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Evaluating the Knowledge-Capital Model

– The impact of verticality on foreign direct investments

ABSTRACT

This paper evaluates the Knowledge-Capital Model (KCM) of foreign direct investments (FDI) as defined by Braconier, Norbäck and Urban (2005). The model predicts that there are both horizontal and vertical motivations for engaging in FDI. The horizontal motives regards access to new markets in case of trade frictions while the vertical motivations implies that multinational enterprises seek to take advantage of relative skill differences. The impact of the vertical component in the KCM has been largely debated and hence is of the largest interest. By using a large data sets for trade flows between OECD countries from 1982 to 2003 along with allowing for structural breaks, the paper try to evaluate the significance of the KCM. The result shows that the vertical component indeed is important, even for FDI among OECD countries. Nevertheless, the impact of the vertical component is clearly decreasing over time.

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INTRODUCTION

The statement that the world is getting smaller is a well-known cliché. Nevertheless, it is valid in many senses. One of the most significant evidence of the globalization has been the vast increase of foreign direct investment (FDI) over the last fifteen years (UNCTAD, 2009). The augment has been steady, with the exception of the current crisis, and the growth of FDI flows has been larger than the growth of output and international trade (Bloningen et al, 2003). In combination with the fact that FDI also has got an impact on issues such as growth and labor markets, has lead to a huge increase in the interest, and consequently the research in the determinants of FDI. The literature on the underlying reasons for investment flows is stretching back to the Heckscher-Ohlin model who constructed a general equilibrium model that predicted trade between countries with different relative factor endowments. Since then, great advances have been made and one of the main issues in the current discussion on the determinants of FDI regards the relevance - or lack of it - of verticality in the investments. More specifically, the question that has been asked is whether relative labor endowment differences still plays a role in the decision to invest. Many distinctive conclusions have been drawn regarding this issue, and some researchers have argued that the vertical FDI could be completely ruled out while others believe that it is increasingly important since firms are more able to slice up their production in different components than ever (see Bloningen, 2005 for further discussion). In the ongoing debate, the Knowledge-Capital Model (KCM) created by Markusen (2002) is an important contribution. It is an attempt to unite the horizontal and vertical reasons for foreign direct investments into a joint model. It hence predicts that horizontal FDI will prevail between countries that are similar in size, in relative factor endowments and when transport costs are high; vertical FDI will prevail when the home country is small, relative abundant in skilled labour and trade costs (in particular trade costs from the host country back to the parent country) are low; finally FDI flows will be minimal if the home country is both large and skilled-labour-abundant or when home and host country are similar in size and relative endowments and trade costs are low.

The purpose of the paper is to investigate whether the prediction given by the model is valid. This will be made using data on FDI from thirty OECD countries stretching between the years 1982 and 2003. The main objective is to investigate whether vertical FDI among OECD countries is still a significant part of total FDI. A second, minor, aim is to examine if the parameters in a model exploring FDI are constant or changing over time by assuming several structural breaks in the regression. The approach will help me to draw conclusions whether the impact of the vertical component is increasing or decreasing over time. The outline of the paper is the following – in Section 2 the previous research and literature regarding foreign direct investments and the knowledge capital model is presented. Section 3 consists of a discussion regarding the purpose of the paper and the contribution while the economic

specification and discussion regarding the methodology could be found in Section 4. Finally, in Section 5, the main results are presented and discussed.

PREVIOUS RESEARCH

The most ground-breaking theory of international trade is the Heckscher-Ohlin model, which predicts that the main motive behind international trade and investments is differences in relative endowments. Its simplicity made it attractive, but it also ran into trouble, first and foremost because of its lack of empirical evidence (Bloningen 2005). In order to solve the problem with more than one country and more than one factor, the so called gravity model was created. It specified trade flows as a function of the GDP of each country and the distance between them. Contrary to the Hecksher-Ohlin model, the gravity model did fit data reasonable well, but lacked important theoretical foundations (Bloningen 2005).

The development of the Knowledge-Capital Model (KCM) followed from research done by Markusen (1984) and Helpman (1984). It has been an attempt to better explain FDI and multinational activity based on a general equilibrium model incorporating more realistic assumptions of the new trade theory (economies of scale at the plant and firm level, trade costs…).In previous studies it had been argued that there are two distinctive motives for engaging in foreign direct investments, to get access to new markets in the face of trade frictions and to access low wages for a part of the production process. The former kind of investments has been named horizontal, while the latter is called vertical.

Horizontal multinational enterprises (MNE) have their headquarter activities where the knowledge-capital producing the intangible assets is located, tied to their home plant but duplicate some of the production process to other countries with similar characteristics regarding size and factor endowments to better access the foreign markets with local production. These firms will sell all their products locally. In contrast, vertical MNEs slice up the production process and put the stages that require low-skilled workers in relatively low-skilled abundant countries (usually final processing or assembling phases). These foreign plants will hence export their output back to the home country to sell it there. (Carr et al. 2001, Navaretti & Venables 2004). Therefore, the models predict quite different patterns of foreign direct investments due to different peaks that might or might not be compatible. Many researchers were using a horizontal model on one hand and a vertical on the other hand. (Carr et. al. 2001).

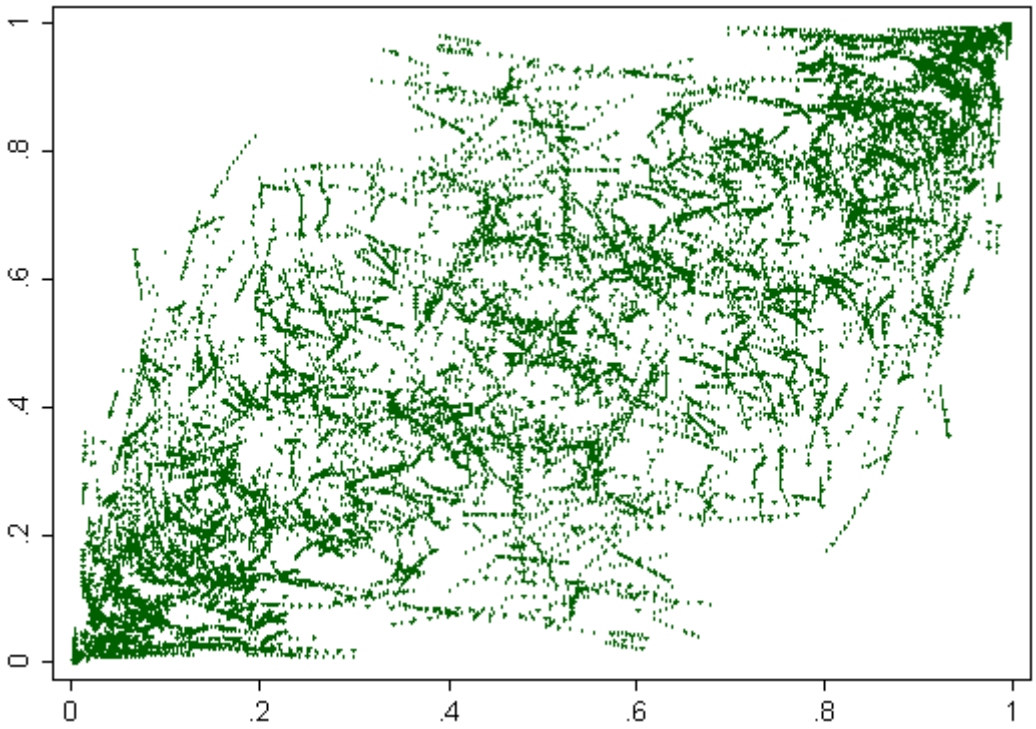
Few attempts were made to combine them before James R. Markusen developed the Knowledge-Capital Model which unified the horizontal and vertical motivations of foreign direct investments (Bloningen 2005). The main point of this model was that countries with similar GDP might have different factor endowments, and the model allowed for such a possibility to be feasible. The KCM also showed that the horizontal and vertical theories of foreign direct investments were not competing theories but could be incorporated under the same framework, since they describe different characteristics of FDI (Navaretti & Venables 2004). A further advantage with the model is that it solves the problem with separating FDI into a horizontal part and a vertical part, an approach which has proven very hard to pull off.

The validity of the KCM has been largely debated and it has suffered some critique, mainly regarding the significance of vertical foreign direct investments. There seem to be consensus among researchers that the horizontal component accounts for a larger part of world FDI, approximately two thirds (Bloningen 2005). Even the creator of the KCM, Markusen, admits that estimation of it have given mixed empirical results, and that the model, under certain specifications, is less valid than a horizontal model (Markusen and Maskus 2002). The key critique did however come from Bruce A Bloningen (2003), who acknowledges that the vertical component has some importance in manufacture sectors, but believes that the overall significance is neglectable. The critique from Bloningen is mainly that the skill differences (the vertical component) suffers from misspecification. For example, since all countries are less skilled than U.S., the skill difference variable is always negative, which means that a positive coefficient implies that the FDI increases when skill differences decline (Bloningen et. al, 2003). Later in the same paper, Bloningen performs an estimation which rejects the KCM for a horizontal one (Bloningen et. al, 2003). Bloningen argues that once you correct for the misspecification of skill differences and uses absolute skill differences instead, an increase in skill differences will decrease affiliate sales, and the horizontal is hence the only reasonable one. In a following reply Carr et al. (2003) points out that the proposed solution by Bloningen (2003) which rejects the KCM suffers from even more evident flaws, namely that the use of absolute skill differences makes no sense what-so-ever from a theoretical point of view. Furthermore, Bloningen (2003) impose a quite unrealistic assumption, namely that the affiliate sales are the same in both direction; "Sales of U.S. firms in Peru must be the same as the sales of Peruvian firms in the U.S. This is inconsistent with any version of the theory, whether horizontal or […] vertical…" (Carr et al 2003). As will be mentioned in the discussion regarding the econometric specification, the critique by Bloningen (2003) could indeed be overcome, as has been done by for example Braconier et. al. (2005).

PURPOSE/CONTRIBUTION

The main purpose of the paper is to estimate the KCM in the way that it is defined by Braconier et. al (2005), using a data set which consists of bilateral FDI stocks between OECD countries between the years 1982-2003. In total, the data set will consist of close to ten thousand observations compared to less than two thousand in the paper by Braconier et. al (2005). The main reason for using the variable definition proposed by Braconier et. al. (2005) is the definition of skill differences do not suffer from the critique by Bloningen (2003), and further that it is directly mapped from theory. The definition of skill differences could be observed in Table 1. The definition has got some main advantages in comparison with other solutions. For example, a measure which only takes into account relative skill differences has to be complemented by dummies for positive or negative differences in order to be interpretable. This is not the case with the definition used in the present paper, and the problem that occurs with U.S. data, namely that U.S. is always more skill-abundant than their trade partner is solved. There might be a slight fear that the OECD-countries are far too equal to generate any actual skill differences. This fear is however not supported as the following Edgeworth box shows.

Figure 1. Inbound and outbound trade in the sample. The home country origin (country i) is located in the lower left corner while the host country origin (country j) is located on the upper right corner. The home country skilled-labor share of the combined skilled-labor endowments is on the vertical axis and its share of unskilled-labor endowments is on the horizontal axis.



The sample covers the Edgeworth box well, which makes it possible to get sufficient factor endowment differences (i.e. points far away from the diagonal) for a feasible estimation. The data set have enough differences to allow for vertical FDI to be detected. One further advantage with the paper by Braconier is that the model is directly mapped from theory, in comparison with for example the estimation done by Bloningen who used absolute differences as a way of testing the KCM. Since the KCM predicts that vertical FDI should come from small skilled-labour abundant countries to large unskilled, we should include such combinations in the econometric specification. This has seldom been the case in other econometric studies why they lack relevance (Braconier 2005). Hence, if the estimation with OECD countries can confirm the vertical component, the relevance of the KCM increases even further. In addition, structural breaks will be introduced in the estimation to determine whether the parameters are constant or changes over time. The main reasons for this approach are two – first and foremost because previous research has shown that the parameters vary over time and this will in turn have an impact on the significance of the model (Mariel et. al. 2009). Secondly, if structural breaks are allowed in the model, it is possible to analysis whether the influence of some variables on FDI are increasing or decreasing, which allows for more relevant conclusions regarding the KCM, and which kind of FDI which has been important in different time periods.

ECONOMETRIC SPECIFICATION

The estimation is based upon panel data analysis, and the method used is fixed effect estimation with different intercepts for each home country. The equation that will be estimated is the following:

$$FDI_{it} = \beta_{0t} + \beta_{1t} GDPSUM_{it} + \beta_{2t} SIZE_{it} + \beta_{3t} SIZESQ_{it}$$

$$+\beta_{4t} SKILL_{it} + \beta_{5t} INTER_{it} + \beta_{6t} PROTECTION\ HOME\ COUNTRY_{it}$$

$$+\beta_{7t} PROTECTION\ HOST\ COUNTRY_{it} + \beta_{8t} INVESTMENT\ COST_{it}$$

$$+\beta_{9t} INTERPROT_{it} + \beta_{10t} DISTANCE_{it} + \varepsilon_{it}$$

$$i = 1,2,\dots N \qquad t = 1,2,\dots T, \tag{1}$$

N is the cross-section while T is the time-series sample size. The home country is simply defined as the country in which the head quarter is located, a definition shared with Carr et. al. (2001). The main motivation for using fixed effects estimation, instead of for example random effects, is because the data set contains almost all OECD countries, which is the targeted population in this paper, and which allow differences across units to be captured in differences in the constant term. All the countries within the sample are part of OECD which limits the variation to a great extent. Regarding the error term, it is assumed to be normally distributed. There might be a slight worry that the problem with non-stationary variables could occur when using series of panel data. However, there are two key arguments against this doubt. Primarily, the data on foreign direct investment are not growing persistently. There is indeed a growing trend from 1998 an onwards but after 2001 there has been a fast decline in FDI outflows. Secondly, the KCM is a general equilibrium model that provides long-run static equilibrium prediction and do not provide specific dynamic changes.

Table 1. Definition of the variables in the model (Appendix A contains descriptive statistics of all variables used). The subscript i represents the home country while the subscript j represents the host country.

Variable	Definition	Units	Expected sign
FDI bilateral stock		Million U.S. $ in constant prices	
GDP SUM	$GDP_i + GDP_j$	Million U.S. $ in constant prices	+
SIZE	$\sqrt{s_i^2 + u_i^2}$		+
	$s_i = \frac{S_i}{S_i + S_j}$		

	$u_i = \frac{U_i}{U_i + U_j}$		
	S_i = Endowment of skilled labor in country i	% of population over 25 with secondary or higher education	
	U_i = Endowment of unskilled labor in country i	% of population over 25 with less than secondary or higher education	
			-
SIZESQ	$SIZE^2$		
INTER	$SKILL*SIZE$		-
			+
SKILL	$\frac{s_i}{u_i}$		

INVESTMENT COSTS	0 least restrictive, 1 most restrictive	-
PROTECTION OF HOST COUNTRY	Maximum value of trade openness minus country value. Difference in %	+
PROTECTION OF HOME COUNTRY		-
		?
INTERPROT	$SIZE^2 * PROTECTION\ OF\ I$	
DISTANCE	Kilometers	?

The variables GDP SUM and SIZE could be interpreted as variables related to horizontal FDI; hence a positive sign means that the horizontal model is supported. The one variable that is of

most interest to us is the skill variable which measures the relative skill differences compared to the country in which investments are done. This is, as mentioned above, a reasonable measure of the vertical component of the KCM. If the expected sign is obtained, we can conclude the model finds support by the estimation. Regarding the other expected signs, they are primarily obtained from Bloningen (2005). It is believed that higher investment costs leads, not particularly surprising, to lower investments. The reason why trade protection in the host country has a expected positive sign is because of the theory of tariff jumping foreign direct investments, which implies that multinational enterprises substitute exports for FDI in order to avoid trade protection and instead use them to their advantage, thus be protected from international competition once they have invested. The situation is the opposite for companies that are protected in their home countries, they will have less incentive to invest in foreign countries since the cost of re-import is high. Finally, regarding the distance, the effect is ambiguous, since it is an element in both export cost as well as in investment and monitoring costs (Carr et. al, 2001).

The structural breaks will be identified using a method by Perron (2005). It is a simple method based upon the least square principle. If we assume the following multiple linear regression model

$$y_t = x_t'\beta + z_t'\delta_j + u_t \tag{2}$$

where $t = T_{j-1} + 1, \dots, T_j$. For j=1,…,m+1. In the above model, $y_t$is the observed dependent variable at time t, both x_t and z_t are vectors of covariates and β and δ_j are the corresponding vectors of coefficients (j=1,…,m+1). In this scenario, we are assuming the possibility of m breaks. The break points $(T_1, \dots, T_m)$ are explicitly treated as unknown. The purpose of the method is to estimate the unknown regression coefficients together with the break points when T observations are available. Equation (2) could in turn be rewritten into matrix form.

$$Y = X\beta + \bar{Z}\delta + U \tag{3}$$

Where $Y = (y_1, \dots, y_T)', X = (x_1, \dots, x_T)', U = (u_1, \dots, u_t)', \delta = (\delta'_1, \delta_2', \dots, \delta_{m+1})'$ and Z is the matrix with diagonal partitions Z at$(T_1, \dots, T_m)$. As is further used in Perron (2005), the true values of the parameters and the break points are denoted with a 0 as subscript, hence $\delta = (\delta_1^{0'}, \dots, \delta_{m+1}^{0'})$ and $(T_1^0, \dots, T_m^0)$. Given the subscripts, equation (3) could be rewritten as:

$$Y = X\beta^0 + \bar{Z}^0\delta^0 + U \tag{4}$$

The method of estimation is based upon the least square principle and for each m possible break points, the least square estimates of the coefficients are obtained by minimizing the sum of squared residuals. Thus, the break points are the global minimizers of the objective function. Even though changes of the error term u are allowed, the method imposes equal weight on all residuals. Hence, in more practical terms, a matrix is created, allowing the variables to vary over time. A loop is then formed, and the variables are tested one by one by regressing them on year to year basis. The sum of squared for each regression is obtained and for the year in which the smallest sum of squared residuals is acquired, a structural break is inferred. One issue that should be treated with care is the question regarding the number of structural breaks and how far from each other they could occur. It would for example be unrealistic to assume that two structural breaks occur two years in a row. Further, a structural break that occurs at the second year of the data period is not very reasonable either. The basic rule of thumb on this issue is one that stretches back to a paper by Davies (1977). The proposition in the paper is that if we are dealing with an interval [0,1] with $\varepsilon_1$being the lower bound and $1-\varepsilon_2$being the upper bound, the most common choice is to use $\varepsilon_1 = \varepsilon_2 = .15$. This is also a selection made in this paper. The reason, which the paper by Davies shows, is that the power of the test decreases as ε_1 and ε_2 are getting smaller. However, as ε_1 and ε_2 increases, the possible break dates are decreasing. The above mentioned pick translates into an interference of three years in the beginning and the end of the period. This restriction implies that the structural breaks could only occur between 1985 and 2000. Once a break is detected, there will be further restrictions before new search for structural breaks are performed, all according to the above described method. In practice, this limits the amount of structural break to three for each variable. Finally, it is worth mentioning that there will be a number of breaks detected which in reality do not generate two periods that are significantly different from each other. If this is the case, the structural breaks are overlooked in the sense that the variables will keep their original structure.

DATA AND RESULTS

In the paper, we use bilateral FDI stocks for 30 OECD countries. The time span stretches from 1982 to 2003 and even though there are some observations missing, there is a very complete coverage, for example regarding skill differences, as is explained above. Because of the missing observations, the original sample of 19140 observations is reduced to 9639. The data is collected from OECD international direct investments statistic yearbook. The data on GDP is obtained from OECD as well. Data on skill is attained from Barro and Lee (2000) and is defined above. Since there are only observations available for every five year, linear

interpolation has been used to cover the absent years. For the variable investment cost, the definition is obtained from Golub (2003) who put indices on the countries that ranges from zero (least restrictive) to one (most restrictive). The trade costs definition is attained from Bloningen et. al. (2003) who defines the variable as the maximum openness to trade minus the actual openness. The distance variable is obtained from Centre D'Etudes Prospectives et D'Informations Internationales (CEPII 2008) and is measured in kilometers between capitals. A more thorough description of the variables could be seen in Table 1 as well as in Appendix A.

The result from the estimation of the KCM as defined in (1) could be observed in Table 2. Since heteroskedasticity has been detected, White's robust standard errors have been used.

Table 2. Fixed effect estimation with different intercept for each country (robust standard errors)

Variable	*Coefficient*	*t-statistics*	*Expected sign*
GDP Sum	3.862877***	13.40	+
Size	35.34632***	11.21	+
Size squared	-20.38424***	-12.85	-
Skill	2.572803***	8.48	+
Inter	-6.099821***	-9.64	-
Investment cost	-6.176026***	-5.38	-
Trade protection host country	-3.763099***	-7.18	+
Inter*Trade protection host country	-0.0394208***	-2.78	?
Trade protection home country	-2.975886***	-3.71	-
Distance	-0.3717837***	-12.71	?

***Significant at a 1 percent level. **Significant at a 5 percent level. *Significant at a 10 percent level.

The main results are similar to those obtained by Braconier et. al (2005). All the variables in the model are significant and just one obtain an unexpected sign. The variable of main interest to us, the skill variable, has got a positive and a significant impact on the foreign direct investments. Thus, the main conclusion is that, for OECD countries, the effect of the vertical component is clearly important. The impact of verticality cannot be ruled of which means that the KCM which contains both horizontal and vertical component is empirically supported. Regarding the vertical component, the value of the coefficient is strikingly similar to that obtained by Braconier et. al. (2005), which leads to the conclusion that even though different data sets are analyzed, the importance of vertical investments is fairly similar. The main difference between the result of the estimation in this paper and the one by Braconier et. al. (2005) is the sign of the investment cost and the trade cost for the host country respectively. While the expected sign for investment cost is obtained in this paper, namely that FDI decreases with higher investment costs, the expected sign for trade cost in the host country is not attained. According to theory, higher trade cost in the host country should increase the incentive to carry out foreign direct investments as a way of substituting away from export. Still, the result I attain is far from unique, in fact Mariel et. al. (2009) and Bloningen (2003) do

obtain the same result as well. Hence, it is safe to say that the model do not suffer from misspecification. In fact, the KCM performs well with OECD data, which implies that the proposal by Bloningen (2003) that the model could be replaced by a purely horizontal one could be rejected. The distance, which was expected to have an ambiguous sign, has got a negative impact on FDI as well as the combination of inter and the protection of the host country.

Turning to the estimation regarding structural breaks, the impact of the vertical component still clearly exists, but is becoming slightly weaker as time goes by. Regarding the other variables, the sign and the significance is similar, but the method with structural breaks has the advantage that we can see the evolvement of some key variables. Table 3 shows the structural breaks created, assuming different structural breaks for each variable.

Table 3. Fixed effect estimation with structural breaks (robust standard errors)

Variable	*Coefficient*	*t-statistics*	*Expected sign*
GDP Sum (1982-1985)	2.335655***	7.29	+
GDP Sum (1986-1997)	3.362464***	12.23	+
GDP Sum (1998-2003)	4.240506***	12.03	+
Size (1982-1993)	28.86217***	9.35	+
Size (1994-2003)	37.26156***	11.27	+
Size squared (1982-1993)	-16.36982***	-10.03	-
Size squared (1994-2003)	-22.27833***	-12.40	-
Skill (1982-1995)	2.674002***	8.13	+
Skill (1996-2003)	1.977726***	7.64	+
Inter	-5.962867***	-9.57	-
Investment cost (1982-1994)	-3.644355***	-3.03	-
Investment cost (1995-2003)	-12.77671***	-7.34	-
Trade protection host country (1982-1996)	-3.567971***	-4.32	+
Trade protection host country (1997-2003)	-2.8022***	-4.59	+
Inter*Trade protection host country	-0.038367***	-3.23	?
Trade protection home country	-0.5225031	-0.48	-
Distance (1982-1986)	-0.2106294***	-3.75	?
Distance (1987-2003)	-0.3741529***	-12.26	?

***Significant at a 1 percent level. **Significant at a 5 percent level. *Significant at a 10 percent level.

The main pattern that could be observed is that the importance of GDP has increased over the period 1982-2003. Two structural breaks have been detected, very similar to the result obtained by Mariel (2009). Along with the increase of size, it seems like the horizontal component of the KCM is becoming gradually more important. At the same time, the coefficient of skill differences has decreased and is of less weight from 1996 onwards. The usage of structural breaks thus provides the insight that that even though the KCM is valid over the whole time period, the vertical component is less important, at least for the OECD countries. The decrease in the impact of the skill variable could be due to a actual decrease in skill differences in the OECD countries. If we observe the Edgeworth box of relative skill differences for the year 1982 and the year 2003 (Figure 3 and Figure 4 respectively) we can distinguish two distinctive patterns:

Figure 2. Inbound and outbound sample for all countries in the year 1982

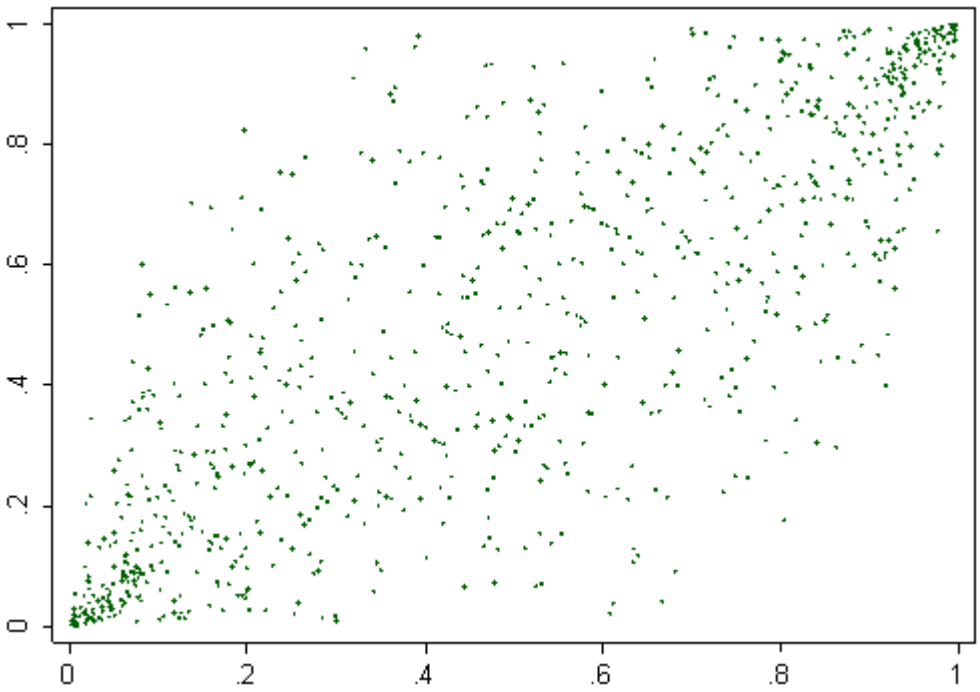
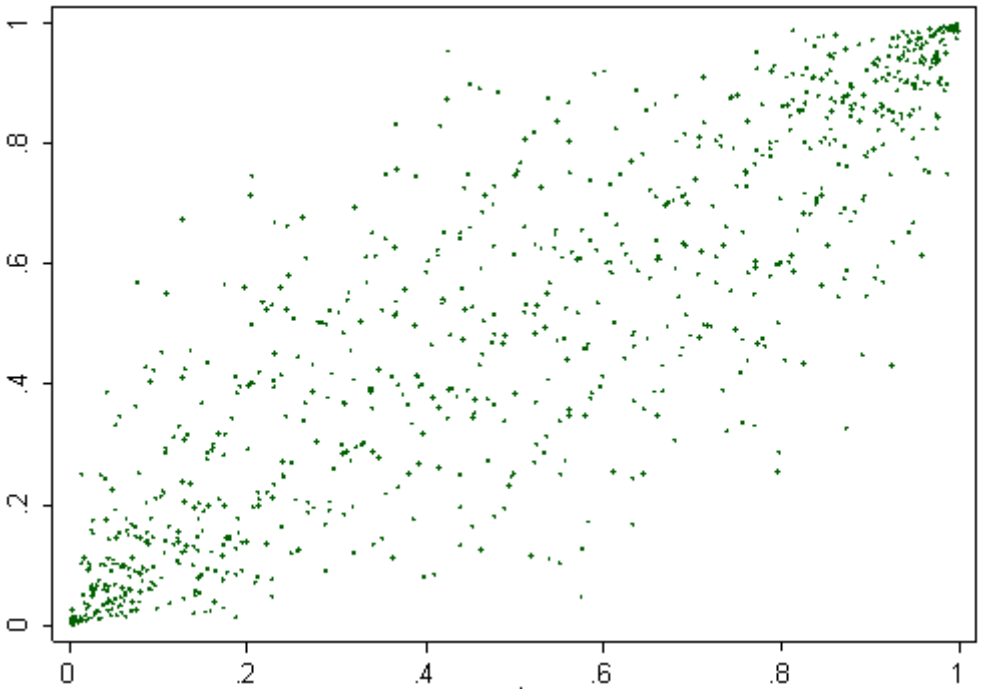


Figure 3. Inbound and outbound sample for all countries in the year 2003



Undoubtedly, the observations are more spread out in 1982 than in 2003, implying a convergence in relative skill endowments among OECD countries. This will, naturally, have impact on the value of the coefficient, and can explain why the value, and significance, has decreased over time. Regarding the other variables in which structural breaks are attained the importance of investment cost for engaging in foreign direct investments has increased. It seems like investment costs leads to lower direct investments after 1994, and the difference is quite great. This may be because the remaining low FDI obstacles play a great depressing effect since the cost advantage of vertical FDI (relative factor endowment convergence) is declining too. Further, the impact of the only variable with unexpected sign, the trade protection for the host country, is decreasing after 1996 while the negative coefficient of distance is greater after 1986. The differences are however marginal. Finally, the usages of structural breaks do not lead to any other noteworthy conclusions concerning the other variables in the model. Their meaning is quite the same as in the estimation with no structural breaks. Hence, it is safe to say that the KCM, as defined by Braconier et. al (2005), is valid even when some parameters change over time, a fact that even strengthens the model.

CONCLUSIONS

The main finding in the paper is that the vertical component in the KC model could not be ruled out, not even in OECD countries data set where this type of investment is not the expected one. Nevertheless, its importance in the OECD countries seems to have been decreasing slightly in recent year. The reason for the decrease might partly have to do with the actual convergence of skill differences within OECD countries. While the percentages of people who are taking part in tertiary education have increased in previously low skilled countries, it has remained quite steady in western countries. The proposition by Navaretti & Venables (2004) stating that the vertical FDI plays an increasingly important rule is not satisfied in this paper. Instead, it seems like the situation is the opposite within OECD, namely that it is the horizontal component that increases in importance. However, the KCM still finds support in the sense that almost all of the variables, and especially the key ones, are significant and have attained the expected sign. The only unexpected result, namely that the protection of the host country has got a positive impact on FDI, is far from unique in the literature on FDI determinants.

The usage of structural breaks in the paper also has the advantage that it provides further insight on the importance of analyzed variables. The most noticeable changes regard the investment cost which seems to increase in importance for the decision to carry out FDI. In addition, the horizontal components of FDI are determining a clearly larger amount of the FDI flows than in the 80s and early 90s. The paper hence lays ground for further research to determine if the pattern is valid even outside OECD countries.

REFERENCES

Barro, R. J. and Lee, J.W. (2000) International data on educational attainment: Updates and implications, CID Working paper No. 42.

Bloningen, B. A., R B. Davies and K. Head (2003) Estimating the Knowledge-Capital Model of Multinational Enterprise: Comment, American Economic Review, June, pp. 980-994.

Bloningen, B. A. (2005) A Review of the Empirical Literature on FDI Determinants, Atlantic Economic Journal. Volume 33, pp. 383-403

Braconier, H, P-J. Norbäck and D. Urban (2005) Reconciling the Evidence on the Knowledge-Capital model, Review of international economics, 13(4), pp. 770-786.

Carr, D. L., J. R. Markusen and K. E. Maskus (2001) Estimating the Knowledge-Capital Model of Multinational Enterprise, The American Economic Review, June, pp. 693-708

Carr, D. L., J. R. Markusen and K. E. Maskus (2003) Estimating the Knowledge-Capital Model of Multinational Enterprise: Reply, The American Economic Review, June, pp. 995-1001

CEPII (2008) Centre D'Etudes Prospectives et D'Informations Internationales (available at www.cepii.fr)

Greene, Willam H. (1993) Econometric analysis Macmillan, second edition

Golub, S.S. (2003) Measures of restrictions on inward foreign direct investments for OECD countries, OECD Economic Studies, No. 36.

Mariel, P., S. Orbe and C. Rodriguez (2009) The Knowledge-Capital model of FDI: A time-varying coefficients approach, Scottish Journal of Economy Vol 56, No 2. May 2009, pp. 196-212.

Markusen, J. R. and K. E. Maskus (2002) Discriminating Among Alternative Theories of the Multinational Enterprise, Review of International Economics, vol. 10(4), pp. 694-707

Markusen, James R. (2002) Multinational Firms and the Theory of International Trade Massachusetts Institute of Technology.

Navaretti, G. B. and A. J. Venables (2004) Multinational Firms in the World Economy Princeton University Press.

Perron, Pierre (2005) Dealing with structural breaks, Boston University working paper series.

UNCTAD (2009) Assessing the impact of the current financial and economic crisis on global FDI Flows, United Nations Conference on Trade and Development

APPENDIX A

Table 4 Descriptive statistics of the variables estimated

Variable	Rescaling	Comment	Mean	Std. deviation	Min.	Max.
FDI	10^{-3}	US $ GDP deflator	4.6735	15.6309	1.64625	244.774
GDP SUM	10^{-6}	PPs	1.4668	2.03853	0.007	13.5567
SIZE	10^{-3}		0.7207	0.43704	0.00265	1.4117
$SIZESQ_i$	10^{-3}		0.7104	0.64061	7.05e-06	1.992
$INTER_i$			0.8163	0.59787	0.00037	8.05060
$SKILL_i$	10^{-3}	Linear interpolation between five-years data	1.2690	1.156503	0.023422	22.4446
INVESTMENT			0.3144	0.2170634	0.063801	1

COSTS					
PROTECTION OF	10^{-2}	0.3129	0.4523303	-1.8831	0.88020
HOST COUNTRY					
PROTECTION OF	10^{-2}	0.3129	0.4523303	-1.88311	0.88020
HOME COUNTRY					
		1.4545	8.83113	-14.7320	382.739
$INTERPROT_j$					
DISTANCE	10^{-3}	5.2515	5.388683	0.059617	19.5861