Vertical FDI

Economics 689 Texas A&M University

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  – general equilibrium model of location of plants in a differentiated product industry
  – describes trade patterns, volumes of trade, the share of intra-industry trade, and the share of intra-firm trade
  – as functions of relative country size and differences in relative factor endowments.
  – Main base model of vertical FDI.
• Ramifications of the existence of MNCs are of major concern to international trade experts.
• Lacked a well-articulated theory to explain the conditions for their emergence and predicts a structure of trade that comes close to observed trade patterns.
• Existing general equilibrium theories of international trade developed without including the multinational corporation.

• Many treatments of the multinational corporation in a partial equilibrium framework, and shed only limited light on trade patterns.
• Needed a theory that describes conditions under which firms shift activities to foreign locations
  – and that can predict the pattern of trade that emerges.
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• Such a theory is proposed in this paper, with the following important features:
  – differentiated products, economies of scale, and monopolistic competition; and
  – inputs (management, marketing, and R&D) that can serve product lines without being located in the plants.

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• Firms choose locations to minimize costs.
• Multinational corporations emerge as a result of factor rewards differing across countries.
• Transport costs and tariffs are assumed away.
  – plants are not established to save transport costs or to produce behind tariff walls.
• Other reasons for multinationals to form, such as tax advantages, are also not considered.
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- **Basic Model**
- Two-sector version of standard model of international trade in differentiated products.
- Preferences are assumed to be identical everywhere and represented by a homothetic utility function \( u(Y, U_X) \),
  - where \( Y \) is the consumption level of a homogeneous product and
  - \( U_X = u_X() \) is the sub-utility level attained in the consumption of differentiated products, which is based on the specification of preferences for a differentiated product.

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- A demand function facing a producer of a single variety can be derived; in the Dixit-Stiglitz case the demand function has constant elasticity (assumed to be larger than one).
- Assume two factors of production: labor, \( L \), and a general purpose input, \( H \) (human capital), with a special role in the production of differentiated products.
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• The homogeneous product $Y$ is produced by a standard linear homogeneous production function with the associated unit cost function $c_Y(w_L, w_H)$, where $w_i$ is the reward to factor $i$.
• A producer of the homogeneous product must employ all inputs in the same location (no FDI).
• In a competitive equilibrium, the price of the homogeneous product, taken to be the numeraire, equals unit costs: $1 = c_Y(w_L, w_H)$.

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• A firm that wants to produce a variety of a differentiated product has to hire the general purpose input $H$ and adapt it at a cost in order to make it suitable for the production of this variety.
  – Think about training scientists or managers to have the skills needed for a firm’s particular product.
• Once adapted, the input becomes a firm-specific asset, and it is tied to the entrepreneurial unit.

• However, this firm-specific input can serve many plants and it need not be located within a plant in order to serve its product line.
  – In particular, it can serve plants that are located in different countries.

• Inputs that fit this description are management, distribution, and product-specific R & D.
  – In practice, combinations of inputs are required in order to generate such assets; here this aspect is simplified by assuming that only $H$ can serve this purpose.

• Let $l(x, h_X)$ be the quantity of labor required to produce $x$ units of a variety of the differentiated product in a single plant when $h_X$ units of $H$ have been adapted for its particular use.
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- Could have a plant-specific fixed cost and the variable cost part having constant returns to scale.
- The firm or corporation has fixed costs that are corporation specific but not plant specific (hiring $h_X$ and adapting it), it has plant-specific fixed costs, and it has plant-specific variable costs.
  - No transportation costs.

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- All varieties have the same cost structure.
- Free entry achieves zero profits in every firm.
- In a symmetrical equilibrium, firms equate marginal revenue to marginal costs for every variety of the differentiated product
  $$ p_X = C_X(w_L, w_H, x) $$
• As in most trade theory, assume that the factors of production do not move across borders.
• However, due to the technology available in the differentiated product industry,
  – the firm-specific asset \( h_X \) can serve product lines in plants that are located in countries other than the country where \( h_X \) is located, and
  – the firm-specificity of \( h_X \) implies that arm's-length trade in its services is an inferior organizational form to an integrated firm (rules out licensing).

• Brings about the emergence of multinational corporations.
• Call the country in which \( h_X \) (and the headquarters) are located the parent country (aka source or home country)
  – and the country in which the subsidiary is located the host country.
Equilibrium in an Integrated World Economy

- To study international trade, first describe the symmetrical equilibrium of an integrated world economy (as if there were only one country).
- The features of the integrated world economy are then used to identify patterns of cross-country distributions of the world's endowment of labor and the $H$ factor that generate certain trade patterns and volumes of trade.

Differences in factor endowments cause differences in relative country size and differences in relative factor endowments,
  - These variables play a major role in empirical studies.

- Examine trade patterns and volumes of trade for a world economy with a fixed size
  - (holding the total amount of labor and the $H$ factor in the world fixed).
In a symmetrical equilibrium of an integrated world economy factor prices are the same everywhere.

All corporations that operate in the sector that produces differentiated products have a similar structure; they
- employ the same quantity of the $H$ factor and the same quantity of labor;
- charge the same price for every variety and
- produce the same quantity of each.

Free entry into the industry makes profits zero.

The number of corporations $n$ is treated as a continuous variable, a reasonable approximation when $n$ is large.

Determine the equilibrium values of the
- factor rewards ($w_L$ and $w_H$),
- price of differentiated products ($p$),
- output level of a single variety of the differentiated product ($x$),
- output level of the homogeneous good ($y$), and
- number of corporations in the differentiated product industry ($n$), which equals the number of varieties available to consumers.
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Equilibrium conditions in the labor and H factor markets are:

\[ a_{LY}(w_L, w_H)y + A_{LX}(w_L, w_H, x) n = L \]
\[ a_{HY}(w_L, w_H)y + A_{HX}(w_L, w_H, x) n = H \]

- where \( a_{iy}(w_L, w_H), i = L, H \), is the cost-minimizing input of factor \( i \) per unit of output of the homogeneous product;
- \( A_{ix}(w_L, w_H, x), i = L, H \), is the cost-minimizing input of factor \( i \) in a representative corporation in the differentiated product industry, and
- \( L \) and \( H \) are the total quantities of labor and the \( H \) factor available in the world.

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Assume that the homogeneous product is labor intensive relative to the differentiated product

\[ a_{LY} / a_{HY} > A_{LX} / A_{HX} \]

- Produce the homogeneous good using a higher ratio of labor (\( L \)) to the \( H \) factor than when produce the differentiated product.
- Natural assumption since differentiated products are more sophisticated.
The Pattern of Trade

- Generates affiliate sales in both domestic and host countries.
- Establishing a new plant for the same variety requires additional fixed costs but does not require hiring of new H factors.
- Generates simultaneous inter-industry (Y for X), intra-industry, and intra-firm trade.
  - Intra-firm trade has become of major importance recently.

The pattern of trade that emerges in the present model is richer than the standard HOS model.

Two cases arise in the standard Heckscher-Ohlin two-country, two-good, two-factor model in which there are no factor intensity reversals and preferences are homothetic and identical across countries. Depending on how different factor endowments are across countries:
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- One case has factor price equalization and no specialization in production (both produce $X$ and $Y$).
  - Each country exports the good whose production makes relatively intensive use of the factor with which the country is relatively well endowed.
- In the other case every country pays a lower reward to the factor of production with which it is relatively well endowed and a higher reward to the other factor of production,
  - at least one country specializes in the production of the good which is a relatively heavy user of its cheaper factor of production, and
  - the pattern of trade is the same as before.

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- There can be an equilibrium with factor price equalization that looks the same as the integrated world equilibrium.
  - In this equilibrium corporations based in one country have no incentive to open subsidiaries in the other country in order to locate product lines there.
  - The input-output coefficients in the homogeneous product sector and labor and H-factor use per corporation in the differentiated product industry are the same as in the equilibrium of the integrated world economy.
  - Factor prices, product prices, and output per variety are the same in both cases.
Since both countries have the same spending pattern, country 1 consumes a proportion $s_1$ of the world’s output $Y$, where $s_1$ is its share in world income.

The country that is relatively abundant in the H-factor imports the homogeneous product.
- Since trade is balanced, this country must be a net exporter of differentiated products.

The pattern of trade that emerges matches in the models of trade in differentiated products.

The structure of trade is the same as in recent models of trade in differentiated products;
- the inter-industry trade pattern is explained by differences in relative factor endowments while
- intra-industry trade is explained by monopolistic competition in differentiated products.
The theory proposed in this paper can identify and analyze the implications of circumstances in which corporations find it profitable to establish subsidiaries abroad.

This theory associates multinational corporations with the ability of firms to exploit cross-country differences in factor prices by shifting activities to the cheapest locations.

Suppose factor $H$ is cheaper in (developed) country 1 and labor is cheaper in (developing) country 2.

Consider what happens when allow FDI, that is when a corporation need not employ all labor and $H$ in the same country;

Corporations will choose country 1 as their parent country and open subsidiaries in country 2.

- Reduces the demand for labor in country 1 and increases it in country 2; Increases the demand for the $H$ factor in country 1 and reduces it in country 2.

The heart of the debate about whether outward FDI generates job losses hinges on this relationship.

- Labor demand shifts abroad but demand for the factors used intensively in headquarter services shift back home.
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• An equilibrium is attained when either factor prices are equalized or country 1 becomes the parent country of all corporations (with unequal factor prices all differentiated products are located in the cheap country).
• When factor price equalization obtains, there are many equilibrium configurations with various degrees of foreign involvement of the corporations in the differentiated product industry.

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• Generates invisible exports of the parent to its subsidiaries for services of the $H$ input.
• Due to the zero-profit condition, labor costs are lower than the revenue obtained from sales.
• The profits of the subsidiary are just sufficient to cover the costs of the $H$ input, which is hired in the parent country.
• This is where transfer pricing becomes a particular issue.
  – Firms may manipulate the price the parent charges its subsidiary for these headquarter services in a way that minimizes its total tax bill.
  – Both vertical and horizontal firms can arise when there are trade costs together with different factor intensities across activities.
  – Conditions under which each mode dominates matches the theory well.

• Helpman's original 1984 model of vertical multinationals assumed no trade costs,
  – no motive for horizontal multinationals (given plant-level scale economies).
• The early models of horizontal firms assumed that different activities (e.g., headquarters services and plant production) use factors in the same proportion or that there is only one factor of production.
  – no factor-price motive for vertical fragmentation across countries.
Carr, Markusen & Maskus AER 2001

• Theory can explain the volume of production of foreign affiliates of one country's firms in another country as a function of the characteristics of both countries.
  – Analytical difficulties imply that most results are derived from numerical simulations.

Carr, Markusen & Maskus AER 2001

• Translate these and other predictions into a tractable empirical specification.
  – Many relationships interactive or nonlinear.
• Results of estimates closely consistent with theory.
  – The volume of affiliate sales follows the theoretical predictions based on characteristics of both parent and host countries.
• Both vertical and horizontal investments are important and related to country characteristics as the model predicts.
“Knowledge-capital model" of the multinational enterprise.

- Services of knowledge-intensive activities, such as R&D, can be geographically separated from production.
- These knowledge-intensive activities are skilled-labor-intensive relative to production.
- Knowledge-intensive services can be used simultaneously by multiple production facilities.

- Creates a motive for the vertical fragmentation of production, locating R&D activities where skilled labor is cheap and production where unskilled labor is cheap.
- Also a market-size motive for locating production if there are plant-level scale economies.
- Firm-level scale economies motivates horizontal investments that replicate the same products or services in different locations.
• Assume two countries (home $h$ and foreign $f$).
• Two homogeneous goods ($X$ and $Y$).
• Two factors, unskilled labor ($L$) and skilled labor ($S$), which are internationally immobile.
• Good $Y$ is labor-intensive and produced under constant returns to scale in a competitive industry.
• Good $X$ is skilled-labor-intensive overall, exhibits increasing returns to scale, and is subject to Cournot competition with free entry and exit.
  – Within a firm, headquarters services and plant facilities may be geographically separated and a firm may have plants in one or both countries.

• Six firm types, with free entry and exit into and out of firm types:
• Type $N_h$ - national firms that maintain a single plant and headquarters in country $h$ ($N_f$ if in $f$); they may or may not export to the foreign country.
• Type $H_h$ - horizontal multinationals that maintain plants in both countries with headquarters located in country $h$ ($H_f$ if hq in $f$).
• Type $V_h$ - vertical multinationals that maintain a single plant in country $f$ and headquarters in country $h$; they may or may not export back to home country $h$ ($V_f$ if hq in $f$).
• Assume there are multi-plant economies of scale for horizontal MNCs due to knowledge capital.
• Headquarters service (blue-prints, manuals, formulas, procedures, etc.) can be supplied to additional plants.
• Thus, in good X the total fixed costs of headquarters and two plants is less than double the total fixed costs of a single-plant firm
  – (the joint-input property of knowledge capital).

• Assumed that headquarters services are more skilled-labor-intensive than production.
• More controversial is the assumption that plant-level production is more skilled-labor-intensive than the composite rest of the economy.
• The ranking of skilled-labor intensity of activities is that [headquarters only] > [integrated X] > [plant only] > [Y].
• National markets for goods are segmented.
• Transport costs use unskilled labor.
• Consider first factors that favor national firms being headquartered in country $h$ and also producing there.
• Type $N_h$ firms (national firm headquartered in home) will be the dominant type active in the home country if:
  1. Home is both large (so produce there) and skilled-labor-abundant (so headquarters there);
  2. The countries are similar in size and relative endowments and transport costs are low; or
  3. Foreign investment barriers in foreign are high.

• Type $H_h$ firms (horizontal MNCs headquartered in the home country) will be the dominant type active in country $h$ (type $H_f$ will also produce in $h$) if
  – the countries are similar in size and relative endowments and transport costs are high.
• Horizontal multinationals firms should arise when countries are similar in both size and in relative factor endowments.
• If countries are dissimilar in either size or relative endowments, one country will be favored as a site of both production and headquarters, or of one of these two activities.
• If the countries are similar in relative endowments but of different sizes, then national firms located in the large country will be favored because they avoid costly capacity in the smaller market.

• If the countries are different in relative endowments but of similar size, then there is an incentive to concentrate headquarters in the skilled-labor-abundant country and production in the skilled-labor-scarce country.
  – Thus vertical firms headquartered in the skilled-labor-abundant countries are favored unless trade costs are high.

• Type $V_h$ firms (vertical MNCs headquartered in the home country with a plant in foreign) will be dominant in $h$ if the home country is
  – small, skilled-labor-abundant, and trade costs from the host country back to the parent country are not excessive.

• Simulations are performed to demonstrate that the results follow this intuition.

• Econometric analysis also supports these predictions.
• An increase in the host-country's trade costs will raise production by affiliates of parent-country firms.

• A bilateral increase in parent and host-country trade costs:
  – decreases affiliate production, so trade and investment are "complements";
  – generally decreases affiliate production when the non-U.S. country is a developing country ("complements") but increases affiliate production when the non-U.S. country is another high-income country ("substitutes").

• A convergence in income (GDP) between the United States and any host country (holding the sum of their incomes constant) increases affiliate sales in both directions.

• A bilateral increase in parent and host country incomes increases affiliate production by a greater proportion.
Carr, Markusen & Maskus AER 2001

• When the United States is parent, an increase in host-country skilled-labor abundance increases U.S. affiliate production in the host country
  – production by U.S. affiliates is attracted to skilled-labor-abundant host countries.

• When the United States is host, an increase in parent-country skilled-labor abundance increases the parent-country's affiliate production in the United States.

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  – Empirical study of the industry and country determinants of U.S. outward foreign direct investment (FDI).
  – Demonstrates that the structure of U.S. FDI reflects an interaction between country skilled-labor abundance and industry skilled-labor intensities that is consistent with comparative advantage.
  – Confirms that market access plays an important role in the structure of U.S. FDI.
• Model identifies a set of industry characteristics (such as transport costs, plant scale economies, and factor intensities) and a set of country characteristics (such as market sizes, tariff levels, and factor abundances) that interact to determine the structure of FDI.

• This study confirms results of earlier studies that trade frictions between countries, plant and firm-level scale economies, and countries' relative market sizes influence structure of U.S. outward FDI.

Knowledge-capital model has two motives for firms to engage in FDI.

1. Market access motive = produce in multiple countries to avoid costs associated with international trade.

2. Comparative advantage motive = produce in multiple countries in order to locate production activities where the factors used intensively in these activities are cheap.
   - If firms can decompose their production process into various stages, and if relative production costs vary across countries.
Two special cases highlight the two distinct motives for FDI:
1. **Horizontal model** = if the factor intensities of different productive stages vary little and transport costs are nontrivial, then only the market access motive to FDI remains.
   - Horizontal FDI occurs between countries of similar factor abundance, such as from developed to other developed countries.
   - This type of FDI is often two-way if the countries are of similar size (firms from both countries have plants in both countries).
2. **Vertical model** = if transport costs are negligible and production stages vary in their factor intensity, then only the comparative advantage motive remains.
   - Vertical FDI occurs between countries with large differences in relative factor abundance, such as from developed into developing countries.

Several empirical strategies in this literature:
- One branch motivates their empirical specifications by simulating patterns of FDI across countries while holding industry characteristics fixed.
- These specifications are then applied to data aggregated across industries to the country level.
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• Examines whether the aggregate data favor a theoretical specification in which factor intensity differences across production activities within an industry are important determinants of FDI (the knowledge-capital model) over one in which they are not (the horizontal model).

• Most models assuming low transport costs (such as the purely vertical model) are rejected by the data in favor of models in which market access issues arise.

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• Another branch of the literature looks at the variance in the country-industry pairs.

• Considers whether a mixture of country and industry characteristics can explain the variance in FDI across country-industry pairs in a manner consistent with the knowledge-capital model.

• Brainard (1997) found support for the market access motive.
  – FDI appears to be high in Industry-country pairs in which transport costs are high and plant scale economies are low.
  – Also explored the effect of relative factor abundance differences across countries on the structure of FDI across country-industry pairs.
In general, the results do not suggest an important role for the comparative advantage motive for FDI. On average, FDI is primarily attracted to developed countries and not to developing countries. The preponderance of evidence suggests that the comparative advantage motive for FDI is far less important than the market access motive in explaining the bulk of FDI.

There is evidence that some component of FDI is motivated by the desire to shift production activities to countries in which factors are relatively cheap. LDCs are relatively more likely to act as export platforms back to their parent country. Intra-firm trade varies across countries in a way consistent with a vertical motive for FDI in skilled-labor-scarce countries. The factor usage of multinational affiliates in the United Kingdom and Korea appears to be consistent with the comparative advantage of those countries.
First, this paper explains the country-industry pair variation by considering an empirical specification in which a country's skilled-labor abundance is interacted with an industry's skilled-labor intensity.

- Model estimated using data highly disaggregated in both dimensions.

Highlights country skilled-labor abundances as a key determinant of FDI.

Shows that the effect of a country's relative skilled labor abundance on the volume of U.S. multinational sales in that country varies across industries in a manner consistent with comparative advantage.

- In industries with high skilled-labor intensities, U.S. MNEs favor skilled-labor abundant countries over skilled-labor-scarce countries,
- whereas in sectors with low skilled-labor intensities U.S. MNEs favor skill-scarce countries over skill-abundant countries.
Second, this paper provides evidence that is consistent with the market access motive.

Our results confirm many of the results of Brainard (1997): Firms tend to substitute FDI for exports when transport costs are high and plant scale economies are low.

Also confirms the result of Carr, Markusen, and Maskus (2001) that market size plays a critical role in determining the cross-country distribution of FDI.

The results suggest that obtaining market access is a crucial motivation for U.S. MNE, and models based on this motive therefore obtain support from the data.

Finally, while the analysis confirms the existence of a statistically significant comparative advantage explanation, its importance in explaining the structure of FDI is harder to assess.

According to the magnitudes of the estimated coefficients, comparative advantage plays a nontrivial role in explaining the variation in industry-country pairs.

Harder to quantify is the additional explanatory power offered by incorporating a comparative cost motive for investing abroad.

– Here the results vary considerably across specifications.
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  - Strategies often involve vertical integration in some countries and horizontal integration in others, known as complex integration.
  - Three-country model shows that falling transport costs between countries may increase the importance of complex integration strategies.

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- Vertically integrated multinational enterprises (MNE) arise to exploit factor price differences across countries.
  - Fragment their production process to locate different stages in different countries.
- Horizontally integrated MNEs arise to avoid the costs of international trade.
  - Replicate the same production process across countries.
Many MNEs increasingly observed following complex integration strategies.
- Both horizontally and vertically integrated,
- Establish affiliates in some foreign countries to conserve on transport cost and
- Establish affiliates in other countries to take advantage of factor price differentials.
- Boundaries between types of MNEs blurred.

Three-country framework in which transport cost gives rise to the horizontal motive between one set of countries, while factor price differentials gives rise to the vertical motive between another.

Ask under what circumstances are firms likely to follow complex integration strategies?
Can we say more about how these strategies affect the structure of FDI across countries?
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• Firms from one developed, northern country may invest in:
  – Another developed, northern country (horizontal integration), or
  – A developing, southern country (vertical integration), or
  – Both (complex integration), or
  – Not abroad at all (national).

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• Key insight: north-north and north-south FDI reduce the cost of serving international markets, creating a complementarity between the two forms of FDI.
  – Firms that undertake vertical foreign investments lower their unit costs and thereby expand their sales.
  – Having expanded the number of units sold, these firms stand to gain proportionately more by further reducing their unit cost by undertaking horizontal foreign investments.
  – Ditto that undertaking horizontal FDI makes vertical FDI more attractive.
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• Complex integration strategies dominate other foreign investment strategies when the level of transport costs fall within an intermediate range.
• Low transport costs encourage vertical FDI by making the use of low cost southern labor attractive while high transport costs encourage horizontal FDI by making international trade expensive.
• When transport costs lie between these extremes, FDI is only viable when firms take advantage of the complementarity between north–north and north–south FDI by investing in both locations.

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• Complex integration strategies create dependence between the level of FDI in one country and the characteristics and policies of its neighbors.
• Two locations are complements when events in one country that expand MNE activity in that country also expand MNE activity in the other, and
  – are substitutes when events in one country that expand MNE activity in that country also contract MNE activity in the other.
• Whether the two foreign locations are substitutes or complements depend critically on the initial level of transport cost.
• Important implications for empirical research into the determinants of FDI.
• Complex integration strategies expand the determinants of FDI from the level of the country to the level of the neighborhood, but the effect of a country’s neighborhood is a function of industry characteristics such as the level of transport cost, the factor intensity of production, and the cost of investing abroad.
• As a result, the complete set of FDI determinants includes both country and neighborhood characteristics, and these determinants interact differently across industries.

• Two industries: one composed of perfectly competitive firms that produce a homogeneous good that is freely traded internationally, and the other composed of monopolistically competitive firms producing differentiated varieties that are costly to ship internationally.
  – MNE arise only in this second industry.
• Two of the countries are identical and are collectively labeled ‘the north,’
  – label these countries East and West.
  – The remaining country is ‘the south.’
• Let the subscript $j$ indicate the country: east (E), west (W) or south (S).
• Each country is endowed with labor $L$ and skill $H$ with factor prices $W_j$ and $R_j$.
  – Southern labor is the numeraire, so $W_S = 1$.

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• Factors are mobile between sectors but immobile internationally.
• Northern countries are relatively skill abundant and the distribution of factors between north and south is sufficiently skewed that north-south factor price equalization does not obtain.
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• There are two traded final goods, \( X \) and \( Y \).
• Good \( Y \) is homogeneous, is produced by perfectly competitive firms using a technology that exhibits constant returns to scale, and requires both labor and skill in its production.
• International trade in good \( Y \) is assumed to be costless so there is a single global price for \( Y \).
• The technology used to produce \( Y \) also has the feature that both factors must be located at the same production site.

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• It is in the \( X \) sector that multinationals may arise.
• Goods in the \( X \) sector are differentiated by variety and the producers of these varieties are monopolistically competitive.
• Entry into the \( X \) sector requires a firm to employ \( G \) units of skill to invent a new variety.
• Like \( Y \), the production of \( X \) requires both labor and skill.
• Unlike \( Y \), the two factors need not be located at the same site for production of \( X \) to take place because good \( X \) can be costlessly assembled from two intermediate inputs, one that requires only labor and another that requires only skill.
• Both of these intermediates are potentially traded
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• Sector $X$ also differs from sector $Y$ in that there is an iceberg-type transport cost that afflicts $X$ sector goods.
  – These shipping costs create the motive for horizontal integration but dull the motive for vertical integration by making intermediates more costly to ship.

• For one unit of either an intermediate or final good to arrive at a foreign destination, $\delta > 1$ units must be sent.
  – A variety of costs associated with international trade but not associated with FDI including shipping costs, information costs associated with being distant from one’s customers, and the cost associated with the potential for delayed delivery.
  – Assume initially that these transport costs for intermediate and final goods are identical.

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• The act of investing abroad requires the investing firm to incur an additional fixed cost.
• The form of this cost is an additional administrative burden on the home office associated with managing each additional foreign plant.
• Allow these fixed costs to vary across countries so that $\theta_S$ units of skill is required to open a plant in the south and $\theta_N$ units of skill is required to open a plant in the other northern country.
• Strong assumptions over preferences are necessary to keep the analysis tractable. The north consumes both $X$ and $Y$ while the south consumes only $Y$. 
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- Consider equilibrium in the MNE sector at fixed factor prices with $C_S < C_N$ assuming $\delta < W_N$.
- Focus on the factors affecting the FDI decisions of a firm originating from one of the two northern countries that may invest in up to two foreign locations, the other northern country and the south.

Table 1 Cost Configurations by Firm Type

<table>
<thead>
<tr>
<th></th>
<th>Home market unit cost</th>
<th>Foreign market unit cost</th>
<th>Total fixed cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>No foreign plants</td>
<td>$C_N$</td>
<td>$C_N\delta$</td>
<td>$G$</td>
</tr>
<tr>
<td>Northern only</td>
<td>$C_N$</td>
<td>$C_N$</td>
<td>$G + \theta_N$</td>
</tr>
<tr>
<td>Southern only</td>
<td>$C_S$</td>
<td>$C_S\delta$</td>
<td>$G + \theta_S$</td>
</tr>
<tr>
<td>Both</td>
<td>$C_S$</td>
<td>$C_S$</td>
<td>$G+\theta_N+\theta_S$</td>
</tr>
</tbody>
</table>
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• As long as southern labor is sufficiently cheap, firms that follow the complex integration strategy have the lowest unit cost of serving global markets but the highest fixed costs.

• National firms, those that have no foreign affiliates, have the highest unit costs but the lowest fixed costs.

• The costs of horizontally and vertically integrated firms lie within these two extremes.

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• Shift from national firm to horizontal MNC with a plant in the other northern country:
  – Lower unit costs abroad, extra fixed cost

• Shift from national firm to vertical MNC with a plant in the southern country:
  – Lower unit costs everywhere, extra fixed cost
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- Shift from horizontal MNC with a plant in the other northern country to complex with both plants:
  - Lower unit costs everywhere, extra fixed cost
- Shift from vertical MNC with a plant in the southern country to complex with both plants:
  - Lower unit costs abroad, extra fixed cost

Yeaple JIE 2003

- Proposition 1.
  - For low enough transport costs, only national and vertical firms are potentially viable.
  - For moderate transport costs, only national firms and firms following complex integration strategies are potentially viable.
  - For high enough transport costs, only firms following horizontal and complex integration strategies are potentially viable.
Proposition 2.
- National firms occur when transport cost $\delta$ is low to moderate and the relative wage of northern labor in terms of southern labor, $W_N$, is low.
- Vertical MNE occur when $\delta$ is low and $W_N$ is high.
- Complex MNEs occur when $\delta$ is moderate to high and $W_N$ is high.
- Horizontal MNE occur when $\delta$ is high and $W_N$ is low.

Proposition 3. An increase in the fixed cost of investing in either the north or the south extends the range of transport costs over which the only type of MNE that are viable in equilibrium are those that follow a complex integration strategy.
Yi JPE 2003

  - Develops a model of vertical specialization in stages of production to help explain the striking growth in the trade share of output.

Antras et al QJE 2006

  - A theory of vertical FDI where heterogeneous agents join teams.
  - Less skilled agents specialize in production, and
  - More skilled agents specialize in problem solving.
  - Provides better fit to income distribution data.
Antras et al QJE 2006

- Study the equilibrium of a two-country model (North and South), where countries differ in their distributions of ability, and in which agents in different countries can join together in teams.
- Globalization leads to better matches for all southern workers but only for the best northern workers.
- As a result, globalization increases wage inequality among nonmanagers in the South, but not necessarily in the North.
- Also study how globalization affects the size distribution of firms and the patterns of consumption and trade in the global economy.

Antras et al QJE 2006

- Some tasks such as data entry in consumer banking, software upgrades and maintenance, low-level customer handling in call centers, or standardized manufacturing processes, are now frequently done offshore.
- Other, more knowledge-intensive, tasks (such as data manipulation, software development, high-end sales and service, and R&D and product design in manufacturing industries) continue to be undertaken domestically.
- Broadly, routine tasks are offshored, while more complex tasks are done domestically.
Antras et al QJE 2006

- High skill agents in more developed countries can leverage their knowledge at lower cost by working with cheaper labor on routine tasks, and the better workers in less developed countries are able to become part of international high value added teams.
- Framework that puts agent skill heterogeneity and matching at the center of the analysis.
- Examines the impact of offshoring on wages, on occupational choices (production versus knowledge jobs), and (as matches are "many-to-one") on the distribution of firm sizes.