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A Nested logit approach to modelling the location of foreign direct investment in the Central and Eastern European Countries

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ABSTRACT

This paper applies the Nested logit model to a three-level dataset in order to examine the factors explaining foreign investment location decisions into 13 Central and Eastern European Countries (CEECs) over an eleven-year period between 1997 and 2007. The three-level dataset allows firm, industry and country factors to simultaneously determine the firm-level investment location decisions. The Nested logit model partially relaxes the assumption of the independence from irrelevant alternatives and tests if national boundaries affect the choice of investment location of multinational enterprises in the CEECs. In addition, the Heteroskedastic Extreme Value model is used to help identify an appropriate nesting structure. Empirical results show that the responsiveness of the firms' decision regarding where to locate capital in the CEECs to country-level variables differs both across sectors and across firms of different sizes and profitability.

1. Introduction

The existing empirical literature on the determinants of foreign direct investment (FDI) has tended to focus either on macroeconomic (i.e. country) characteristics or microeconomic (i.e. firm and industry) characteristics. The traditional approach to the determinants of FDI was to take a macroeconomic perspective such that the location of FDI was based on portfolio theory (see for example, Ailber, 1970; Prachowny, 1972) or investment theory, where market size or growth were of fundamental importance (Boatwright and Renton, 1975; Kwack, 1972). Extensions to this macroeconomic approach have emphasised the role of wage rates or wage differentials (Culem, 1988; Goldsbrough, 1979) or the role of FDI in establishing export platforms (Barrell and Pain, 1996) or in avoiding exchange rate fluctuations (Barrell and Pain, 1996; Cushman, 1985).

A second distinct strand of the FDI literature has come from the intersection between industrial organisation theory and trade theory especially with the introduction of scale economies, imperfect competition and product differentiation (see Markusen and Svensson, 1985). This approach is primarily microeconomic in nature and has emphasised the role of firm or industry-level attributes as determinants of FDI. More recently, agglomeration economies have been considered important for FDI decisions (Krugman, 1991). These kinds of models are difficult to test empirically because they require extensive amounts of firm-level data and so the approach has been to calibrate a model, by assuming some parameter values, and to attempt some numerical simulations (see for example, Markusen and Venables, 1998). These heterogeneous theories view the firm's FDI decision primarily from a microeconomic perspective.

The macroeconomic and microeconomic strands of the FDI literature have recently been drawn together through the development of the discrete choice econometric methodology, which has become a popular technique for investigating firms' location decisions of FDI, especially in the regional science literature (see, for example, Guimaraes et al., 2000; Head et al., 1999; Kim et al., 2003). This literature has not, however, accounted for investing firms' characteristics, which are also important determinants of the investment location decisions. Furthermore, the most frequently used Multinomial logit approach (MNL) (see for example, Becker et al., 2005) is subject to the restrictive assumption of the independence from irrelevant alternatives, which means that the random components of the potential profits of the different alternatives are assumed to be independent and identically distributed. Therefore, the model does not test if national boundaries affect the investment location choices of multinational enterprises (MNEs) as opposed to countries belonging to the same geographical region. In other words, it largely ignores the fact that investment location choices of foreign investors are likely to have a nested structure. Moreover, where the nested structure is acknowledged it is treated in a purely judgmental, rather than scientific, manner (see, for example, Barrios et al., 2004; Disdier and Mayer, 2004; and Guimaraes et al., 2000).

This paper therefore, makes two principal contributions to the existing literature. First, it uses the Heteroskedastic Extreme Value

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model (HEV) developed by Bhat (1995) to help select the most appropriate nesting structure for the data, prior to the estimation of the Nested logit (NL) model, rather than to base such decisions on intuition, which could lead to inappropriate estimates. The second contribution of this paper is to make use of a novel multi-level data set — allowing firm, industry (or sector) and country effects to simultaneously determine the firm-level FDI location decisions, thus integrating both macroeconomic and microeconomic characteristics, including the characteristics of investing firms, to give a more general approach than previous studies, which should lead to more robust estimates. The dataset includes the location choices of 1108 foreign direct investment decisions of firms in the EU (15), Norway, Switzerland, Russia, Japan and the USA into 13 Central and Eastern European Countries (CEECs) — the 12 recent EU member states excluding Cyprus and Malta, but including Croatia, Russia and Ukraine — over an eleven-year period from 1997 to 2007.

The results show that not only country and industry-level factors, but also investing firm characteristics, are important to investment location decisions of MNEs. Although, the direction of the effects of the main factors, such as market size, labour costs, distance and common border are consistent with traditional FDI literature, it is difficult to compare other results to the standard literature for two main reasons. First, the traditional literature focuses on either macroeconomic or microeconomic determinants of FDI, ignoring the importance of the integration of the factors at all the three levels and in particular the interaction between firm, industry and country characteristics. Second, in most of the empirical, discrete choice literature on FDI location choices the analyses and policy implications are based only on estimated coefficients, which have little explanatory power (Greene, 2008). Further post-estimation needs to be carried out to show both the direction and the magnitude of the various factors influencing the FDI location decision. Therefore the elasticities and marginal effects presented in this paper are not easily comparable to the results of the majority of other studies that investigate investment location choices of MNEs and thus represent a further small contribution to the literature.

The rest of the paper is set out as follows. Section 2 explains the empirical methodology of the NL model and in particular, the HEV model that helps to determine appropriate nests for the data set. Section 3 explains the construction of the variables included in the econometric model and Section 4 presents the econometric results. Finally, Section 5 concludes.

2. The empirical methodology

The empirical model of the multinational enterprises' (MNEs') investment location choices is based on the random utility maximisation Nested logit (UMNL). A firm i, investing in sector s chooses location c, if it yields the highest expected profit from the set of alternative locations, such that $\pi_{isc} > \pi_{isg}$ for all $g \neq c$ and $g = 1,2,\ldots,C$. The profit for each alternative c can be expressed as:

$$\pi_{isc} = V_{isc} + \varepsilon_{isc} \tag{1}$$

where π_{isc} consists of an observed component, V_{isc}, and a stochastic error term, ε_{isc}, where i indicates investing firm, s investment receiving sector and c investment receiving country. The observed component can be represented as:

$$V_{isc} = \beta_{0isc} + \beta_{1isc} f(X_{1isc}) + \ldots.. + \beta_{Nisc} f(X_{Nisc}) \tag{2}$$

where the terms X_{nisc}, where $n = 1,2,\ldots N$, includes the potential variables that determine π_{isc} and ε_{isc} is the error term. The unobserved components of profit, can each influence ε_{isc} in a different way resulting in different variances (standard deviations) of the random errors across groups of alternatives in the choice set (Hensher and Greene, 2002). As scale parameters in the NL model vary due to the different variances of the unobserved effects of alternatives in different nests, the scale parameter μ becomes an additional multiplicand of each factor influencing a choice. Therefore:

$$V_{isc} = \mu_{isc}\beta_{0isc} + \mu_{isc}\beta_{1isc} f(X_{1isc}) + \mu_{isc}\beta_{2isc}(X_{2isc}) + \ldots + \mu_{isc}\beta_{Nisc} f(X_{Nisc}) \tag{3}$$

The scale parameter μ can be moved to the left-hand side of the equation:

$$V_{isc} / \mu_{isc} = \beta_{0isc} + \beta_{1isc} f(X_{1isc}) + \ldots + \beta_{Nisc} f(X_{Nisc}) \tag{4}$$

Each alternative c in nest k will have a scale parameter $\mu'(c|k)$ and each nest (upper level) will have a scale parameter λ_k. The variance of the unobserved effects and therefore, the scale parameters for alternatives in the same nest have to be equal, therefore $\mu'(c|k) = (\mu_k)$.

The NL model can be decomposed into a standard logit model with marginal and conditional probabilities. In the case of the two-level NL model, the probability of choosing alternative c in nest k is equal to the product of the marginal probability P_k of choosing nest k and the conditional probability $P_{c|k}$ of choosing the alternative conditional on that nest k being chosen:

$$P_c = P_{c/k} \times P_k \tag{5}$$

where

$$P_{c/k} = \frac{\exp\left(\mu_k V_{c/k}\right)}{\sum_{g \in L} \exp(\mu_l V_{g/l})} \tag{6}$$

and

$$P_k = \frac{\exp(\lambda_k V_k + (\lambda_k / \mu_k)\mathrm{IV}_k)}{\sum_l \exp(\lambda_l V_l + (\lambda_l / \mu_l)\mathrm{IV}_l)} \tag{7}$$

where the indices g and l indicate alternative location and nest respectively. The log of the denominator in Eq. (6) is called the inclusive value IV_k. It corresponds to the expected value of the profits the investing firm i obtains from alternatives g in nest l, that is:

$$\mathrm{IV}_l = \ln \sum_{g \in L} \exp\left(\mu_l V_{g/l}\right) \tag{8}$$

The parameter IV is the ratio of the scale parameter at the upper level to the scale parameter at the lower level λ_k/μ_k. The standard identification problem means that normalisation of one of the scale parameters is required. If the numerator is normalised to 1 ($\lambda_k = \lambda_l = 1$), we have RU2 UMNL model (normalisation at the upper level), and if the denominator is normalised to 1 ($\mu_k = \mu_l = 1$), we have RU1 UMNL model (normalisation at the lower level). The estimated parameters of both the RU1 UMNL model and the RU2 UMNL model will be the same (after rescaling) only when all the parameters are alternative specific (for example, the market size variable varies across investment receiving countries but not across investing firms). As the model also includes variables that vary among investing firms, the RU2 specification is preferred. In the case of RU2 UMNL, the probability of choosing alternative c in nest k is the following:

$$P_c = \frac{\exp(V_c / \mu_k)\left(\sum_{c \in L} \exp\left(V_g / \mu_k\right)\right)^{\mu_k - 1}}{\sum_{l=1}^{K} \left(\sum_{c \in L} \exp\left(V_g / \mu_l\right)\right)^{\mu_l}} \tag{9}$$

The parameter μ_k is a measure of the degree of independence in unobserved profit among the alternatives in nest k. When $\mu_k = 1$,