC, TC Ind. Dum. (5)	Basic INVC, TC Ind. Dum. J, C Dum. (6)
Constant	**1.05** (7.34)	**1.11** (6.74)	**1.08** (5.97)	**1.01** (4.05)	**1.06** (4.18)	**0.97** (3.59)
SUMGDP	**6.5e-5** (3.38)	**6.1e-5** (3.43)	**5.3e-5** (2.32)	**6.6e-5** (3.35)	**6.2e-5** (3.40)	**4.7e-5** (2.00)
GDPDIFSQ	**-2.4e-8** (-3.63)	**-2.2e-8** (-3.72)	**-1.9e-8** (-2.23)	**-2.4e-8** (-3.65)	**-2.3e-8** (-3.75)	**-1.6e-8** (-1.89)
SKDIFSQ	-1.56 (-0.34)	-1.22 (-0.29)	-1.43 (-0.33)	-1.81 (-0.35)	-1.62 (-0.34)	-1.71 (-0.35)
INVCJ				0.007 (0.71)	0.009 (0.93)	0.013 (1.26)
TCJ				-0.006 (-0.72)	-0.007 (-0.90)	-0.01 (-1.26)
No. of Obs.	181	181	181	181	181	181
Adj. R^2	0.06	0.23	0.22	0.06	0.22	0.22

Figure 1: Intra-Industry Trade with No Liberalization





Intra-Industry Trade Index

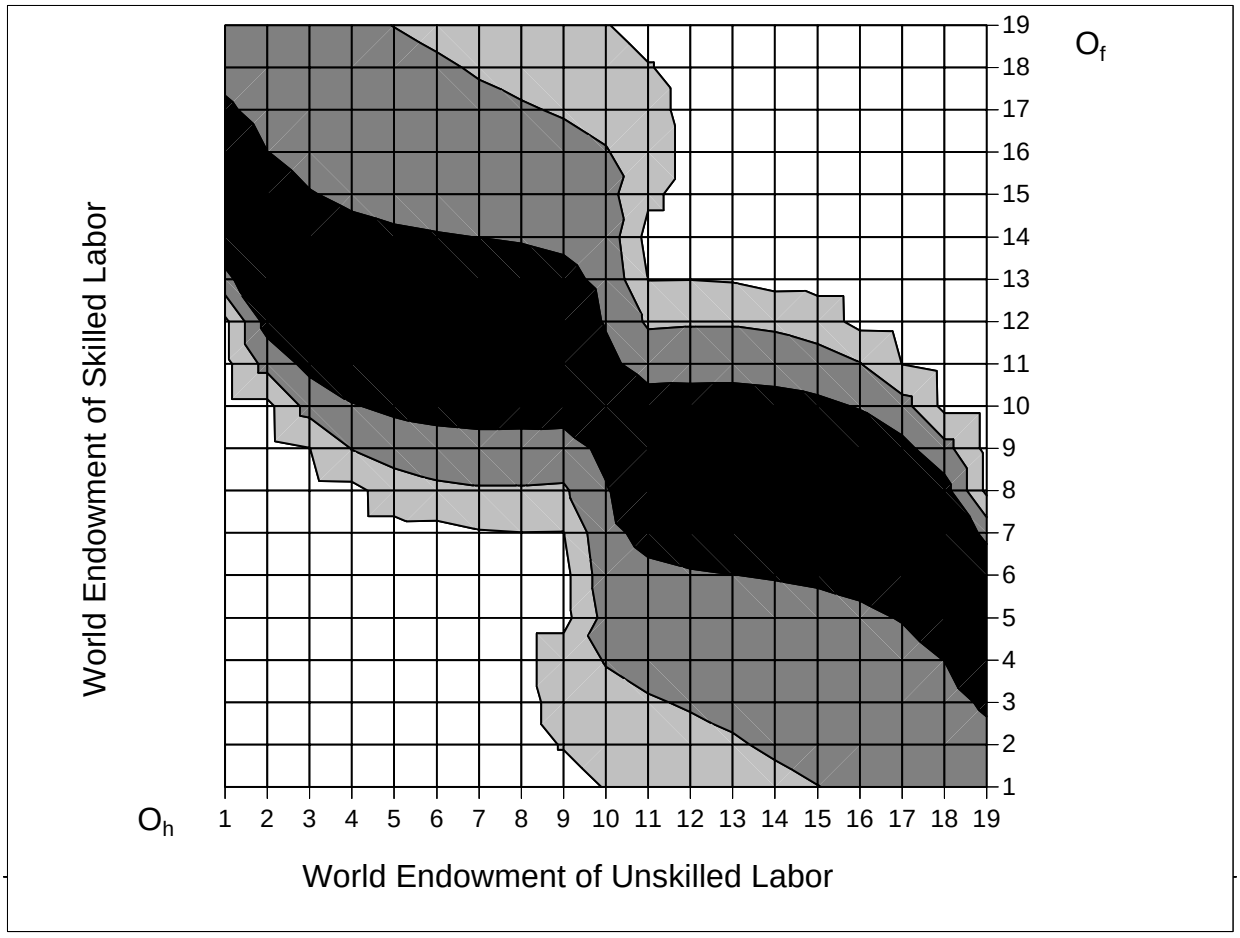
0.7 - 1.0

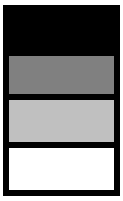
0.4 - 0.7

0.1 - 0.4

0.0 - 0.1

Figure 2: Intra-Industry Trade with Trade Liberalization





Intra-Industry Trade Index

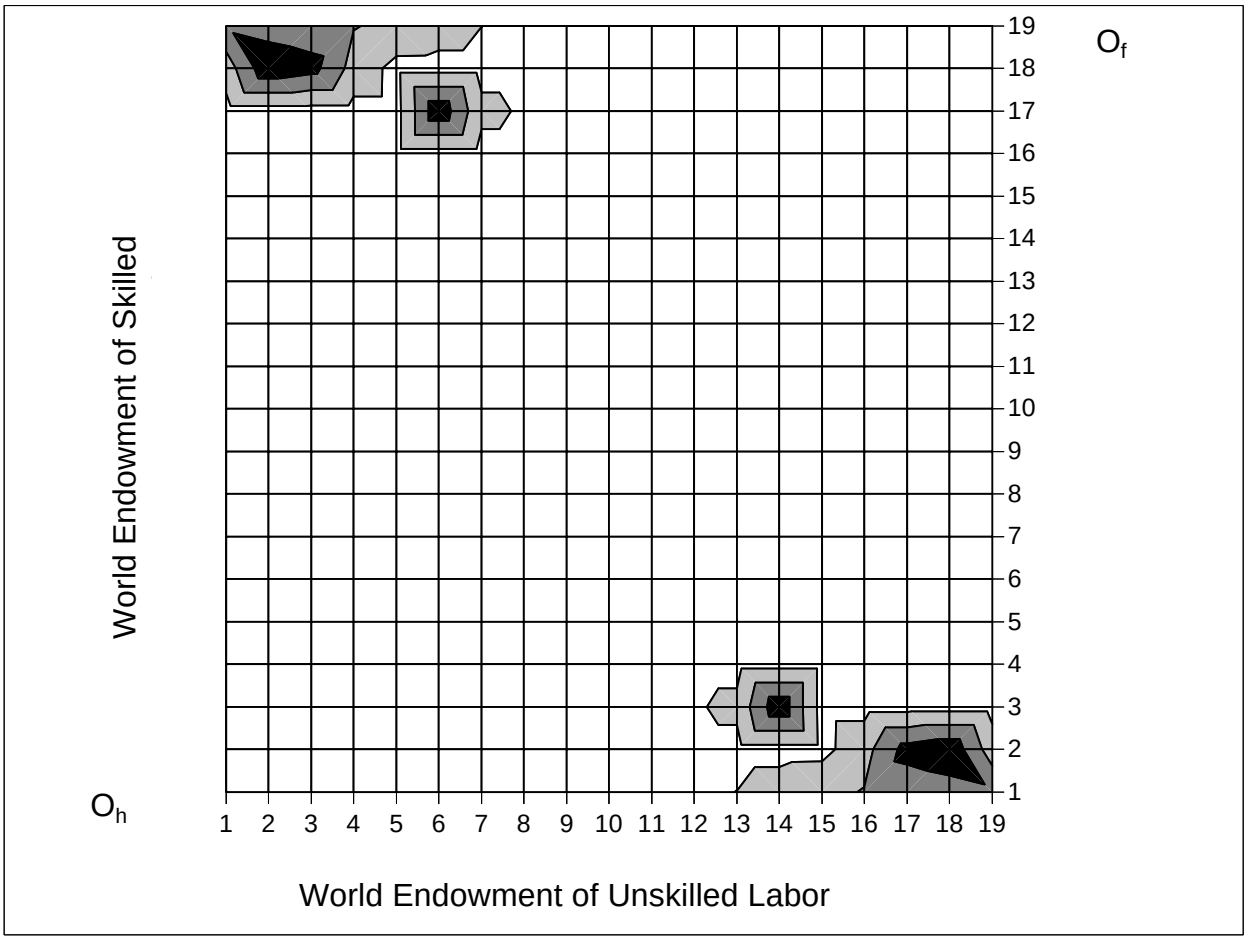
0.7 - 1.0

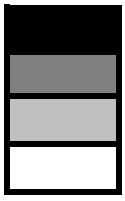
0.4 - 0.7

0.1 - 0.4

0.0 - 0.1

Figure 3: Intra-Industry Trade with Investment Liberalization





Intra-Industry Trade Index

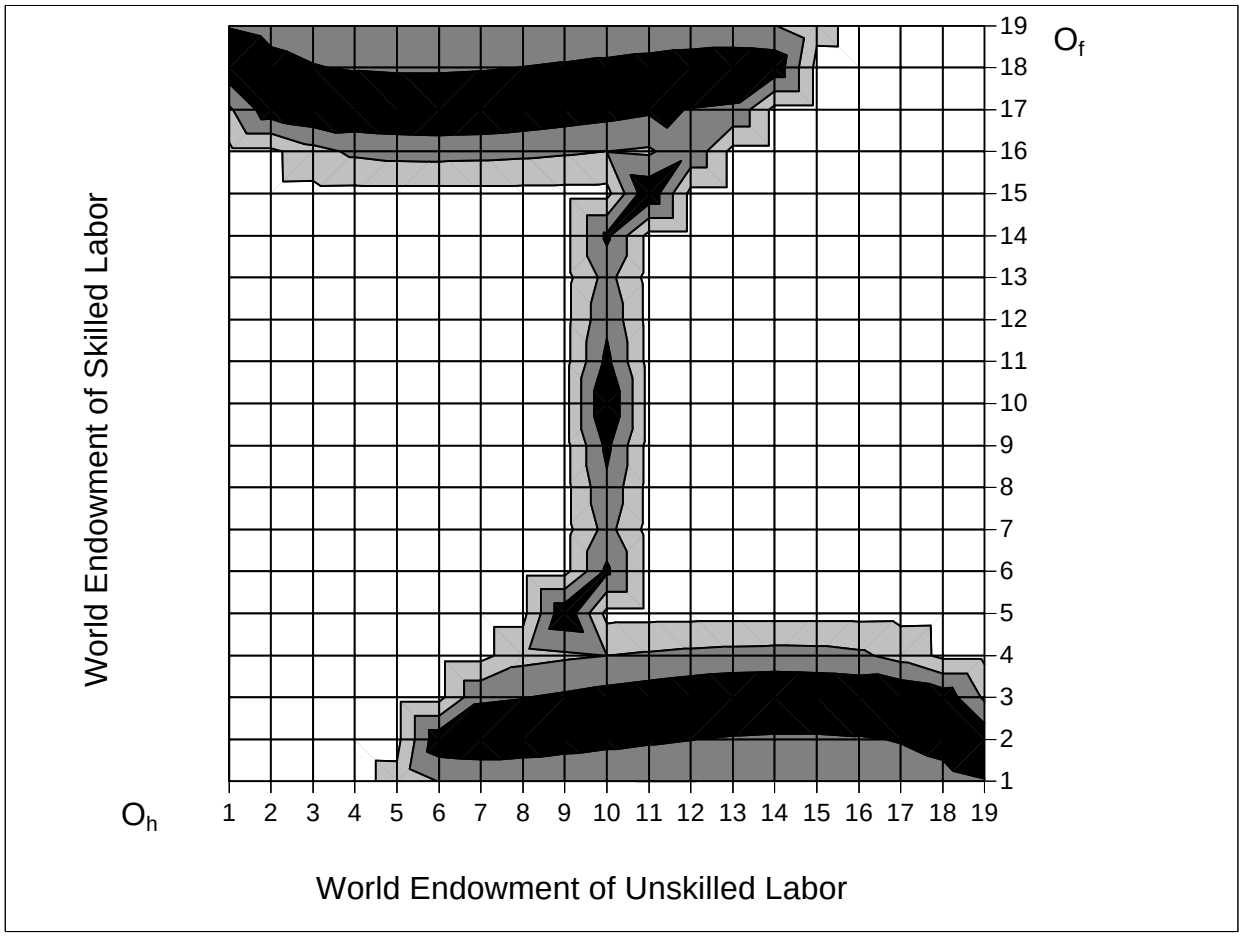
0.7 - 1.0

0.4 - 0.7

0.1 - 0.4

0.0 - 0.1

Figure 4: Intra-Industry Trade with Investment and Trade Liberalization



Intra-Industry Trade Index

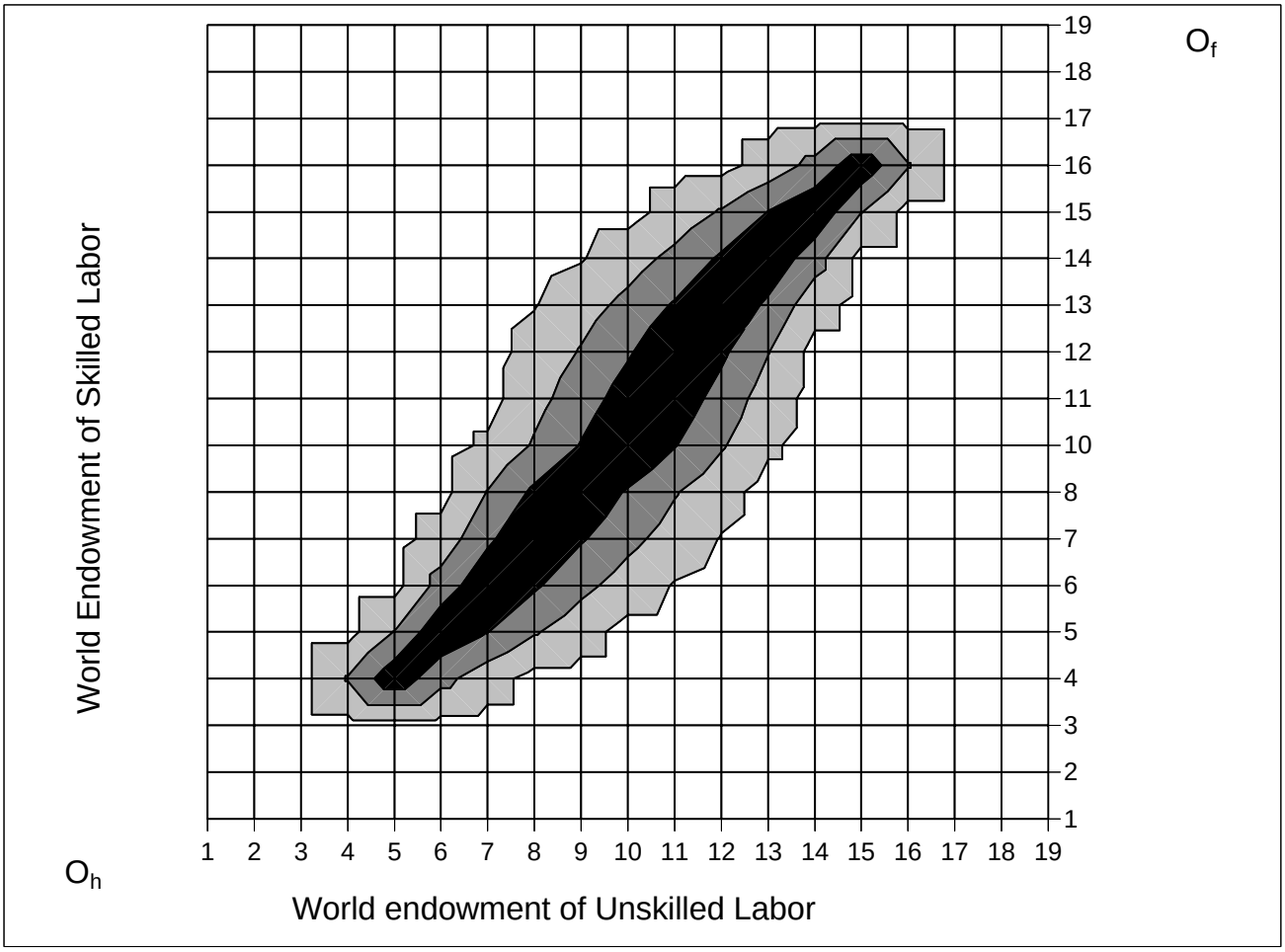
0.7 - 1.0

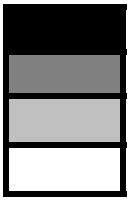
0.4 - 0.7

0.1 - 0.4

0.0 - 0.1

Figure 5: Intra-Industry Affiliate Sales with Investment Liberalization





Intra-Industry Affiliate Sales Index

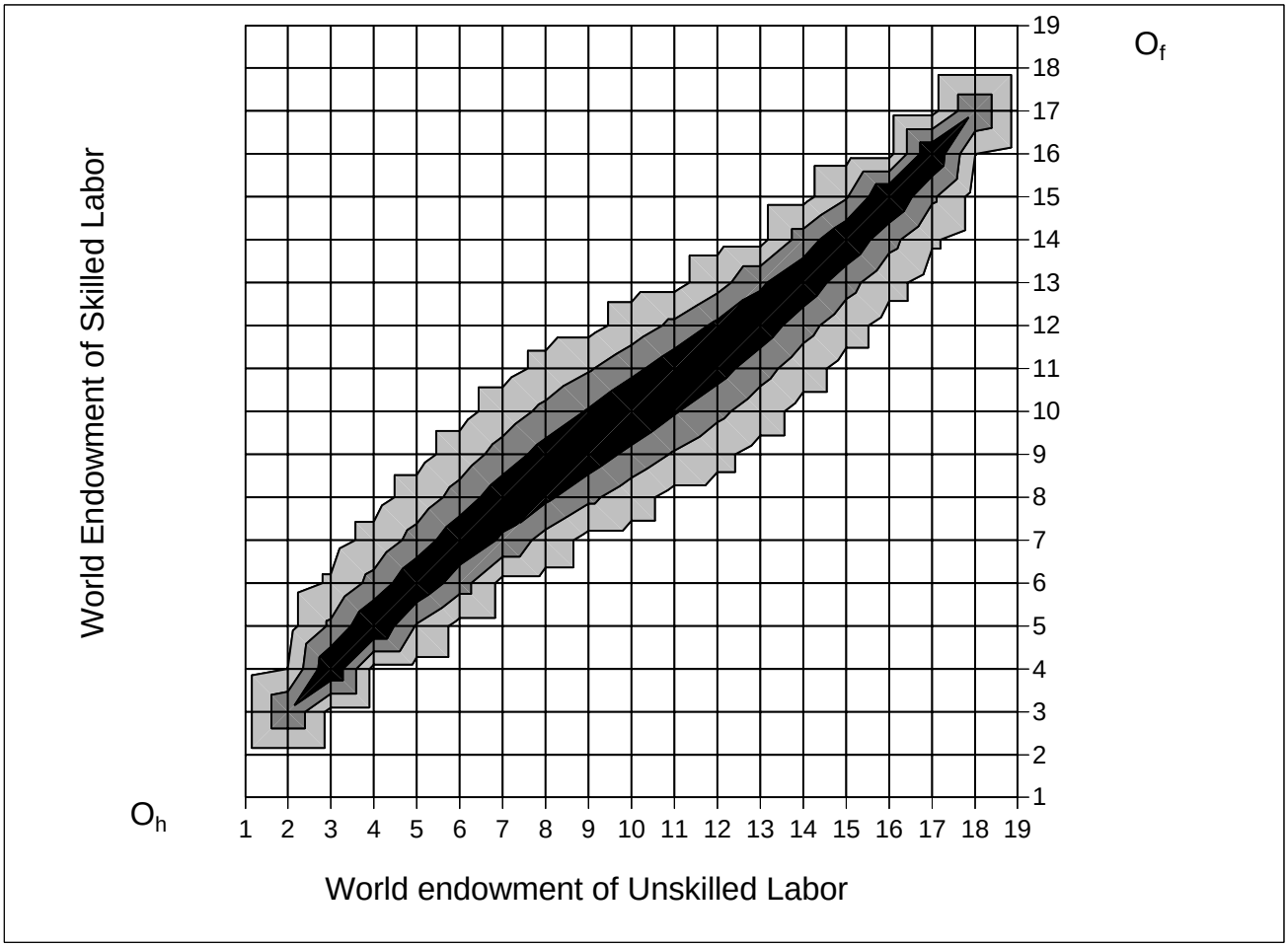
0.7 - 1.0

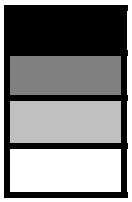
0.4 - 0.7

0.1 - 0.4

0.0 - 0.1

Figure 6: Intra-Industry Affiliate Sales with Investment Liberalization, Countries Twice as Big





Intra-Industry Affiliate Sales Index

0.7 - 1.0

0.4 - 0.7

0.1 - 0.4

0.0 - 0.1