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Abstract

This study looks at the link between the patterns of trade-revealed comparative advantage and net inward foreign direct investment in five developed countries: France, Italy, Japan, the United Kingdom, and the United States. Despite assertions that market access is the primary motive for foreign direct investment flows among developed countries, the study confirms an earlier study which found a significant role of comparative advantage in determining inflows of foreign direct investment in developed countries, especially in the services industry.

Keyword(s): foreign direct investment; comparative advantage; Heckscher-Ohlin-Vanek

JEL Code(s): F21, F14

1. Introduction

This paper investigates empirically the link between the patterns of trade revealed comparative advantage and net inward foreign direct investment. It extends an earlier study of Maskus and Webster (1995) in order to improve the robustness of their findings. This extension is important given the relatively scarce evidence on the positive link between comparative advantage and foreign direct investment (FDI). More specifically, in their study, Maskus and Webster related FDI factor intensity to the underlying factor abundance of the host country. They did this by computing the factor contents of net inward FDI (inflows – outflows) for the United Kingdom (UK) and South Korea and the rank correlation of factor contents of FDI and factor contents of net exports (exports-imports). They found that, for UK, there was a statistically significant positive relationship between the patterns of revealed comparative advantage and inward FDI.

This paper extends Maskus and Webster in three directions. First, it expands the sample to five developed countries which are also known as members of the G7: France, Italy, Japan, the United Kingdom (UK), and the United States (US).[1] Maskus and Webster's (1995) findings differed between the two countries they studied. Therefore, it is still an open question whether their results with the UK hold for other developed countries. Because of the heavy concentration of FDI in developed countries, an extension of the study to other developed economies is necessary in order to understand more about the role of comparative advantage as a determinant of FDI flows.

Second, it uses three different measures of FDI depending on how the FDI values are measured: one-year flow of FDI—which is the only measure used by Maskus and Webster (1995), four-year accumulated flow of FDI, and FDI stock.[2] It has been shown that, in the short-run, the flows of FDI may reflect fluctuations in the exchange rates (Blonigen, 1997).

[1] Two other members of the G7, Canada and Germany, are excluded due to comparable data availability reasons.
[2] This is simply the stock data as reported by United Nations (1993).

As a result, the use of one-year flow data to relate the factor content of FDI and revealed factor endowment--a long-run measure derived from a long-run general equilibrium theory--may be inappropriate and misleading. That is, since short-run flows of FDI may arise from many different reasons, it is plausible for the chosen year of study to influence the outcome of the analysis in an unknown way.[3] As our findings seem to suggest, we cannot be sure of the direction of bias from the use of flow rather than stock data.

Lastly, as explained in more detail in the appendix, compared to Maskus and Webster (1995), this paper uses technology and trade data which are defined more uniformly across countries. Arguably, this implies improved data robustness coming from both higher quality of the data and higher validity of the data for making cross-country comparisons.

Overall, the findings indicate that for the whole sector of the economy, comparative advantage is an important determinant of FDI for developed countries. Looking at the service industry and the agriculture and manufacturing industry separately reveals that the relationship between factor abundance and factor intensity of FDI seems to be much stronger in the service industry than in agriculture and manufacturing, though there are some country variations. Except for Italy, there is no evidence that factor contents of net exports and net inward FDI are positively correlated for the latter. That is, FDI in the agriculture and manufacturing sector appears to be motivated more by market access motives than low factor cost reasons. Finally, the findings also indicate that there is no clear pattern of how the link between FDI and comparative advantage varies by the different measures of FDI used. In particular, for Japan and the US, there is a stronger link between revealed comparative advantage and the short-run FDI measure. On the other hand, in the other three countries, the link is stronger when the long-run measure of FDI is used. Nevertheless, this finding highlights the potential robustness issues in any study which uses only one specific measure.

[3] The years of 1999 and, more significantly, 2000 have been characterized as the years with exceptionally high cross-border Merger and Acquisition activities. The total value world FDI inflows in 2000, for example, is more than twice the value in 1998 or 2001 (United Nations, 2002).

The rest of this paper is structured as follows. Section 2 discusses the background of the study. It is then followed by a discussion of the empirical framework and the data in Section 3. Section 4 reports and discusses the empirical finding. Finally, section 5 provides some concluding remarks.

2. Background of the study

In the last two decades, developed countries accounted for the bulk of world foreign direct investment (FDI) flows. In 1989, for example, they shared approximately 97% of global FDI outflows and 83% of inflows (United Nations, 1991). More recently, the share of developed countries was lower but still more than twice the share of developing countries. In 2001, developed countries accounted for around 94% of world FDI outflows and 68% of inflows (United Nations, 2002). Much earlier, Dunning (1993) observed a significant change in the pattern of foreign investment within developed countries themselves. In particular, he noted that foreign investors within these countries had shifted their location of interests from countries traditionally rich in resources, such as Canada and Australia, to top manufacturing countries such as the U.S. and Continental Europe.

Given the similarity of developed countries in terms of factor endowments such as labor and capital goods, these two observations appear to suggest the significance of motives other than those based on factor proportions theory in determining the global flows of FDI. In fact, more recent empirical works based on general-equilibrium theoretical models which categorize FDI as either vertical or horizontal seem to support such conclusions regarding the limitation of factor abundance as a determinant of FDI. For example, in their review of relevant literature, Markusen and Maskus (2002) found that most of FDI was of the horizontal type, the type arising mainly from market access motive. That is, FDI tended to flow among countries of similar relative endowments such as observed among developed

countries in response to high transportation costs or trade barriers. On the other hand, much less evidence has been found in support of vertical FDI–which is motivated more by relative factor endowments.[4] For example, in a vertical FDI, the low-skilled intensive process of production is conducted by an affiliate plant located in the foreign country, which output is intended to be exported back to the home country. However, Brainard (1997) finds that less than 13 percent of US foreign affiliates' production is shipped back to the home country and that foreign affiliates located in the US sent no more than 2 percents of their outputs back to their home countries. This evidence is a strong indication against the underlying idea of vertical FDI.

Early theory of the firm approach to the determinants and motivations that lead to the establishments of multinational corporations (MNCs) through FDI has been synthesized by Dunning (1977, 1981) into his Ownership, Location, and Internalization (OLI) paradigm.[5] Its basic idea is that in order to be able to compete in the foreign terrains, MNCs have to possess certain competitive advantages such as better production process, trademarks, or patents that national firms do not possess. In addition, there must be some location-advantages from operating in the foreign countries in order to supply their market directly rather than through exports. For example, a location advantage can be in the form of a lower production cost due to lower wage or costs of raw materials or avoidance of trade barriers. Finally, the establishment of foreign affiliates must be a reflection of the higher costs in alternative contractual arrangements including licensing or partnership relative to internalizing a foreign subsidiary.

Buckley and Casson (1976) and Caves (1982), as cited in Maskus and Webster (1995), for examples, argue that in order to exploit its advantages in technology, managerial techniques, or brand names, a firm will be more likely to choose FDI if other alternatives,

[4] However, see Braconier, Norback, and Urban (2002) and Davies (2002) for recent findings which seem to provide support for vertical FDI.
[5] Dunning (1993) provides a comprehensive review of the early literature on FDI.

such as licensing or exporting, for such exploitation are too costly. Furthermore, Buckley and Casson (1976) also argued that firms would search for cost minimizing production locations according to comparative advantage. Therefore, in this case, there will be a positive correlation between the pattern of inward FDI and the underlying pattern of the host country comparative advantage.[6]

The more recent literature, in particular from the general-equilibrium approach, divides foreign direct investment into vertical and/or horizontal FDI. The vertical model of multinational firm originates from the work of Helpman (1984), while Markusen (1984) started the early horizontal model. Markusen (1997) unified the vertical and horizontal models into what has been referred to as the knowledge-capital (KK) model.[7]

In a vertical FDI, production processes are assumed to be separable into parts which can be located in different geographical locations. For example, developing countries abundant in low-skilled labor will be targeted as the location for low-skilled labor intensive activities to produce goods or intermediates to be shipped back to the parent firms located in high-wage countries abundant in high-skilled labor. In this case, factor abundance is an important determinant of inward FDI.

The horizontal FDI, on the other hand, would establish multiple plants producing the same products in different locations in order to service local markets directly rather than through exports. Usually, the reason is to avoid trade barriers or high transportation costs. In other words, the main motivation of this type of FDI is usually for market access, rather than for finding low cost location.

[6] Another alternative approach such as Mundell (1957) views that when there is significant barrier to trade based on the Hecksher-Ohlin-Vanek principle, FDI would arise. Thus, capitals would flow to the economy with the higher relative return. This implies that the relationship between comparative advantage and the location of FDI is the reverse of the firm-specific advantage argument.

[7] See Markusen and Maskus for a review.

Most recently, the horizontal and vertical models are combined into a unified approach in Markusen's (1997) knowledge-capital model (KCM). There are several important predictions from the KCM model which reinforce the conclusion of earlier vertical and horizontal model of FDI. First, vertical FDI arises between countries which are different in their relative factor abundance. Second, affiliate production of horizontal multinationals would be most important for countries with relatively similar factor abundance and size. Therefore, one may expect that FDI flows between developed countries to involve horizontal multinational corporations rather than the vertical ones and, thus, are guided more by market access than by comparative advantage motivation.

Carr et al (2001) provide empirical supports for the above predictions.[8] In particular, they find that U.S. affiliate productions in non-developed countries are complements to trade, which is consistent with vertical FDI. On the other hand, U.S. affiliate productions in developed countries are substitutes to trade, which is consistent with horizontal FDI.

The above stylized facts and supporting theoretical predictions seem to lead the literature to a conclusion that it is market access motivation, rather than comparative advantage, which acts as the primary determinant of FDI. However, Yeaple (2003) cautioned that the literature might move to such conclusion a little too fast. He argued that the comparative advantage motivation for the international location of multinational production might still be important. In particular, he pointed out the need of relating the host country factor endowmenst and the factor intensity of FDI such as done by Maskus Webster (1995).

3. Analytical Framework and Data

This paper follows Maskus and Webster's (1995) analytical approach by relating a measure of which factors of production are the sources of comparative advantage and a

[8] However, see Blonigen, Davies, and Head (2003).

measure of which factors of production are used relatively more intensively by FDI. Both of these measures are constructed using the well established techniques of factor content analysis in the spirit of Heckscher-Ohlin-Vanek (HOV) theorem. The theorem starts with the following identity:

$$T_c = Q_c - C_c \tag{3.1}$$

where T_c, Q_c, and C_c are $n \times 1$ vectors of the amounts of net exports, output, and consumption, respectively, of a country *c; n* denotes the number of goods that are internationally, freely mobile. Thus, the above identity simply states that a country *c* trades the part of its production that is not consumed.

Assume identical homothetic preferences and free and frictionless trade with perfectly competitive market for goods and services. Then, C_c can be defined as a constant fraction $s_c = (Y_c - B_c)/Y_w$ of world production (Q_w), where *Y* is the value of gross domestic product and B_c is the value of country *c*'s trade balance. That is,

$$C_c = s_c Q_w \tag{3.2}$$

Let *A* be an $m \times n$ input-output matrix of any country where *m* denotes the number of production factors that are internationally perfectly immobile. In other words, a_{mn}, an element of *A* from row *m* and column *n*, represents how much of a factor *m* is needed to produce one unit of output in sector *n*. Then, $F_c = A_c T_c$ is the vector of country *c*'s factor content of net trade which indicates how much skilled labor, unskilled labor, capital, and so forth the country's net exports contain.

Let V_c and V_w denote the $m \times 1$ vectors of factor endowment for country *c* and the world. Assume that every country uses identical constant returns to scale technology and factor prices are equalized across countries. Then, $A_c = A_{c'} = A$, and, by definition, $V_c = AQ_c$ and

$V_w = AQ_w$. Therefore, pre-multiplying (3.1) and substituting (3.2) into the result yields a vector equation for country *c* with its *k*-th element given as

$$F_{kc} = V_{kc} - \left(\frac{Y_c - B_c}{Y_w} \right) V_{kw} \tag{3.3}$$

Equation (3.3) is the essence of the HOV theorem. The left hand side is the trade revealed factor endowments predicted by the theorem. If it is positive then country *c* is revealed to be abundant in factor *k*. The right hand side is the true relative factor endowment. If it is positive, then country *c* is truly relatively abundant in factor *k*.

Following Corvers and Reininga (1998), a further manipulation of (3.3) yields the following inequality that has to be satisfied for country *c* to be revealed more abundant in factor *k* than in factor k', $\frac{F_{kc}}{V_{kw}} > \frac{F_{k'c}}{V_{k'w}}$.[9] Pre-multiplying (3.2) with *A*, incorporating the definitions of *V*, and substituting the result to the previous inequality yields

$$\frac{F_{kc}}{F_{kc}^C} > \frac{F_{k'c}}{F_{k'c}^C} \tag{3.4}$$

where F_{kc}^C is the contents of factor *k* in the domestic consumption.

Intuitively, equation (3.4) states that if the ratio of the factor content of net trade to the factor content of domestic consumption for a production factor *k* is larger than the same ratio for production factor k', then, in country *c*, factor *k* is revealed to be more abundant than k'. In other words, the rank order of the factor content of ratios of net trade relative to consumption indicates the revealed relative factor abundance of the production factors within country *c*. The larger the ratio, the more abundant the factor is.

Similarly, we can assess the location of inward FDI using its factor content (Maskus and Webster, 1995). The basic idea is to measure where inward FDI is concentrated in terms of

[9] Rearranging (3.4) yields $\frac{F_{kc}/V_{kw}}{y_c/y_w} - \frac{B_c}{y_c} = \frac{V_{kc}/V_{kw}}{y_c/y_w}$. The left-hand-side still measures the trade revealed factor abundance for country *c* in terms of factor *k* and provides the basis for the inequality condition for the relative abundance of factor k with respect to k'.

factor intensity. Are they more concentrated in industrial activities which are intensive in high-skilled labors and capitals, or, are they more focused in activities intensive in low-skilled labors and natural resources? In other words, we want to measure the link between, on the one hand, the factor content of net exports (relative to consumption) which 'reveals' which factors are relatively abundant, and, on the other, the factor content of inward FDI which shows whether such investment is focused in industries intensive in the use of abundant factors. Because of the possibility of unaccounted intra-industry FDI patterns due to the use of highly aggregated FDI data, Maskus and Webster (1995) suggested the use of net inward investment, inward – outward, in computing the factor contents of FDI as explained earlier. In addition, because some industries may have higher volumes of investment than the others, they also suggested scaling the computed factor contents of FDI with the factor contents of domestic investment in each sector.

Denote F_{kc}^{*} and F_{kc}^{I} as the total contents of factor k in net inward FDI and domestic investment, respectively. Then, factor k is used more intensively by inward FDI than factor k' if the following inequality holds:

$$\frac{F_{kc}^{*}}{F_{kc}^{I}} > \frac{F_{k'c}^{*}}{F_{k'c}^{I}} \tag{3.5}$$

Data

To compute the factor content of net exports for each country we use the *OECD Input-Output Database* which is part of the "*STructural ANalysis* "(STAN) project conducted by the Economics Analysis and Statistics Division of the OECD Directorate for Science, Technology, and Industry. This database provides the 1990 input-output matrices as well as

export, import, output, and consumption vectors for each of the five countries being studied.[10] The OECD STAN database also provides us with data on sectoral Gross Fixed Capital Formation.

The foreign direct investment flows and stock data for all countries are obtained from *World Investment Directory 1992, Volumes I, 1993: United Nations: New York.* This publication reports FDI statistics of the 1987-1990 period for Italy, Japan, and the United States, and of the 1986-1989 period for France and the United Kingdom.

Finally, the labor skill data were taken from *OECD Data On Skills: Employment By Industry and Occupation* another project of the OECD Directorate for Science, Technology and Industry. This project provides occupation data disaggregated into four types: White-collar high-skill, White-collar low-skill, Blue-collar high-skill, and Blue-collar low skill. For France, Japan, and US the data period is 1990, for UK it is 1986, and for Italy it is 1991.

For more detailed explanation about the variables and data processing steps we refer to the Appendix.

4. Results

This section discusses the results from applying equations (3.4) and (3.5) separately on the corresponding data from each of the five developed countries in our sample. In the actual computation, this paper uses three different measures of net inward FDI depending on how long the period of the FDI data is used: long-run FDI stock, four-year accumulation of FDI flows, and one year FDI flows.[11] Furthermore, following Maskus and Webster (1995), we also produce three separate computations, depending on which sector is used: all sector, agricultural and manufacturing sector, and services sector.

[10] Davis and Weinstein (2001) summarized the reasons for why we should use individual country's technology matrix rather than forcing the assumption of identical technology and explained some desirable properties of more uniformly defined data.

[11] United Nations (1993) reported stock of net inward FDI for each country. The actual definition of the 'stock' data varies from country to country.

Given the potential inconsistency problems with the use of short-run FDI flows data as explained in the beginning, our results discussion focuses more on the results based on the long-run and medium-run measures of FDI. In addition, it should be noted that, for the denominator in equation (3.5), the computation of accumulated values of gross fixed capital formation for each country may differ depending on data availability. For example, four and eleven years of accumulation period are used to construct medium and long-term domestic capital stock whenever possible. For France, however, the available GFCF series at the desired aggregation level dictates the use of three year data (1987-1989) to construct such measure.

France

Table 1 summarizes the computed values of the factor contents of France's net exports relative to the factor contents of domestic consumption in 1990 (column 2), the factor contents of net stock of inward FDI in 1989 relative to the factor contents of accumulated gross fixed capital formation (column 3), the factor contents of net accumulated inflows of FDI in 1987-1989 relative to the factor contents of accumulated GFCF (column 4), and the factor content of net inflows of FDI relative to the factor contents of GFCF. All factor content values are provided separately for all sectors, agricultural and manufacturing sectors, and services sectors. In addition, the corresponding ranks are given in the parentheses.

As seen in Table 1, there seems to be a strong positive relationship between comparative advantage and long-run net inward FDI for the whole economy. The all-sector results show that France is a net exporter of the services of agricultural-related factors and white collar labors and a net importer of all other factor services. Furthermore, France appears to be a net recipient of FDI that concentrates on the intensive use of white collar labor. In other words,

Table 1: Factor contents of net exports and net inward FDI - France

Factors of Production	Net Exports	FDI Stock	Acc. FDI	FDI Flows
A. All sectors				
Agricultural resources	0.015 (1)	-0.489 (7)	-0.511 (7)	-1.143 (10)
Mining and Quarrying	-0.146 (12)	-2.345 (12)	-1.021 (12)	-1.429 (11)
Basic metal	-0.034 (8)	-1.244 (11)	-0.952 (11)	-1.641 (12)
Fabricated metal	-0.040 (9)	-0.778 (10)	-0.675 (10)	-1.031 (9)
Machinery, non-electrical	-0.060 (11)	-0.707 (9)	-0.588 (8)	-0.847 (7)
Office and Computing Machinery	-0.055 (10)	0.158 (3)	-0.155 (1)	-0.135 (3)
Electrical apparatus	-0.024 (7)	-0.319 (6)	-0.442 (6)	-0.442 (6)
Radio, TV & Telecommunication	-0.006 (5)	-0.536 (8)	-0.637 (9)	-0.856 (8)
White collar, high-skilled	0.000 (3)	0.450 (2)	-0.205 (2)	0.035 (2)
White collar, low-skilled	0.006 (2)	0.503 (1)	-0.268 (5)	0.066 (1)
Blue collar, high-skilled	-0.001 (4)	-0.019 (5)	-0.250 (4)	-0.303 (5)
Blue collar, low-skilled	-0.024 (6)	0.102 (4)	-0.232 (3)	-0.226 (4)
B. Agriculture & Manufacturing				
Agricultural resources	0.014 (1)	-0.616 (3)	-0.585 (2)	-1.329 (3)
Mining and Quarrying	-0.197 (12)	-3.722 (12)	-1.439 (12)	-2.328 (12)
Basic metal	-0.046 (4)	-1.416 (10)	-1.046 (9)	-1.887 (11)
Fabricated metal	-0.054 (5)	-1.265 (8)	-0.978 (6)	-1.624 (8)
Machinery, non-electrical	-0.096 (10)	-1.096 (4)	-0.751 (4)	-1.311 (2)
Office and Computing Machinery	-0.116 (11)	-0.024 (1)	-0.616 (3)	-1.464 (5)
Electrical apparatus	-0.077 (8)	-1.534 (11)	-1.124 (11)	-1.824 (10)
Radio, TV & Telecommunication	-0.013 (2)	-1.282 (9)	-1.114 (10)	-1.738 (9)
White collar, high-skilled	-0.069 (7)	-1.260 (7)	-1.040 (8)	-1.580 (7)
White collar, low-skilled	-0.063 (6)	-1.161 (6)	-0.973 (5)	-1.538 (6)
Blue collar, high-skilled	-0.014 (3)	-0.543 (2)	-0.457 (1)	-0.822 (1)
Blue collar, low-skilled	-0.079 (9)	-1.117 (5)	-0.994 (7)	-1.433 (4)
C. Services				
Agricultural resources	0.039 (1)	0.621 (2)	0.097 (1)	0.163 (3)
Mining and Quarrying	0.011 (11)	0.021 (10)	-0.300 (10)	-0.071 (10)
Basic metal	0.023 (4)	-0.039 (12)	-0.335 (12)	-0.103 (12)
Fabricated metal	0.015 (8)	0.203 (7)	-0.121 (6)	0.033 (8)
Machinery, non-electrical	0.013 (10)	0.015 (11)	-0.314 (11)	-0.095 (11)
Office and Computing Machinery	0.019 (6)	0.187 (8)	-0.082 (4)	0.076 (7)
Electrical apparatus	0.009 (12)	0.078 (9)	-0.219 (9)	-0.016 (9)
Radio, TV & Telecommunication	0.025 (3)	0.232 (6)	-0.087 (5)	0.081 (6)
White collar, high-skilled	0.019 (7)	0.611 (3)	-0.128 (7)	0.166 (2)
White collar, low-skilled	0.019 (5)	0.633 (1)	-0.215 (8)	0.170 (1)
Blue collar, high-skilled	0.014 (9)	0.468 (5)	-0.070 (3)	0.091 (5)
Blue collar, low-skilled	0.028 (2)	0.560 (4)	0.021 (2)	0.150 (4)

( ): Rank
Acc. FDI = Accumulated FDI Flows

the factor content of net exports shows that France is relatively abundant in factors related to agricultural resources and white collar labor and at the same time inward FDI tends to be concentrated in the use of the relatively abundant white collar labors. In addition, France is

revealed to be relatively scarce in non-agricultural resources and basic capital goods. At the same time, net inward FDI is least concentrated in the use of these factors. Finally, both the medium- and short-run measures of FDI seem to exhibit ranking similar to the long-run measure, indicating a similar fit between relative factor abundance and the shorter term FDI location.

From the same table, however, we can also see that the relationship between the factor contents of net trade and the factor contents of inward FDI is less clear when we exclude the service sector. The exclusion of services from the analysis shows that France is revealed to be abundant only in agricultural resources and no longer a net recipient of FDI in any factor. Though net inward FDI targeted for the use of agricultural services is still ranked high, it is not the highest. Non-basic physical capital such as non-electrical machinery and office and computing machinery are both revealed to be relatively scarcer than other factors. Yet, long-term net inward FDI is relatively more concentrated in activities highly intensive in the use of these factors.

Fontagne and Pajot (1997) found that French FDI outflows increased French exports of inputs and complementary final products to French affiliates in the foreign countries. At the same time, inflows of FDI in France were usually aimed at gaining an entry to the European market. The first observation implies a negative correlation between the factor contents of France's net inward FDI and net exports, while the second implies a possible positive correlation. The net result seems to be consistent with the low correlation we find for the agriculture and manufacturing sector.

In contrast, the results of the service-sector show a stronger match between the pattern of net inward FDI and revealed comparative advantage. In the service sector, France is a net exporter of all factors and, in the long-run, a net recipient of FDI in all factors but basic

Table 2: Rank Correlation – France

	Rank Correlation Coefficient	t-stat
A. Net exports & stock of net inward FDI		
All Sectors	0.594	2.337
Agriculture and Manufacturing	0.091	0.289
Services	0.503	1.843
B. Net exports & accumulated inflows of FDI		
All Sectors	0.399	1.374
Agriculture and Manufacturing	0.266	0.872
Services	0.538	2.021
C. Net exports & inflow of FDI		
All Sectors	0.371	1.262
Agriculture and Manufacturing	0.147	0.470
Services	0.476	1.709

metal.[12] In the service sectors, net inward FDI tends to be more focused in the activities which use agricultural resources and low-skilled blue-collar labors which are revealed to be abundant. Furthermore, net inward FDI is less focused on the intensive use of relatively scarce factors such as mining and quarrying and non-electrical machinery.

Table 2 provides the rank correlation coefficient between comparative advantage and net inward FDI. The correlation coefficients for all-sector and services are high (0.594 and 0.503, respectively) and statistically significant. However, the correlation coefficient for agriculture and manufacturing sector is small and insignificant. These confirm our earlier observation of a weaker match for the non-services sector and stronger match for the services sector. In addition, even for the all-sector result, the correlation coefficient between inward FDI and comparative advantage is still far from perfect, indicating that comparative advantage is not the only determinant of FDI. Finally, the coefficients vary across the three different measures of FDI, with those based on the one-year flow observation as the smallest of the three groups.

[12] Notice also that for the service sector, FDI is a net source of FDI in all but one sector, but is a net recipient of the single year FDI flow. This evidence reflects the effect of fluctuations in FDI flows and provides an indication of the possible inconsistencies in factor content analysis based on short-run data.

Italy

Table 3 summarizes the results of factor contents computation of Italian net exports, net stock of inward FDI, net accumulated inflows of FDI, and net inflow FDI. The all-sector results indicate that Italy is a net exporter of the services of all factors except natural resources and blue-collar high-skilled labor. More importantly, both long-term and medium-term net inward FDI tend to avoid activities with intensive use of scarce factors and to be more concentrated in activities which uses more abundant factors such as capital more intensively. For example, four of the six measures of capitals (basic metal, fabricated metal, non-electrical machinery, office and computing machinery, and radio, TV and telecommunication equipment) receive high rankings in both relative abundance and relative intensity inward FDI. The factor services of which Italy is a net importer occupy the three lowest ranks in terms of the factor intensity of net inward FDI.

The exclusion of services from the analysis does not change much of the rankings of revealed factor abundance and factor intensity of net inward FDI. For agriculture and manufacturing sector, capital is revealed to be most abundant and this is matched by high concentration of net inward FDI in utilizing these factors.

The exclusion of non-services, however, changes the ranking more significantly. For the service sector, low-skilled workers and natural resources are revealed to be abundant. Yet, activities intensive in the use of natural resources receive relatively less inward FDI. Thus, the relationship between factor endowment and the location of FDI seems to be stronger in the non-service industry than in the service industry.

Such conclusion is supported by the rank correlation coefficients reported in Table 4. Based on the FDI stock data, the rank correlation coefficient for non-services is higher (0.587) and more significant than the coefficient for services (0.385). Furthermore, Italy seems to exhibit a stronger match between the pattern of factor abundance and the location of

Table 3: Factor contents of net exports and net inward FDI – Italy

Factors of Production	Net Exports	FDI Stock	Acc. FDI	FDI Flows
A. All sectors				
Agricultural resources	-0.078 (12)	0.022 (3)	0.032 (3)	0.032 (2)
Mining and Quarrying	-0.021 (11)	0.004 (11)	0.003 (10)	-0.013 (6)
Basic metal	0.056 (3)	0.004 (9)	0.026 (4)	-0.070 (12)
Fabricated metal	0.032 (4)	0.020 (4)	0.025 (5)	-0.021 (10)
Machinery, non-electrical	0.072 (2)	0.039 (2)	0.036 (2)	0.012 (3)
Office and Computing Machinery	0.157 (1)	0.061 (1)	0.053 (1)	0.040 (1)
Electrical apparatus	0.006 (9)	0.013 (6)	0.007 (8)	-0.007 (5)
Radio, TV & Telecommunication	0.026 (5)	0.013 (5)	0.008 (7)	-0.020 (9)
White collar, high-skilled	0.012 (8)	0.004 (8)	-0.006 (12)	-0.016 (8)
White collar, low-skilled	0.020 (6)	0.004 (10)	-0.004 (11)	0.001 (4)
Blue collar, high-skilled	-0.019 (10)	0.001 (12)	0.011 (6)	-0.034 (11)
Blue collar, low-skilled	0.016 (7)	0.006 (7)	0.003 (9)	-0.015 (7)
B. Agriculture & Manufacturing				
Agricultural resources	-0.087 (12)	0.027 (6)	0.044 (6)	0.048 (3)
Mining and Quarrying	-0.043 (11)	0.006 (10)	0.013 (12)	-0.016 (5)
Basic metal	0.066 (3)	0.005 (11)	0.035 (8)	-0.101 (12)
Fabricated metal	0.046 (4)	0.039 (3)	0.060 (3)	-0.031 (7)
Machinery, non-electrical	0.100 (2)	0.077 (2)	0.081 (2)	0.050 (2)
Office and Computing Machinery	0.204 (1)	0.113 (1)	0.109 (1)	0.336 (1)
Electrical apparatus	0.007 (8)	0.028 (5)	0.028 (9)	0.007 (4)
Radio, TV & Telecommunication	0.041 (5)	0.030 (4)	0.039 (7)	-0.032 (8)
White collar, high-skilled	0.022 (6)	0.016 (7)	0.047 (4)	-0.060 (11)
White collar, low-skilled	0.007 (7)	0.012 (8)	0.046 (5)	-0.057 (10)
Blue collar, high-skilled	-0.029 (10)	0.000 (12)	0.025 (11)	-0.047 (9)
Blue collar, low-skilled	-0.012 (9)	0.011 (9)	0.027 (10)	-0.022 (6)
C. Services				
Agricultural resources	0.026 (3)	0.005 (1)	-0.011 (9)	-0.021 (12)
Mining and Quarrying	0.029 (2)	0.003 (10)	-0.002 (1)	-0.011 (2)
Basic metal	0.003 (12)	0.003 (12)	-0.009 (7)	-0.015 (7)
Fabricated metal	0.006 (8)	0.003 (9)	-0.010 (8)	-0.014 (6)
Machinery, non-electrical	0.017 (5)	0.003 (5)	-0.010 (6)	-0.017 (9)
Office and Computing Machinery	0.005 (11)	0.004 (3)	-0.014 (12)	-0.021 (11)
Electrical apparatus	0.005 (10)	0.003 (11)	-0.008 (4)	-0.014 (5)
Radio, TV & Telecommunication	0.006 (9)	0.004 (4)	-0.012 (11)	-0.018 (10)
White collar, high-skilled	0.010 (6)	0.003 (6)	-0.011 (10)	-0.013 (4)
White collar, low-skilled	0.023 (4)	0.003 (8)	-0.008 (3)	0.005 (1)
Blue collar, high-skilled	0.007 (7)	0.003 (7)	-0.009 (5)	-0.015 (8)
Blue collar, low-skilled	0.041 (1)	0.004 (2)	-0.006 (2)	-0.013 (3)

( ): Rank
Acc. FDI = Accumulated FDI Flows

inward FDI than France. This is especially clear if we look at the coefficients based on the accumulated FDI data.

Table 4: Rank Correlation – Italy

	Rank Correlation Coefficient	t-stat
A. Net exports & stock of net inward FDI		
All Sectors	0.490	1.775
Agriculture and Manufacturing	0.587	2.295
Services	0.385	1.318
B. Net exports & accumulated inflows of FDI		
All Sectors	0.476	1.709
Agriculture and Manufacturing	0.727	3.351
Services	0.559	2.134
C. Net exports & inflow of FDI		
All Sectors	0.021	0.066
Agriculture and Manufacturing	0.035	0.111
Services	0.406	1.403

Like in the France case, if we compare the correlation coefficients across the three different measure of FDI, the measure based on one-year flow data exhibit the weakest link between FDI and comparative advantage. One possible explanation to the weak fit of the short term is that net exports in both countries are less sensitive to possible common sources of short-run fluctuation, such as exchange rate movements, which affect short-run FDI flow more strongly.

Japan

Table 5 reports the results of factor contents computation of net exports and net inward FDI relative to domestic consumption and investment, respectively. One important difference between Japan and France or Italy or any other developed country is the fact that Japan is the largest net source of FDI outflows. This is shown by all negative signs in the factor content values of inward FDI indicating that there is instead a net outward FDI in all factors.

The all-sector results show that the relationship between factor endowment and inward FDI is much weaker than in the case of France or Italy. In particular, Japan is revealed to be abundant in non-basic capital such as radio, TV, and communication equipment and office

Table 5: Factor contents of net exports and net inward FDI – Japan

Factors of Production	Net Exports	FDI Stock	Acc. FDI	FDI Flows
A. All sectors				
Agricultural resources	-0.098 (11)	-0.079 (6)	-0.129 (7)	-0.114 (7)
Mining and Quarrying	-0.108 (12)	-0.086 (7)	-0.083 (2)	-0.072 (2)
Basic metal	0.013 (5)	-0.067 (4)	-0.096 (6)	-0.082 (3)
Fabricated metal	-0.003 (6)	-0.065 (2)	-0.090 (4)	-0.084 (4)
Machinery, non-electrical	0.059 (4)	-0.069 (5)	-0.087 (3)	-0.090 (5)
Office and Computing Machinery	0.091 (3)	-0.040 (1)	-0.042 (1)	-0.058 (1)
Electrical apparatus	0.120 (2)	-0.149 (9)	-0.214 (9)	-0.243 (9)
Radio, TV & Telecommunication	0.137 (1)	-0.181 (10)	-0.269 (10)	-0.320 (11)
White collar, high-skilled	-0.024 (8)	-0.238 (12)	-0.319 (12)	-0.325 (12)
White collar, low-skilled	-0.019 (7)	-0.218 (11)	-0.269 (11)	-0.269 (10)
Blue collar, high-skilled	-0.064 (9)	-0.065 (3)	-0.095 (5)	-0.098 (6)
Blue collar, low-skilled	-0.068 (10)	-0.147 (8)	-0.179 (8)	-0.185 (8)
B. Agriculture & Manufacturing				
Agricultural resources	-0.113 (10)	-0.057 (4)	-0.099 (5)	-0.085 (4)
Mining and Quarrying	-0.153 (11)	-0.051 (3)	-0.048 (2)	-0.027 (1)
Basic metal	0.015 (5)	-0.070 (6)	-0.103 (6)	-0.088 (5)
Fabricated metal	-0.010 (6)	-0.094 (9)	-0.138 (10)	-0.140 (10)
Machinery, non-electrical	0.081 (4)	-0.049 (2)	-0.069 (3)	-0.082 (3)
Office and Computing Machinery	0.107 (3)	-0.020 (1)	-0.020 (1)	-0.045 (2)
Electrical apparatus	0.171 (1)	-0.194 (11)	-0.286 (11)	-0.349 (11)
Radio, TV & Telecommunication	0.155 (2)	-0.208 (12)	-0.313 (12)	-0.386 (12)
White collar, high-skilled	-0.055 (7)	-0.084 (7)	-0.115 (8)	-0.129 (8)
White collar, low-skilled	-0.061 (8)	-0.085 (8)	-0.115 (9)	-0.128 (7)
Blue collar, high-skilled	-0.086 (9)	-0.058 (5)	-0.087 (4)	-0.091 (6)
Blue collar, low-skilled	-0.159 (12)	-0.100 (10)	-0.110 (7)	-0.133 (9)
C. Services				
Agricultural resources	-0.004 (10)	-0.224 (10)	-0.289 (10)	-0.223 (10)
Mining and Quarrying	-0.001 (8)	-0.184 (9)	-0.171 (8)	-0.158 (8)
Basic metal	-0.004 (7)	-0.047 (1)	-0.052 (1)	-0.046 (1)
Fabricated metal	0.001 (6)	-0.047 (2)	-0.063 (2)	-0.055 (2)
Machinery, non-electrical	0.009 (2)	-0.109 (6)	-0.121 (4)	-0.105 (4)
Office and Computing Machinery	0.016 (1)	-0.119 (7)	-0.131 (6)	-0.108 (5)
Electrical apparatus	0.003 (4)	-0.082 (3)	-0.108 (3)	-0.095 (3)
Radio, TV & Telecommunication	0.008 (3)	-0.100 (5)	-0.133 (7)	-0.121 (7)
White collar, high-skilled	-0.012 (12)	-0.304 (12)	-0.392 (12)	-0.388 (12)
White collar, low-skilled	-0.004 (11)	-0.266 (11)	-0.319 (11)	-0.309 (11)
Blue collar, high-skilled	-0.001 (9)	-0.088 (4)	-0.122 (5)	-0.117 (6)
Blue collar, low-skilled	0.002 (5)	-0.174 (8)	-0.213 (9)	-0.207 (9)

( ): Rank
Acc. FDI = Accumulated FDI Flows

and computing machinery, yet inward FDI is the among the least intensive in these factors. In other words, since Japan is a net source of FDI, Japanese outward FDI seems to follow the

same comparative advantage exhibited by Japanese exports. This seems to be a better match to the 'market access' motivation for Japanese outward FDI.

Excluding services from the analysis of the factor contents indicates a similar poor fit between factor endowment and net inward FDI. In addition to the lack of concentration of net inward FDI in activities intensive in the abundant non-basic capitals, there is a tendency for concentration in activities intensive in scarce natural resources. This finding also supports the notion that Japanese FDI might seek market access for its manufacturing and other non-service products.

The rank correlation coefficients of factor content of net trade and net inward FDI are reported in Table 6. These coefficients allow us to assess more objectively the strength of the relationship between comparative advantage and net inward FDI. As can be seen from that table, the all-sector correlation is negative for the case of short-run FDI. The non-service sector's correlation coefficient is also negative, indicating a possibly reversed link between factor abundance and net inward FDI. However, none of these negative correlations is statistically significant.

Table 6: Rank Correlation – Japan

	Rank Correlation Coefficient	t-stat
A. Net exports & stock of net inward FDI		
All Sectors	0.042	0.133
Agriculture and Manufacturing	-0.182	-0.585
Services	0.497	1.809
B. Net exports & accumulated inflows of FDI		
All Sectors	-0.077	-0.244
Agriculture and Manufacturing	-0.329	-1.101
Services	0.545	2.058
C. Net exports & inflow of FDI		
All Sectors	-0.105	-0.334
Agriculture and Manufacturing	-0.308	-1.023
Services	0.601	2.380

There is one possible explanation to the negative correlation in Japanese agriculture and manufacturing industry. Such a negative correlation can be interpreted as a positive correlation between Japanese net outward FDI and its comparative advantage. In other words, the negative correlation we find means Japanese outward FDI and exports move in the same direction. This seems to be consistent with existing evidence. Dunning (1986, pp. 103-118), for example, found that Japanese manufacturing affiliates in British industry imported 58% of their supplies. Approximately 90% of these recurrent imports were imported from Japan. Such high import ratios were necessary due to the tendency of Japanese affiliates' product to be based on Japanese specifications and originally designed with the Japanese market in mind.[13] In addition, Caves (1993) notes that US trade restrictions boosted Japanese outward FDI to the US and certain East Asian Countries for building them as Japanese export platforms.

In contrast to the agriculture and manufacturing sector, the correlation coefficient for the service sector is consistently positive and statistically significant across the three different measures of FDI. So, in the services industry, comparative advantage is an important determinant of FDI location in Japan.

Finally, the correlation coefficient based on the one-year inflow data (the short-run FDI) seems to be higher than in the previous two countries. This indicates that the difference between the role of comparative advantage in short-run and in long-run may not be straight forward. That is, the link between factor abundance and net inward FDI is not always weaker in the short run than in the long-run. One possible explanation to this finding is that there may be common sources of short-run fluctuations of Japanese net exports and net outward FDI such as exchange rates. In fact, Dunning (1993) noted that Japan and Germany were two industrial countries with most improved outward/inward capital stakes resulting from the

[13] Bayoumi and Lipworth (1997) also argued that Japanese FDI outflows led to a short-run increase in Japanese exports since the new facilities in the foreign locations usually required Japanese capital goods.

rapid appreciation of their currencies. In addition, Bayoumi and Lipworth (1997) found that since the early 1980s, Japanese outward FDI had exhibited significant cyclical pattern they attributed partly to the movements in Japanese currency.

United Kingdom

Table 7 summarizes the computed values and rankings of UK factor contents of net exports in 1990, stock of net inward FDI in 1989, accumulated flows of net inward FDI in 1986-1989, and net inflow FDI in 1989. For the whole economy, the relationship between revealed factor abundance and each pattern of FDI is weaker than in the case of Italy or even France. Though there is a higher concentration of net inward FDI in activities intensive in the use of energy natural resources, which is revealed to be abundant, net inward FDI tends to be focused on non-basic capital (machineries and electrical apparatus) intensive activity which are revealed to be relatively scarce.

The exclusion of services from the analysis also shows a similarly weak match between revealed comparative advantage and inward FDI. However, the service sector alone seems to show stronger fit. For example, net inward FDI in services is focused on capital intensive activities which are revealed to be abundant by the factor contents of net exports in services. Furthermore, net inward FDI is less focused on activities intensive in the use of relatively scarce labor.

Table 8 reports the rank correlation coefficients of the factor contents summarized in the previous table. Overall, the relationship between net inward FDI and revealed comparative advantage is not statistically significant, except when we use the accumulated FDI-which is borderline significant at 10% level. Also, the service sector seems to indicate a stronger

Table 7: Factor contents of net exports and net inward FDI – UK

Factors of Production	Net Exports	FDI Stock	Acc. FDI	FDI Flows
A. All sectors				
Agricultural resources	-0.123 (7)	-0.347 (12)	-0.469 (12)	-0.803 (12)
Mining and Quarrying, energy	-0.063 (2)	-0.080 (2)	-0.032 (1)	0.022 (3)
Basic metal	-0.153 (11)	-0.149 (8)	-0.182 (7)	-0.103 (8)
Fabricated metal	-0.124 (9)	-0.284 (11)	-0.299 (11)	-0.309 (11)
Machinery, non-electrical	-0.114 (4)	-0.134 (5)	-0.098 (3)	0.029 (2)
Office and Computing Machinery	-0.151 (10)	-0.090 (3)	-0.162 (6)	0.008 (4)
Electrical apparatus	-0.123 (8)	-0.077 (1)	-0.079 (2)	0.080 (1)
Radio, TV & Telecommunication	-0.177 (12)	-0.146 (7)	-0.195 (9)	-0.009 (5)
White collar, high-skilled	-0.069 (3)	-0.137 (6)	-0.141 (5)	-0.070 (7)
White collar, low-skilled	-0.060 (1)	-0.131 (4)	-0.135 (4)	-0.064 (6)
Blue collar, high-skilled	-0.119 (5)	-0.165 (9)	-0.188 (8)	-0.128 (9)
Blue collar, low-skilled	-0.122 (6)	-0.181 (10)	-0.198 (10)	-0.145 (10)
B. Agriculture & Manufacturing				
Agricultural resources	-0.144 (2)	-0.408 (12)	-0.591 (12)	-1.084 (12)
Mining and Quarrying, energy	-0.106 (1)	-0.138 (3)	-0.045 (1)	0.042 (3)
Basic metal	-0.182 (5)	-0.162 (5)	-0.217 (4)	-0.114 (6)
Fabricated metal	-0.185 (6)	-0.382 (11)	-0.454 (10)	-0.476 (11)
Machinery, non-electrical	-0.157 (3)	-0.150 (4)	-0.110 (2)	0.056 (2)
Office and Computing Machinery	-0.182 (4)	-0.115 (1)	-0.266 (5)	-0.004 (4)
Electrical apparatus	-0.206 (10)	-0.121 (2)	-0.187 (3)	0.246 (1)
Radio, TV & Telecommunication	-0.230 (12)	-0.287 (8)	-0.484 (11)	-0.048 (5)
White collar, high-skilled	-0.189 (7)	-0.293 (9)	-0.376 (8)	-0.195 (8)
White collar, low-skilled	-0.195 (8)	-0.330 (10)	-0.424 (9)	-0.292 (10)
Blue collar, high-skilled	-0.207 (11)	-0.219 (6)	-0.296 (6)	-0.195 (9)
Blue collar, low-skilled	-0.196 (9)	-0.250 (7)	-0.322 (7)	-0.188 (7)
C. Services				
Agricultural resources	-0.034 (8)	-0.126 (12)	-0.128 (12)	-0.062 (10)
Mining and Quarrying, energy	-0.011 (3)	-0.021 (1)	-0.021 (3)	-0.027 (4)
Basic metal	-0.009 (1)	-0.094 (6)	-0.056 (5)	-0.059 (9)
Fabricated metal	-0.013 (4)	-0.108 (7)	-0.075 (7)	-0.055 (6)
Machinery, non-electrical	-0.011 (2)	-0.078 (5)	-0.068 (6)	-0.058 (8)
Office and Computing Machinery	-0.030 (6)	-0.044 (3)	-0.020 (2)	0.025 (1)
Electrical apparatus	-0.031 (7)	-0.049 (4)	-0.029 (4)	-0.004 (3)
Radio, TV & Telecommunication	-0.036 (9)	-0.028 (2)	-0.010 (1)	0.017 (2)
White collar, high-skilled	-0.041 (11)	-0.114 (10)	-0.111 (10)	-0.055 (7)
White collar, low-skilled	-0.037 (10)	-0.112 (8)	-0.109 (9)	-0.044 (5)
Blue collar, high-skilled	-0.027 (5)	-0.113 (9)	-0.106 (8)	-0.077 (11)
Blue collar, low-skilled	-0.042 (12)	-0.123 (11)	-0.117 (11)	-0.116 (12)

( ): Rank
Acc. FDI = Accumulated FDI Flows

match than the non-service sector, though the correlation coefficient is not large enough to be statistically significant. Finally, as in the France and Italy, the one-year flow correlation is the smallest among the three measures of FDI perhaps reflecting less comparative advantage influence in the short-run FDI decision.

Table 8: Rank Correlation – UK

	Rank Correlation Coefficient	t-stat
A. Net exports & stock of net inward FDI		
All Sectors	0.259	0.847
Agriculture and Manufacturing	0.105	0.334
Services	0.469	1.677
B. Net exports & accumulated inflows of FDI		
All Sectors	0.490	1.775
Agriculture and Manufacturing	0.301	0.997
Services	0.448	1.583
C. Net exports & inflow of FDI		
All Sectors	0.126	0.401
Agriculture and Manufacturing	0.042	0.133
Services	0.035	0.111

There is one important difference between our findings and those of Maskus and Webster (1995). Unlike ours, their study found significant positive correlations between revealed factor abundance of UK net exports and the factor intensity patterns of UK net inwards FDI. This is probably due to the fact that we use data from different years (1990 net exports data and 1989 FDI flow data) while they used data from the same years (1989).[14] In some sense, however, it is plausible that our results are more consistent with the results of Nachum, Dunning, and Jones (2000) that there was a significant positive correlation between UK *outward* FDI and its revealed comparative advantage. As noted earlier, a positive correlation of outward FDI and factor abundance is equivalent to a negative correlation in our analytical framework. Since Nachum, Dunning, and Jones (2000) use a gross measure, instead of a *net* measure, of outward FDI, it is plausible that the correlation they found would turn out to be smaller if net outward FDI were used.[15]

Furthermore, for the service sector, Maskus and Webster (1995) found that UK is a net exporter of factor services in half of the factors they list. In contrast to their finding, we find

[14] Unfortunately, the STAN database we use only provides UK technology and trade data for 1990, while the United Nations FDI statistics for UK only available for 1989.
[15] It is also possible for the patterns of inward FDI to completely dominate the outward patterns resulting in Maskus and Webster's findings.

that UK is a net importer of all factors in agriculture and manufacturing sector and in services. These seemingly contradictory findings raise an important flag regarding the appropriateness of using a single year trade data in any factor content analysis, especially if trade pattern is sensitive with sources of short-term fluctuations such as the exchange rate movement or other factors.

United States

Table 9 summarizes the values and rankings of US factor contents of net exports relative to domestic consumption, stock of net inward FDI relative to accumulated GFCF, accumulated net inflows of FDI relative to accumulated GFCF, and net inflow of FDI in relative to GFCF.

The all-sector results based on the long-run FDI data indicates a weak match between factor abundance and the focus of net inward FDI. For example, long-run net inward FDI tend to be more focused on, the relatively scarce, non-agricultural natural resources intensive activities and less focused on, the relatively more abundant, basic capital intensive activities and high-skilled labor. The short-run measure of FDI, however, shows much less intensity in the scarce factors and more intensity in the abundant factors.

However, the exclusion of the service sector from the computation of factor contents weakens the link between factor abundance and the location of FDI. Such a weak correlation seems to be consistent with the findings of Feliciano and Lipsey (2002). In particular, Feliciano and Lipsey (2002) found that foreign acquisitions and new establishments in the US manufacturing industry were more likely to occur in the sectors in which the US had comparative disadvantage while the investing country had some comparative advantage in exporting. Furthermore, Lipsey (2000) also found significant evidence that the manufacturing sectors in which US had comparative disadvantages, such as apparel and textiles and stone

clay and glass products, were more likely to have higher shares of inward FDI production than outward FDI.

Table 9: Factor contents of net exports and net inward FDI – US

Factors of Production	Net Exports	FDI Stock	Acc. FDI	FDI Flows
A. All sectors				
Agricultural resources	0.014 (2)	0.021 (4)	0.108 (5)	-0.070 (13)
Mining and Quarrying, non-energy	-0.044 (12)	0.051 (2)	0.132 (2)	-0.034 (11)
Mining and Quarrying, energy	-0.044 (11)	0.051 (1)	0.133 (1)	-0.038 (10)
Basic metal	-0.012 (7)	0.007 (8)	0.128 (3)	0.089 (1)
Fabricated metal	-0.015 (8)	0.004 (10)	0.105 (6)	0.007 (7)
Machinery, non-electrical	-0.025 (9)	-0.027 (11)	0.096 (8)	0.029 (5)
Office and Computing Machinery	-0.011 (6)	-0.061 (13)	0.107 (4)	-0.008 (9)
Electrical apparatus	-0.035 (10)	-0.030 (12)	0.073 (12)	-0.001 (8)
Radio, TV & Telecommunication	-0.071 (13)	0.005 (9)	0.083 (11)	-0.069 (12)
White collar, high-skilled	0.012 (3)	0.027 (3)	0.102 (7)	0.066 (2)
White collar, low-skilled	0.022 (1)	0.012 (7)	0.070 (13)	0.047 (3)
Blue collar, high-skilled	-0.000 (4)	0.018 (5)	0.090 (10)	0.039 (4)
Blue collar, low-skilled	-0.007 (5)	0.016 (6)	0.093 (9)	0.026 (6)
B. Agriculture & Manufacturing				
Agricultural resources	0.011 (1)	0.017 (3)	0.108 (11)	-0.096 (12)
Mining and Quarrying, non-energy	-0.069 (11)	0.067 (1)	0.185 (1)	-0.067 (11)
Mining and Quarrying, energy	-0.069 (10)	0.067 (2)	0.185 (2)	-0.067 (10)
Basic metal	-0.019 (2)	0.005 (5)	0.140 (6)	0.099 (1)
Fabricated metal	-0.043 (6)	-0.009 (10)	0.137 (7)	-0.008 (7)
Machinery, non-electrical	-0.052 (8)	-0.052 (11)	0.106 (12)	0.018 (2)
Office and Computing Machinery	-0.026 (3)	-0.099 (13)	0.157 (3)	-0.024 (9)
Electrical apparatus	-0.083 (12)	-0.062 (12)	0.088 (13)	-0.020 (8)
Radio, TV & Telecommunication	-0.118 (13)	-0.002 (7)	0.127 (9)	-0.132 (13)
White collar, high-skilled	-0.035 (4)	-0.006 (9)	0.136 (8)	-0.001 (5)
White collar, low-skilled	-0.040 (5)	-0.000 (6)	0.151 (5)	0.017 (3)
Blue collar, high-skilled	-0.057 (9)	-0.004 (8)	0.151 (4)	0.016 (4)
Blue collar, low-skilled	-0.046 (7)	0.006 (4)	0.124 (10)	-0.002 (6)
C. Services				
Agricultural resources	0.043 (1)	0.045 (1)	0.101 (1)	0.090 (1)
Mining and Quarrying, non-energy	0.005 (13)	0.015 (10)	0.041 (11)	0.015 (12)
Mining and Quarrying, energy	0.005 (12)	0.017 (9)	0.044 (10)	0.018 (10)
Basic metal	0.008 (11)	0.021 (8)	0.054 (8)	0.022 (9)
Fabricated metal	0.009 (10)	0.029 (4)	0.059 (7)	0.030 (7)
Machinery, non-electrical	0.017 (8)	0.033 (2)	0.075 (3)	0.052 (4)
Office and Computing Machinery	0.021 (5)	0.002 (13)	0.037 (12)	0.017 (11)
Electrical apparatus	0.015 (9)	0.024 (7)	0.052 (9)	0.028 (8)
Radio, TV & Telecommunication	0.020 (7)	0.015 (11)	0.034 (13)	0.008 (13)
White collar, high-skilled	0.021 (6)	0.033 (3)	0.096 (2)	0.077 (2)
White collar, low-skilled	0.031 (3)	0.013 (12)	0.063 (5)	0.050 (5)
Blue collar, high-skilled	0.021 (4)	0.028 (5)	0.064 (4)	0.049 (6)
Blue collar, low-skilled	0.039 (2)	0.026 (6)	0.063 (6)	0.056 (3)

( ): Rank
Acc. FDI = Accumulated FDI Flows

On the other hand, restricting only on services gives a stronger match between the two patterns, especially those based on the short-run FDI measures. Unfortunately, we were not aware of available empirical evidence of FDI in the US services industry to compare with.

The rank correlation coefficients of the factor contents are reported in Table 10. For the US, services exhibit a stronger link between comparative advantage and net inward FDI. In addition, similar to the case of Japan, short-run FDI seems to be more influenced by comparative advantage consideration than long-run FDI as shown by the stock data.

Table 10: Rank Correlation – US

	Rank Correlation Coefficient	t-stat
A. Net exports & stock of net inward FDI		
All Sectors	0.121	0.404
Agriculture and Manufacturing	-0.027	-0.091
Services	0.203	0.689
B. Net exports & accumulated inflows of FDI		
All Sectors	-0.247	-0.846
Agriculture and Manufacturing	0.000	0.000
Services	0.527	2.059
C. Net exports & inflow of FDI		
All Sectors	0.462	1.726
Agriculture and Manufacturing	0.335	1.180
Services	0.637	2.743

5. Conclusion

Traditional theories of multinational corporations look at foreign direct investment as a response to international differences in factor abundance. However, such a view seems to be against the recent stylized facts of FDI, such as the large concentration of FDI flows among developed countries similar in factor endowments. Furthermore, in a recent survey, Markusen and Maskus (2002) noted that there existed little empirical evidence that formally tested the hypothesis that the pattern of FDI inflows vary according to factor endowments. They also

noted that Maskus and Webster (1995) is one simple exception. In this paper, we seek to extend Maskus and Webster (1995) by studying four additional developed countries, constructing FDI measures which are more appropriate for long-run analysis, and using better data with more uniformly defined technological matrix, trade, and production variables.

Overall, our all-sector results suggest that comparative advantage is still an important determinant of FDI even for developed countries. However, the link seems to vary in strength, and sometimes in direction, from countries to countries. Furthermore, when we split the economy into services and non-services, the relationship between factor abundance and factor intensity of FDI seems to be much stronger in the service industry than in agriculture and manufacturing. . In fact, except for Italy, we do not find any significant evidence that the factor contents of net exports and net inward FDI are positively correlated for the non-services sector. That is, FDI in the agriculture and manufacturing sector appears to be motivated by market access motives than low factor cost reasons.

In light of the second finding, it is quite unfortunate that the bulk of empirical studies of FDI often only look at non-services sector. [16] First, this deficiency makes it difficult to assess the robustness of our finding. More importantly, however, for those who could not find any relationship between comparative advantage and FDI flows, they might not be looking at the right place

Our analysis also reveals that there is no clear pattern of how such relationship varies by the way the FDI measure is constructed. In particular, for Japan and the US, there is a stronger match between revealed comparative advantage and short-run FDI measure. In the other three countries, the match is stronger when the long-run measure of FDI is used.

Finally, our study can be further extended in two important directions. First, significant insights can be gain from conducting a more careful construction of revealed factor

[16] This is actually rather surprising and disappointing since around 60% of developed countries' FDI flows are in the services sector.

abundance and revealed location of FDI using bilateral data. This requires the computation of factor contents based on bilateral trade such as done in Davis and Weinstein (2001) or by Debaere (2003). In addition, it will also need the computation of factor contents of bilateral net inward FDI, paying careful attention to the use of correct technology matrix separately for outflow and for inflow. Second, as indicated by the comparison of our findings with Maskus and Webster (1995), a potentially rewarding exercise should be done by constructing longer-term measures of trade flows similar to our accumulated FDI flows in order to get a more 'accurate' picture of revealed factor abundance in certain countries. Needless to say, the most difficult aspect of these two extensions is on getting the right data.

Appendix: Data

The sample of developed countries is constructed based on the availability of the required sets of data. It consists of France, Japan, Italy, the United Kingdom, and the United States. For all countries, the values of output, exports, imports, consumption (defined as output – exports + imports), and total (domestic + imported) intermediate matrix are measured in domestic currencies and taken from *OECD Input-Output Database*. The technology matrix is then constructed from total intermediate matrix by dividing the values in the matrix with the value of gross-output by industry. The matrix is disaggregated into 36 sectors according to the second revision of the International Standard Industrial Classification (ISIC, Rev 2).

Data on inward and outward FDI were taken from *World Investment Directory 1992, Volumes I and III, 1993, United Nations: New York.* Since the FDI data were more aggregated (21 sectors) than the technology matrix, the technology matrix was aggregated appropriately for the computation of factor contents of net inward FDI.

Data on domestic gross fixed capital formation (GFCF) and capital stock (defined as a simple accumulation of the last 10 year GFCF) were obtained from *OECD Inter-Sectoral*

Database (ISDB). Since the data are more disaggregated than the technology matrix, we aggregate the GFCF data appropriately. The data periods are matched as close as possible to the availability of the FDI data.

Finally, the labor skill data are taken from *OECD Data On Skills: Emplyoment By Industry and Occupation*, an internal project of the OECD Directorate for Science, Technology and Industry. This dataset provides the number of employment in each industry categorized into four types: White-collar high-skill (legislators, senior officials and managers, professionals, technicians and associated professionals), White-collar low-skill (clerks, service workers, shops & sales workers), Blue-collar high-skill (skilled agricultural & fishery workers, craft & related trade workers), and Blue-collar low-skill (plant & machine operators and assemblers, elementary occupations). For France, Japan, and US the data period is 1990, for UK it is 1986, and for Italy it is 1991. The labor input requirements for each category were computed indirectly through the labor requirement per 1 unit currency of the intermediate input.

France

The available data on flow and stock of FDI are from the period of 1986-1989 and year of 1989, respectively. The accumulated flow of net inward FDI is constructed by accumulating net inflows of FDI in 1987-1989 to match the availability of GFCF data. More significantly, the OECD's GFCF data for mining and quarrying are missing and thus substituted with investment in machinery and equipment data for the specific sector obtained from *OECD's Industrial Structure Statistics: Core Data, Vol. 1, 1998, p.101*.

Japan

There are no GFCF data for the whole economy in the OECD's ISDB database. As an alternative, we use consumption of fixed capital. However, the reported fixed capital consumption data is not disaggregated enough for important manufacturing sectors such as chemical, office machinery, electronics, motor vehicles, and hotel & restaurant. Fortunately, there is a detailed GFCF data set for the manufacturing industry published in OECD's *STAN Database for Industrial Analysis 1974-1993*. We then use STAN GFCF data to breakdown the more aggregated values of consumption of fixed capital.

For labor skills data, sectors such as pharmaceuticals, electronics, aircraft, retail trade, insurance, and international services are not disaggregated. Since there is no other alternative to break down the aggregated information, we aggregate the technology matrix in computing labor use related to the above sectors.

Finally, unlike in all other countries in the sample, Japanese FDI is reported in US$ as opposed to Japanese Yen. Since all other data are already in Yen, for convenience, we converted Japanese FDI into Yen using the corresponding exchange rates obtained from *Penn World Table Mark 6.1*.

Italy

FDI stocks data for certain sectors such as metals & mechanical equipment manufacturing and transport & storage are less disaggregated than in other countries. As a result, we aggregate the input-output coefficients during the computation of factor content of FDI.

UK

While the input-output based data such as trade and factor requirement are from 1990, only the 1987 FDI stock data are available. However, since the flows data cover the period of

1986-1989, we update the stock data by simply adding the 1987-1988 flow data into 1987 FDI stock. Furthermore, only the 1986 labor skills data are available.

US

The United States data are the most complete among the countries in the sample. In particular, only in the US FDI data the values of foreign investment in mining and quarrying are separately available for the energy and non-energy sub-sector.

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