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MULTIREGION, MULTIFACTOR TESTS OF THE HECKSCHER-OHLIN-VANEK USING SPANISH REGIONAL DATA

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Abstract

We study the Heckscher-Ohlin-Vanek (HOV) model of trade empirically using regional data rather than country data. Unlike Davis et al. (1997) that find that the HOV model performs remarkably well using Japanese regional data, our findings for the Spanish regions suggest that the HOV model performs poorly after relaxing the "strict" assumptions of world factor price equalisation, world identical and homothetic preferences and Hicks-neutral technological differences across regions. The limited explanatory capacity of the endowment-driven models complements the findings of economic geography models that predict well the regional pattern of production and trade specialization of Spanish regions.

1. Introduction.

The Heckscher-Ohlin-Vanek (HOV) model is the cornerstone of international trade theory due to the useful insights concerning the pattern of trade as well as the distributional consequences of trade. First, trade flows are dictated by the comparative advantages arising from initial factor endowments. Second, trade volume is expected, ceteris paribus, to be positively correlated with the dispersion of relative factor endowments. A capital-abundant country is expected to trade more with a labour-abundant country than with another labour-abundant country. Finally, increased trade is expected to be associated with substantial income distribution effects. The trade liberalisation of trade raises the reward accruing to the relatively abundant factor and lowers the reward accruing to the relatively scarce one. Each of these expected results of traditional trade theory has been refuted by empirical work, as it was first found by Leontief (1953), and later studies done by Maskus (1985) and Bowen et al. (1987), among others. The theoretical implications of the endowment-driven theory of production and trade have stimulated a line of research orientated to find the reasons why the HOV model performs so badly.

This paper investigates the predictive capacity of the HOV model using regional data rather than country data. The reason is that the regions from the same country share similar relative factor endowment and state of technology. These similarities among regions are necessary for the HOV theory to hold. Specifically, the usual caveat about using the technology of one country to evaluate the factor content of trade from other countries does not apply here since we use the Spanish technology matrix to evaluate the factor content of trade of Spanish regions. Moreover, Aulló y Requena (2004) showed that relative factor endowment differences across Spanish regions are not large enough to justify intra-national production specialization and sustainable factor reward differences.

Davis et al. (1997) have already investigated the HOV model using regional data.[1] First they predict the net factor trade of ten Japanese regions using actual world factor endowments. The strict HOV performs poorly and replicate Trefler´s (1995) "mystery of the missing trade". When they relax the assumptions of world factor price equalisation and world identical and homothetic preferences the modified HOV model performs very well. Unlike Davis et al. (1997), our results find limited empirical support for HOV theory using data of 14 Spanish regions. We find that the modified HOV model is a marked improvement over that based on measured world endowments; however, we still find a bad fit with the data. Thus endowment-driven theories play a limited role in explaining net factor trade of Spanish regions leaving some scope for

[1] There are previous attempts to study the factor-endowment theory of trade using regional data (Moroney and Walker, 1966; Grimes and Prime, 1993; Horiba, 1997; Smith, 1999). However, they do not provide a "complete" test of the HOV model. See Davis et al (1997) for a criticism of previous research.

geography models to improve our understanding of regional pattern of production and trade specialization.

2. Spanish regional trade.

One major contribution of this paper is the construction of a database of trade at regional level. To test Heckscher-Ohlin-Vanek we need information about all imports and exports of each region, that is, we need to know both inter-regional and international trade flows to calculate the *factor content of trade*.[2] We have used regional input-output tables to calculate trade flows of the Spanish regions around the year 1995. The data appendix contains detailed information about the construction of the database, variables and sources. Table 1 presents a description of the Spanish regional trade, both at interregional and at international level. Column 1 shows the economic importance of the regions included in our study. We have IO tables for all regions but three, Cantabria, Murcia and La Rioja. As a percentage of the Spanish GDP, the three regions have very small weight in the Spanish economy, around 4.2 % of Spanish GDP in 1995; therefore, our data include almost all the Spanish regional trade.

Column 2 shows the openness ratio at regional level. On average, the sum of exports and imports is greater than the regional PIB. The regions with the largest openness ratio are Aragon (180%), Navarra (167%) and Valencia Region (136%).[3] The regions with the smallest openness ratio are the two island regions, Canarias (49%) and Balearic Islands (61%) and the regions with less per capita income, Extremadura (62%) and Andalucia (76.5%).

An important novelty in the data set is the inclusion of the trade of services.[4] Column 3 shows the importante of tradable services. On average, tradable services represent above

[2] For example, when testing the Heckscher-Ohlin theory using U.S. regional data, Smith (1999) considers only international trade flows. However, any regional empirical test of the endowment-driven theories of trade using only international trade data will be severely biased as inter-regional trade flows account for most of the total trade of the regions. For the regions of Spain, above 60 percent of total trade is inter-regional trade.

3 It is interesting to point out the presence of important multinacionals of the automobile industry: Ford in Valencia, Renault in Aragón and Volswagen in Navarra.

4 Oliver (2003) (dir.) has constructed an alternative database of Spanish regional trade which includes only tradable goods. In the Annex 2 (pages 229-258) of this publication there is a comparison between his database and our database. It is remarkable that there are not large differences between both databases.

10% of the total regional trade, with one particular region, Madrid, whose service trade are the 31% of total trade, three times larger than the national average. Column 4 shows that interregional trade represents a large proportion of the trade of the Spanish regions. On average the percentage is above 60%, with maximum values of 88.7% of Castilla-La Mancha and 92.4% of Extremadura. Column 5 reveals that trade of services is mainly interregional (87.6% on average), compared to the trade of goods and services (71% on average). The last four columns of Table 1 decompose the trade flows in exports and imports to check the importance of the flow direction in regional trade openness as well as to examine the role of service trade.

[INSERT TABLE 1 HERE]

3. The HOV model using regional data.

The Heckscher-Ohlin theory of international trade (Heckscher, 1919; Ohlin, 1933) and the extension by Vanek (1968) to multiple factors of production, commodities and regions (the so called HOV model) represent a long tradition of explaining trade flows based on comparative advantage. The HOV theory establishes a relationship between factor abundances of regions, factor intensities of industries in the different regions and net trade flows: A region is expected to export the services of the factors that has in relative abundance and import the services of the factors that are relatively scarce.

The derivation of the HOV model begins with the identity that a region´s net factor exports can be expressed as the difference between factors absorbed in production and factors absorbed in consumption under the assumption of full employment of factors:

(1) $$B^r (I - A^r)^{-1} T^r = V^r - B^r (I - A^r)^{-1} C^r$$

where $B^r (I - A^r)^{-1}$ is the technology matrix or matrix of gross factor input requirements, which indicates the total (both direct and indirect) amount of each of the factors needed to produce one unit value of gross output within each of the industries.[5]. T^r is the vector of net exports of region r (the vector has n elements, equal to the number of commodities), V^r is the vector of factor endowments of region r (the vector

[5] Gross intensities (or direct-plus-indirect) are the appropriate measure for factor intensities since it is these that determine autarky prices (Deardoff, 1984).

has m elements, equal to the number of factors) and C^r is the vector of domestic absorption of region r. We premultiply T^r and C^r by $B^r(I - A^r)^{-1}$ to convert net output for trade and consumption into total factor content of trade and consumption.

As in the traditional HOV studies, equation (1) is transformed into a testable hypothesis by making one or more of the following assumptions: (i) No measurement errors; (ii) commodities are freely mobile between regions while factors are immobile; (iii) technologies are the same in each region; (iv) factor prices fully equalize between regions (FPE); and, (v) identical homothetic tastes are assumed in all regions (IHP).

In conducting empirical analysis, attention must be paid to these assumptions. While in the 2x2x2 Heckscher-Ohlin model the assumption (iv) arises as a result, the HOV model assumes factor price equalisation to begin with. If there is no full factor price equalisation then in (1) the A matrix of factor intensities will not be the same in all regions and the vector T^r of net exports will not be the appropriate variable for measuring the factor content of trade of a region since exporting and importing industries will not produce under the same factor intensities.

There are two important requirements for assumption (iv) to be met. The first requirement is that countries are not too dissimilar in relative factor endowments. Using recent theoretical advances in trade theory by Deardoff (1994) and Xiang (2001), Debaere (2003, 2004) has showed that OCDE countries and regions of Japan and UK are not too dissimilar in their relative factor endowments.

The second requirement is that technology is similar across countries (Samuelson, 1949). Pioneering papers testing the HOV model such as Maskus (1985) and Bowen et al. (1987) use a large group of developed and underdeveloped countries and utilize a single input-output table (for the U.S.) in constructing the technology matrix, A, after imposing universal factor price equalisation. Bowen et al (1987) and Trefler (1993, 1995) allow for Hicks-neutral technological differences across countries. Hakura (2001) and Davis and Weinstein (2001) used country-specific input-output tables for four EC countries and ten OCDE countries, respectively. All the papers mentioned above find that allowing for technological differences significantly improves the predictive power of the modified HOV model.

In practice, to test the strict HOV model implies to assume that technology is common to all countries and regions. Therefore, the strict HOV model uses a single technological matrix for all countries or regions being tested. This suggests that care must be taken in selecting the countries or regions. James and Elmslie (1996) use the U.S. technological matrix of the U.S. for the test of the validity of the strict HOV model among 7 OCDE countries after showing correlations above 0.87 between the technology matrices of France, Germany, Italy, Japan, U.K. and Canada to the U.S. input-output table for 1965. However, they find weak empirical support for HOV.

If the HOV model is ever to be shown consistent with data, it will be for a group of regions within a country, rather than for a sample of similar countries, since it is more likely that regions share similar factor endowments distribution, technology and preferences. There are some attempts to check the validity of the HOV model using regional data. The idea has been implemented first by Grimes and Prime (1993) and Horiba (1997) using U.S. regional data. Though their findings support the HOV, both papers fail to consider the full world general equilibrium and assume initial autarky equilibrium for the U.S. regions. In a more recent paper, Davis et al. (1997, 2001) show how to derive exact predictions for the factor content of trade in a world in which only a subset of regions share factor price equalisation. This allows us to forego the heroic assumption of universal factor price equalisation, continue to embed this in a full general equilibrium and derive exact predictions to compare with the data.

This paper adopts this strategy: for a group of regions within a country we relax the assumptions (iv) and (v) about world factor price equalisation (W-FPE) and world identical and homothetic preferences (W-IHP). If we require factor price equalisation only for the regions of Spain, rather than for the whole world, this may be expressed as:

$B^r = B^S, A^r = A^S \quad \forall r \in S$,

$B^S (I - A^S) X^r = V^r \quad \forall r \in S$, and

$B^S (I - A^S) X^W = V^W$

where X is gross output and superscript S stands for Spain. If we require identical and homothetic preferences only for the regions of Spain, rather than for the whole world, this may be expressed as:

$$C^r = \left(s^r / s^S\right) C^S \quad \forall r \in S$$

The implied factor content of absorption is:

$$B^S (I - A^S)^{-1} C^r = \left(s^r / s^S\right) B^S (I - A^S)^{-1} C^S$$

where s^r is the share in world spending for region r and s^S is the Spanish share in word spending.

Under the assumptions that factor price equalisation and identical homothetic preferences hold for the world as a whole, the strict HOV model is:

(2) $B^S (I - A^S)^{-1} T^r = V^r - s^r V^W$ **(MODEL I: W-FPE and W-IHP)**

If we believe that FPE fails for the world as a whole but FPE still holds for the regions of Spain, and, as well, we assume that IHP hold for Spain but not for the world as a whole, then the relevant test is:

(3) $B^S (I - A^S)^{-1} T^r = V^r - \left(s^r / s^S\right) B^S (I - A^S)^{-1} C^S$

(MODEL II: R-FPE and R-IHP)

Model I and Model II are the two equations for all tests in this paper. The two sides each equation are vectors with m elements in each side. The elements of left-hand-side of the equation represent the factor content of net exports in each of the m factors and the elements of the right-hand-side show the excess supply of each of the m factors in region i. According to the HOV model, if a region is abundant in a factor relative to Spain, the amount of that factor embodied in its exports will exceed that embodied in its imports. Abundance of a factor is indicated by a region´s endowment exceeding its expenditure share in world endowments (Model I) or its expenditure share in the Spanish endowment of domestic absorption (Model II).

5. Comparing the measured and the predicted net factor of trade.

To test the hypothesis that consideration of similar relative factor endowments, technology and tastes across regions of the same country should improve empirical results, a multiregional multifactor test of HOV is performed using data around the year 1995. In the present paper, the dataset contains information for 14 Spanish regions and six production factors: agricultural land (TA), forest and wood land (TF), low skill labour (LU), high skill labour (LS), stock of R&D capital (RD), and stock of physical capital (K). The Data Appendix provides more details about the construction of the variables and statistical sources.

A typical single-factor equation, which is a row from (2) or(3), will take the form:

(2´) $FX_j^r = V_j^r - s^r V_j^W$ for each region r

(3´) $FX_j^r = V_j^r - \left(s^r / s^S\right) FC_j^S$ for each region r

where FX_j^r is the total quantity of any factor j embodied in region´s r net exports, V_j^r is the endowment of factor j in region r, V_j^W is the endowment of factor j in the world and FC_j^r is the endowments of factor j in Spanish absorption. The theory establishes for a given factor a vector equality between what we term the *measured* (left hand side) and *predicted* (right hand side) net factor content of trade for each region.

Factors and regions must be expressed in comparable units in order to satisfy the statistical hypothesis of homoscedasticity. Following Trefler (1995), each region-factor observation is scale by $\sigma_f \sqrt{s^r}$ where s^r is the region´s *r* share in the Spanish GDP and σ_f is the standard error of prediction error of the model, expressed as the differences between the *measured* and *predicted* net factor content of trade. [6]

5.1. Non parametric tests

Based on equations (2) and (3) three nonparametric tests of the HOV are implemented: the "sign" test, the "rank" test and the "strong" test. The sign test compares the signs of the values of the elements of the vectors on the two sides of equations and checks if they are the same. For a typical element,

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[6] For example, for model I, the deviations from the HOV model are $\varepsilon_f^r = FX_j^r - (V_j^r - s^r V_j^w)$ and $\sigma_j^2 = \sum_r \left(\varepsilon_f^r - \bar{\varepsilon}_f\right)^2 / R - 1$ where $\bar{\varepsilon}_j = \sum_r \varepsilon_f^r / R$.

Model I: $sign(FX_j^r) = sign(V_j^r - s^r V^w) \quad r = 1,...R; j = 1,...,M$

Model II: $sign(FX_j^r) = sign(V_j^r - \left(s^r / s^S\right) FC_j^S) \quad r = 1,...R; j = 1,...,M$

A sign match implies that the region in fact is a net exporter or importer of the factors that theory predicts. One can calculate the proportion of correct sign matches by factor (across regions), by regions (across factors), or for the matrix as a whole. With M factors and R regions, there are MR observations in total, and we are interested in what *percentage* of these has the same sign on the two sides of the equation. Notice that a completely random pattern of signs such as obtained by flipping a coin would still generate correct signs 50% of the time in a large sample. Therefore, the sign test must do considerably better than this in order to conclude that the HOV theory is successful. Bowen et al. (1987) and Trefler (1995) find a poor performance of the HOV model using this test. More recently, Debaere (2003) develops a prediction of the factor content of trade that relates bilateral differences in endowments to bilateral differences in factor contents. He shows that his sign test significantly improves the predictions of the HOV model compared to the sign test based on a comparison between trade factor content and factor endowment by pairs of countries and factors. Following Debaere (2003) the sign test is constructed as:

$$sign\left(\frac{FX_{j1}^{r1} - FX_{j1}^{r2}}{V_{j1}^{r1} + V_{j1}^{r2}} - \frac{FX_{j2}^{r1} - FX_{j2}^{r2}}{V_{j2}^{r1} + V_{j2}^{r2}}\right) = sign\left(\frac{V_{j1}^{r1} - V_{j1}^{r2}}{V_{j1}^{r1} + V_{j1}^{r2}} - \frac{V_{j2}^{r1} - V_{j2}^{r2}}{V_{j2}^{r1} + V_{j2}^{r2}}\right)$$

where each term FX_{jl}^{rk} and V_{jl}^{rk} k=1,2 and l=1,2 has been divided previously by s^r for Model I and (s^r / s^S) for Model II.[7]

The rank test compares the ranking, by factor (across regions) or by region (across factors), of the *measured* and *predicted* factor content of trade. The rank test can be implemented in two ways. First, we can evaluate the ranking of an individual factor across all regions and the ranking of an individual region across factors. Here we use the Kendall concordance test. An alternative is to perform the test for each pair of elements:

Model I:

[7] The results of the sign test proposed by Debaere (2003) should not be very different for Model I and Model II. This test is implemented for comparison purposes with the standard sign test.

$$FX_k^r > FX_l^r \Leftrightarrow (V_k^r - s^r V_k^w) > (V_l^r - s^r V_l^w) \quad r = 1,...R; k,l = 1,...,M$$

Model II:

$$FX_k^r > FX_l^r \Leftrightarrow (V_k^r - \left(s^r / s^S\right) FC_j^S) > (V_l^r - \left(s^r / s^S\right) FC_l^S) \quad r = 1,...R; k,l = 1,...,M$$

This alternative rank test involves a pairwise comparison of all factors for each region, so there are M(M–1)/2 pairs for each of R regions. If the computed factor content of one factor exceeds that of a second factor, then we check whether the relative abundance of that first factor also exceeds the relative abundance of the second factor. Again, a completely random assignment of factor abundance and relative endowments would imply that in 50% of the comparisons in a large sample, the rank test would be satisfied, so we would hope that the actual data perform considerably better than this.

The third non-parametric test, the "*strong*" test, calculates the difference between the measured and predicted factor content of trade divided by the predicted net factor of trade. If the theory works, equation (4) holds exactly.[8] For each region/factor pair we calculate the average prediction error of the HOV model as

$$deviation = \left| MFCT_j^r / PFCT_j^r - 1 \right|$$

Since these tests do not specify a clear null hypothesis, they merely give us an indication of how consistent the data is with the theory. If the model fits the data well, we conclude that relaxing the assumptions will not greatly enhance our understanding of the factor content of trade; when the model fits poorly, we conclude that there is may be substantial gains from considering alternative specifications.

5.2.- Regression analysis

Regression analysis was performed in addition to the nonparametric tests. Regression analysis uses the full HOV equations and pooled data across regions and factors. From the regressions, we get an idea of overall performance and can control for the variation in individual factors and regions; thus, regression analysis supplements the nonparametric tests by considering pooled data. However, we cannot establish a priori

[8] This test is close to Trefler (1995) "missing trade" test.

manner in which pooling the data will affect the results. The "strict" HOV model (W-FPE and W-IHP) as expressed in equation (2) predicts that

(4) $FX_j^r = \gamma_o + \gamma_1 \left[V_j^r - s^r V_j^w \right] + \varepsilon$

On the other hand, the modified HOV model (W-FPE and W-IHP) as expressed in equation (3) predicts

(5) $FX_j^r = \beta_o + \beta_1 \left[V_j^r - \left(s_r / s^S \right) FC_j^S \right] + \varepsilon$

If the HOV works we expect a priori that the constant terms not to be significant and the sign of the coefficients γ_1 and/or β_1 to be positive and statistically significant. If the HOV works exactly as the theory predicts, the value of γ_1 and/or β_1 should be equal to one.

6.- Results

The results of the sign and rank tests are presented in Tables 2 and 3. Each Table reports the results for Model I (World FPE and World IHP) and Model II (Regional FPE and Regional IHP). The difference between the two tables is whether the tests are evaluated for a factor (Table 2) or for a region (Table 3). The column labelled *Sign1* indicates the proportions of matches between the sign of net exports of a factor and the sign of the excess of supply of the same factor, which is a comparison of the signs of the values on either side of the equality in equations (2) and (3). For example, in Table 2 (Model I) the proportion of sign matches is .29 for LU (unskilled labour). This means that of the fourteen equations (2) for LU, one for each region, four had signs that matched on either side of the equality. In contrast, the proportion of sign matches is .93 (nine out of fourteen) for K (physical capital). In similar way, in Table 3 (Model I) the proportion of sign matches is .33 for Madrid and Castilla-Leon, indicating that for each of the six factors, two had signs that matched on either side of the equality. In contrast, the proportion of sign matches is .83 for Vasc Country. Obviously the desired proportion of sign matches is 1.00, and these results do not provide very much support for the HOV model on the basis of this sign test. This is corroborated by the alternative sign test, *Sign2*. The number of sign matches provided by *Sign2* for Model I varies between .36 for the stock of R&D capital and .49 for the stock of physical capital in Table 2, while

Sign2 varies between .43 for Madrid and .74 for Extremadura in Table 3, providing poor support for the HOV model.[9]

When we perform *Sign1* in Model II the number of matches improved significantly. In Table 2 the number of matches increased across regions in three out of six factors (skilled labour, arable land and forest land) and in Table 3 the number of matches increased across factors in six out of fourteen regions (Andalusia, Asturias, Castilla-La Mancha, Catalonia, Extremadura and Madrid). When we examine the HOV under the assumptions of FPE and IHP at regional level, rather than world level, the number of sign matches increased both across regions and factors. Due to the nature of the alternative sign test (*Sign2*) based on comparisons of pairs of regions and pairs of factors we do not expect large differences in the number of matches between Model I and Model II. Although we find a slight improvement in the number of matches in Table 2 Model II for the arable land and forest land, the proportion of matches is below .50, worse than flipping randomly a coin and choosing the sign of the match.

Moving to the next non-parametric test, the rank proposition states that the order of the adjusted factor contents and the order of the adjusted resource abundance conform. Two formal measures of the conformity between the factor content and factor abundance ranking are shown in Table 2 and Table 3. The rank test labelled *Rank1* shows the Kendall rank correlation between the rankings for each factor across the fourteen regions (Table 2) or each region across the six factors (Table 3). The rank labelled *Rank2* shows the proportions of correct ordering when the comparisons are made two at the time. In this case, these proportions are interpreted as the probability, for a given region (factor), that the ranking of factor contents will match the ranking of factor abundance for a randomly selected pair of regions (factors). If HOV model works the factor content and the factor endowment measures should provide consistent rankings for factors across regions and for regions across factors.

[9] We also implemented the Fisher´s exact test for the pooled sample used in *Sign1* and *Sign2* to test the null hypothesis of the independence between the signs of the values of either side of equations (2) and (3). We always rejected the null hypothesis at .05 significance level, suggesting that it is coincidental the observed sign matches.

The poor match of the rankings as well as the low values of *rank1* and *rank2* obtained for Model I are quite disappointed. The Kendall´s coefficient of concordance (*rank1*) is no statistically significant for any ranking in Table 2 and 3 for Model I. When we examine the rankings for Model II, the ranking results in both Table 2 and Table 3 improve significantly. In Table 2 the Kendall´s coefficient of concordance (*rank1*) for Model II are higher than in Model I in all but two factors and statistically significant for two factors (R&D stock and arable land). In Table 3 *rank1* values in Model II are higher than in Model I and there are five regions (Andalucia, Canary Islands, Castilla-Mancha, Valencian Region and Vasc Country) with statistically significant Kendall´s coefficients. Similar conclusions are obtained when we examine *rank2*. Most values are below .5 for Model I in Tables 2 and 3, suggesting no support for HOV under the assumptions of W-FPE and W-IHP. However the *rank2* values for Model II are greater than .5, suggesting that relaxing the assumptions of world FPE and IHP improves the predictive capacity of the HOV model.

The "strong" test results are presented in Table 4. The test involves computing the deviation between the actual and the predicted factor content of trade. Although there are substantial deviations in Model I and Model II, the errors are much smaller for the second one. Interestingly, it occurs across all factors and all regions. At best, the "strong" test shows that Model I is superior to Model II. At worst, the "strong" test confirms the poor results of the HOV model

Finally we complement the non-parametric analysis with a regression analysis. The idea is pooling the data to control for the variation in individual factors and regions. The regression results are presented in Table 5. In the first regression for Model I; the constant term is statistically significant but the estimated coefficient γ_1 is not. In the second regression we omit the constant term but the lack of significance of the coefficient γ_1 remains. Thus, the estimated coefficients for Model I do not support the HOV theory under the assumptions of world factor price equalisation and world identical and homothetic preferences. In the first regression of Model II, the estimated coefficient β_1 is significant at the .01 level and has the correct (positive) sign. The constant term is not significant and its presence or absence does not alter the estimated value of β_1. Thus, the estimated coefficients for Model II support the HOV model under the assumptions of regional factor price equalisation and regional identical and homothetic preferences. The major limiting results from the regression analysis are the magnitudes of the coefficients. Changes in regions factor endowments have little effect on factor services exchanged through trade.

7.- Conclusions

The Hecksher-Ohlin model continues being the cornerstone of international trade theory to explain the pattern of inter-industry flows between regions. Net trade is explained through relative factor endowments. The generally poor empirical results from the Hecksher-Ohlin in both its Vanek and non-Vanek forms have motivated the need to find why.

The current paper builds on previous tests of HOV by giving careful consideration to the assumptions underlying the theory. Specifically we restrict our HOV tests to regional data, which are similar in terms of relative endowments, technology and tastes. We believe that this test provides a “best case” scenario for HOV to hold empirically because of the restriction of similarity between regions. The discussion of results reveals the importance for empirical studies of HOV to be conducted in settings where the assumptions underlying the model can reasonably be expected to be achieved. Indeed, it is likely that the failure to adequately consider the assumptions of factor price equalisation and identical preferences is a partial explanation for the generally poor empirical results that have been generated using the Hecksher-Ohlin model.

The results of our study show poor support for the HOV model in its strict setting, that is, under world factor price equalisation and world identical, homothetic preferences. When we allow a more realistic setting, where factor price equalisation and identical homothetic preferences hold only at regional level, the HOV model performs significantly better.

When testing the strict HOV using regional data under the assumptions of world factor price equalisation and world identical homothetic preferences, the sign and rank tests of both ranking of factors across regions and ranking of regions across factors finds no statistically significant support for HOV. When testing the modified HOV using regional data under the assumptions of regional factor price equalisation and regional identical homothetic preferences, the proportion of sign matches increases both across regions and factors. However, neither of the sign test find statistically significant support for HOV.

The rank tests did not find any statistically significant support for HOV using regional data under the assumptions of world factor price equalisation and world identical homothetic preferences. However, some support is associated with the "rank" tests of factors across regions: using *Rank1* of factors across regions, 2 of the 6 factors are found significant at the 10 per cent and using *Rank1* of regions across factors, 4 of the 14 regions are found significant at the 10 per cent. Moreover, the proportion of matches using *Rank2* increases in 3 of the six factors and in 9 of the 14 regions, providing some limited support of the HOV model.

The "strong" test has no measure of statistical significance; however, the percentage deviations show considerable variation. Clearly, the results that most strongly support HOV are the regressions which pool the regions and factors together into a single equation. The regressions find no support of the strict HOV when factor price equalisation and identical homothetic preferences hold at world level. However, the regression results support the modified HOV when factor price equalisation and identical homothetic preferences hold at regional level. In no case, HOV does hold exactly. All the variables are of the correct sign and are significant at the .01 level. However the magnitude of the coefficients indicates that changes in regions factor endowments have little effect on factor services exchanged through trade.

Our results suggest that the approach taken here of allowing the assumptions of the model determine the empirical testing that is done improves the concordance of the theory to the data. In particular, the predictive capacity of the Heckscher-Ohlin-Vanek model improves ones we use data for a group of "homogeneous" geographic units (in our case, the regions of Spain) and we relax some of the assumptions of the model to hold at regional level rather than at world level (in our case, factor price equalisation and identical homothetic preferences).

Even though the results suggest a limited support of the HOV model of trade using regional data, it is somehow surprising that our results for the Spanish regions do not support the HOV model as well as in Davis et at. (1997) for the Japanese prefectures. One possible explanation is measurement error problems in the construction of the database. However, it seems quite unlikely due to the large difference between our results and their results. Moreover, our trade flows as obtained directly from regional input-output tables while their trade flows are obtained as the difference between actual production and an estimated measure of regional consumption using Household Expenditure Survey). Another explanation is that endowment-driven models are not able to explain all the pattern of production (and trade) specialisation at regional level. Indeed, Bernstein and Weinstein (2002) show that the endowment-driven model of production performs poorly using Japanese regional data and Pons et al. (2001) do the same for the Spanish regions. To conclude, our research suggests the need for economic geography models to complement the endowment-driven models as explanation of the pattern of production and trade specialisation.

Data appendix

Data are collected for trade flows, factor endowments and factor intensities, the three variables of the HOV equation for which independent observations are required in a complete test. The sources of the data used on trade flows, direct factors used and the technology matrix refer to 1995 while data on factor endowments for both the Spanish regions and the OCDE countries refer to 1990. Table A.1 lists the Spanish regions included in the sample and the year for which the regional input-output table is available. The excluded regions are Cantabria, Murcia and La Rioja due to lack of input-output tables. The 19 OCDE countries ("the *World*") included in the sample are USA, Canada, Japan, Australia, New Zealand, Norway, Sweden, Austria, Germany, France, Italy, UK, Netherlands, Belgium, Denmark, Greece, Ireland, Portugal and Spain.

Data on factor endowments, production and trade are available for 23 sectors of the economy including agriculture, industry and services. The sectors are listed in Table

A.2 with the Spanish Input-Output Table and NACE industry numbers to which they correspond. The concordance of sectors for the Spanish regions is available on request.

Data for the Spanish factor endowments was collected from the following sources: *Contabilidad Regional de España,1990* (INE) for total labour; Encuesta de Salarios de la Industria y Servicios, 1990 (INE) for participation of skilled and unskilled labour in labour force, *Anuario de Estadística* (INE) for land endowments; *Encuesta de I+D* (INE) for stock de I+D; Fundación BBVA-IVIE *(1998)* for stock of physical capital. Data for the OCDE factor endowments was collected from the following sources: International Labour Office (1990) *Year Book of Labour Statistics* for skilled and unskilled labour endowments; Statistical Appendix of Coe and Helpman (1995) "International R&D Spillovers" (*European Economic Review,* 39, 859-887) for stock of physical capital and stock of R&D; FAO (1991) *Production Yearbook* for land endowments. The variables are expressed in thousand of euros (physical capital, R&D stock, GDP), units (skilled labour and unskilled labour) and hectares (arable land and forests).

Trade flows were obtained directly from the regional input-output tables. Imports and exports include both interregional trade (exchange of goods and services with other Spanish regions) and international trade (exchange of goods and services with the rest of the world). Interregional trade represents above 60 percent of total regional trade and trade with OCDE countries ("the *World*") accounts for nearly 90 percent of total Spanish trade.

The technological matrix or matrix of indirect input requirements was constructed using the Spanish Input-Output Table (1995), published by INE. The direct factor requirement for labour, R&D and physical capital in each sector was obtained as the ratio between net output and the factor employed in the sector. Factor intensities for types of land are calculated as proportional to the output of the corresponding input-output sector.

Table A.3 presents the database. The first six rows contain the net trade factor content for the Spanish regions. For example, all regions are net importers of physical capital except Madrid. The next six rows contain the factor content of each regional domestic demand while the last six rows contain the factor endowment.

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Tables of results

[APPENDIX TABLE]
Table A.1. Regional input-output tables

ESPAÑA	SPAIN	1995	R71
ANDALUCIA	AND	1995	R89
ARAGON	ARA	1992	R69
ASTURIAS	AST	1995	R59
BALEARES	BAL	1995	R51
CANARIAS	CAN	1992	R59
CASTILLA-LEON	CLE	1995	R56
CASTILLA-MANCHA	CMA	1995	R39
CATALUÑA	CAT	1987	R73
C. VALENCIANA	CV	1995	R69
EXTREMADURA	EXT	1990	R54
GALICIA	GAL	1994	R63
MADRID	MAD	1996	R56
NAVARRA	NAV	1995	R51
PAIS VASCO	PV	1995	R84

[APPENDIX TABLE]
Table A2. Sector categories

Sector name	Sector	Spain IO Table (1995) R71 classification
Agriculture products	1	1 - 3
Energy and water	2	4, 5 , 8 - 11, 39
Metal minerals and primary iron & steel Mfg.	3	6, 29
Non metallic minerals and related manufactures	4	7, 25 - 28
Food, drinks and tobacco	5	12 - 16
Textiles, apparel, footwear, leather	6	17 - 19
Wood & cork products; Miscellaneous Mfg.	7	20, 38
Paper, printing & publishing	8	21, 22
Chemical	9	23
Rubber & Plastic	10	24
Metallic products	11	30
Agricultural and industrial machinery	12	31, 33
Office machines and professional goods	13	32
Electric and electronic products	14	34, 35
Transport equipment	15	36, 37
Construction	16	40
Retail services; reparation; other market services n.e.c.	17	41 - 43, 55 - 58 , 59 - 63 , 71
Hotels and restaurants	18	44
Transport services	19	45 - 49
Post and telecomunications services	20	50
Banking and insurance services	21	51 - 53
State services	22	54
Non-market orientated services	23	64 - 70

Note: We report only the sector conversion table for the Spain IO table. We omit the correspondence tables for the regional IO table (available on request).

Table 1: Description of Spanish regional trade

	OUTPUT	TRADE				EXPORTS		IMPORTS	
Comunidad Autónoma	Porcentage GDP $_{1995}$ (a)	Openness Ratio (b)	Weight of services in total trade (c)	Inter-regional trade (d)		Porcentage inter-regional exports (e)		Porcentage inter-regional imports (e)	
	All sectors	All sectors	Service sectors only	All sectors	Service sectors only	All sectors	Service sectors only	All sectors	Service sectors only
Andalusia	13.4	76.5	11.0	72.2	80.9	64.4	80.3	77.0	81.7
Aragon	3.3	180.2	11.2	60.9	80.7	57.7	81.3	64.0	80.3
Asturias	2.4	103.6	12.0	76.3	89.7	78.6	83.9	74.3	96.8
Balearic Islands	2.3	61.0	7.0	82.4	81.3	37.5	77.5	89.8	83.3
Canary Islands	2.9	49.2	5.0	60.3	97.2	71.4	97.0	57.5	100.0
Castilla-León	6.1	94.7	5.4	65.6	81.7	65.2	78.6	66.0	93.9
Castilla-La Mancha	3.5	120.8	9.3	88.7	92.1	90.0	81.7	87.5	95.1
Catalonia	18.5	124.4	12.6	66.5	86.6	75.1	84.0	57.4	89.8
Valencia	9.5	136.4	12.3	67.8	75.4	62.6	65.0	72.4	85.7
Extremadura	1.6	62.6	6.2	92.4	96.3	91.9	83.4	92.8	100.0
Galicia	6.6	114.7	6.6	71.6	99.7	66.3	100.0	74.8	99.5
Madrid	16.8	90.5	31.4	60.9	78.7	76.2	85.9	44.0	29.7
Navarra	1.7	167.1	5.6	66.2	97.7	54.6	84.2	78.1	99.0
Vasc Country	6.3	121.0	13.4	62.3	88.4	59.0	77.6	65.6	97.0
Cantabria	1.2	nd	nd	nd	nd	nd	nd	nd	nd
Murcia	2.3	nd	nd	nd	nd	nd	nd	nd	nd
Rioja (La)	0.8	nd	nd	nd	nd	nd	nd	nd	nd
Promedio Nacional		**107.3**	**10.6**	**71.0**	**87.6**	**67.9**	**82.9**	**71.5**	**88.0**

Note: na: no available . X: Exports, M: Imports, GDP: Gross Domestic Output. (a): regional GDP / Spanish GDP. (b): (X total + M total) / GDP. (c): Services trade / Total trade. (d): (X interregional + M interregional) / (X total + M total). (e): X interregional / X total. (f): M interregional / M total. Source: Own elaboration using regional IO Tables.

Table 2. Sign and rank tests, factor by factor.

Model I: World factor price equalisation and world identical homothetic preferences

		AND	ARA	AST	BAL	CAN	CLE	CMA	CAT	CV	EXT	GAL	MAD	NAV	PVS	Rank1	Rank2	Sign1	Sign2
K	F.C.	12	11	2	13	8	3	7	5	10	4	14	1	9	6				
	F.E.	13	6	1	7	8	9	4	12	2	3	10	14	5	11	0.27	0.63	0.93	0.49
LS	F.C.	11	12	4	13	7	3	6	2	10	5	14	1	9	8				
	F.E.	2	11	8	6	3	14	5	10	7	4	1	9	13	12	0.23	0.34	0.64	0.48
LU	F.C.	12	10	5	13	11	3	4	2	8	7	14	1	9	6				
	F.E.	4	7	14	13	11	2	6	8	3	5	1	10	9	12	0.09	0.42	0.29	0.45
RD	F.C.	14	6	4	10	9	8	11	2	12	5	13	1	7	3				
	F.E.	13	5	3	4	6	10	7	14	11	2	9	12	1	8	0.07	0.53	0.86	0.36
TA	F.C.	2	6	9	14	10	3	1	7	11	5	8	13	4	12				
	F.E.	11	3	6	7	8	4	2	14	12	1	9	13	5	10	0.36	0.67	0.64	0.39
TF	F.C.	13	12	6	9	11	8	7	3	4	5	10	14	2	1				
	F.E.	11	8	3	9	10	5	6	12	13	2	1	14	7	4	0.25	0.63	0.43	0.45

Model II: Regional factor price equalisation and regional identical homothetic preferences

		AND	ARA	AST	BAL	CAN	CLE	CMA	CAT	PVL	EXT	GAL	MAD	NAV	PVS	Rank1	Rank2	Sign1	Sign2
K	F.C.	12	11	2	13	8	3	7	5	10	4	14	1	9	6				
	F.E.	14	6	1	11	9	8	3	5	12	4	10	13	7	2	0.41	**0.69**	0.93	0.48
LS	F.C.	11	12	4	13	7	3	6	2	10	5	14	1	9	8				
	F.E.	11	2	4	8	3	12	6	14	10	1	5	13	7	9	0.29	**0.53**	**0.79**	0.49
LU	F.C.	12	10	5	13	11	3	4	2	8	7	14	1	9	6				
	F.E.	6	7	14	13	9	2	5	12	3	4	1	10	8	11	0.14	**0.53**	0.29	0.46
RD	F.C.	14	6	4	10	9	8	11	2	12	5	13	1	7	3				
	F.E.	13	5	6	12	8	10	14	2	11	7	9	1	3	4	0,69*	**0.83**	0.86	0.35
TA	F.C.	2	6	9	14	10	3	1	7	11	5	8	13	4	12				
	F.E.	5	4	8	9	11	2	1	13	10	3	7	14	6	12	0,64*	**0.81**	**0.79**	0.43
TF	F.C.	13	12	6	9	11	8	7	3	4	5	10	14	2	1				
	F.E.	12	8	3	9	10	5	7	13	11	2	1	14	6	4	0.27	0.63	**0.50**	0.48

Notes: F.C. factor content measure ranking; F.E. factor endowment measure ranking. Thre are six factors, physical capital (K), R&D (RD), skilled labour (LS), unskilled labour (LU), land for arable and pasture (TA) and forest land (TF). Rank1 is the value of the Kendall´s coefficient of concordance [0, 1]. Rank2 is the proportion of pairwise rank matches. Sign1 is the proportion of sign matches based on one-by-one comparisons. Sign2 is the proportion of sign matches based on comparison of bilateral differences in endowments to bilateral differences in factor contents. Simbols * means statistically significant at 0.10 level.

Table 3. Sign and rank tests, region by region.

		K	LS	LU	RD	TA	TF	Rank1	Rank2	Sign1	Sign2
AND	F.C.	5	3	4	6	1	2				
	F.E.	4	3	1	6	2	5	0.06	0.41	0.50	0.52
ARA	F.C.	6	5	4	2	1	3				
	F.E.	3	5	1	6	2	4	0.06	0.47	0.67	0.53
AST	F.C.	1	2	3	5	6	4				
	F.E.	1	4	5	6	3	2	0.06	0.41	0.67	0.47
BAL	F.C.	5	3	4	2	6	1				
	F.E.	5	3	1	6	4	2	0.06	0.23	0.50	0.49
CAN	F.C.	3	1	6	4	5	2				
	F.E.	4	2	1	5	6	3	0.33	0.17	0.83	0.50
CLE	F.C.	3	2	4	6	1	5				
	F.E.	4	5	1	6	2	3	0.06	0.41	0.33	0.54
CMA	F.C.	5	4	2	6	1	3				
	F.E.	3	5	1	6	2	4	0.33	0.58	0.50	0.49
CAT	F.C.	5	4	2	3	6	1				
	F.E.	3	4	1	6	2	5	0.20	0.35	0.50	0.55
CV	F.C.	4	3	2	5	6	1				
	F.E.	3	4	1	6	2	5	0.33	0.29	0.67	0.51
EXT	F.C.	4	3	5	6	1	2				
	F.E.	4	5	1	6	2	3	0.20	0.35	0.67	0.74
GAL	F.C.	6	3	5	4	2	1				
	F.E.	5	4	2	6	3	1	0.06	0.47	0.50	0.49
MAD	F.C.	2	1	3	4	6	5				
	F.E.	4	3	1	6	2	5	0.06	0.47	0.33	0.43
NAV	F.C.	6	5	4	3	1	2				
	F.E.	4	5	1	6	2	3	0.20	0.53	0.67	0.50
PVS	F.C.	4	5	3	2	6	1				
	F.E.	5	4	1	6	2	3	0.06	0.41	0.83	0.51

		K	SK	UN	RD	TA	TF	Rank1	Rank2	Sign1	Sign2
AND	F.C.	5	3	4	6	1	2				
	F.E.	5	3	6	4	1	2	**0,75****	**0.79**	**0.83**	0.52
ARA	F.C.	6	5	4	2	1	3				
	F.E.	6	5	1	3	4	2	**0.20**	**0.53**	0.67	0.54
AST	F.C.	1	2	3	5	6	4				
	F.E.	1	5	3	4	6	2	**0.46**	**0.64**	**0.83**	0.47
BAL	F.C.	5	3	4	2	6	1				
	F.E.	5	2	3	6	1	4	**0.46**	**0.47**	0.50	0.48
CAN	F.C.	3	2	5	4	6	1				
	F.E.	4	3	1	6	2	5	**0,60***	**0.58**	0.83	0.51
CLE	F.C.	3	2	4	6	1	5				
	F.E.	4	6	1	5	3	2	0.06	0.41	0.33	0.53
CMA	F.C.	5	4	2	6	1	3				
	F.E.	4	5	1	6	3	2	**0,60***	**0.70**	**0.83**	0.50
CAT	F.C.	6	4	2	3	5	1				
	F.E.	4	5	1	2	6	3	**0.46**	**0.64**	**0.67**	0.55
CV	F.C.	4	3	2	5	6	1				
	F.E.	4	3	1	5	6	2	**0,86****	**0.82**	0.67	0.51
EXT	F.C.	3	4	5	6	1	2				
	F.E.	5	4	1	6	3	2	0.20	**0.53**	**0.50**	0.73
GAL	F.C.	6	3	5	4	1	2				
	F.E.	5	3	2	4	6	1	0.06	0.47	0.50	0.51
MAD	F.C.	2	1	3	4	6	5				
	F.E.	5	4	2	1	6	3	0.06	0.47	**0.67**	0.49
NAV	F.C.	6	5	4	3	1	2				
	F.E.	5	6	1	3	4	2	0.20	0.53	0.67	0.49
PVS	F.C.	4	5	3	2	6	1				
	F.E.	3	5	2	4	6	1	**0,73****	**0.76**	0.83	0.51

Notes: F.C. factor content measure ranking; F.E. factor endowment measure ranking. There are six factors, physical capital (K), R&D (RD), skilled labour (LS), unskilled labour (LU), land for arable and pasture (TA) and forest land (TF). Rank1 is the value of the Kendall´s coefficient of concordance [0, 1]. Rank2 is the proportion of pairwise rank matches. Sign1 is the proportion of sign matches based on one-by-one comparisons. Sign2 is the proportion of sign matches based on comparison of bilateral differences in endowments to bilateral differences in factor contents. Simbols * and ** means statistically significant at 0.10 and 0.05 level, respectively.

Table 4. Strong test. (% deviation by region/factor).

Model I: World factor price equalisation and world identical homothetic preferences

	K	LS	LU	RD	TA	TF	average error
AND	48.54	348.84	134.24	315.13	164.33	165.08	196.03
ARA	11.30	29.08	132.03	51.47	102.60	100.64	71.19
AST	98.39	92.90	44.17	72.90	152.47	110.85	95.28
BAL	10.02	58.98	243.29	326.31	92.56	48.48	129.94
CAN	61.69	588.71	156.50	205.35	402.35	81.31	249.32
CLE	98.05	106.41	102.14	59.22	260.42	126.21	125.41
CMA	87.37	31.50	103.99	376.57	959.66	139.29	283.06
CAT	72.17	117.80	85.95	141.19	95.84	245.23	126.37
CV	45.71	44.35	108.74	221.76	158.66	125.45	117.44
EXT	50.37	74.64	109.76	83.33	188.67	106.38	102.19
GAL	29.72	501.00	140.67	521.54	165.28	105.38	243.93
MAD	228.39	526.01	185.94	297.14	40.83	15.29	215.60
NAV	23.84	63.34	125.34	129.36	156.01	58.26	92.69
PVS	374.25	55.16	122.71	68.07	30.05	204.11	142.39
average error	88.56	188.48	128.25	204.95	212.12	116.57	156.49

Model II: Regional factor price equalisation and regional identical homothetic preferences

	K	LS	LU	RD	TA	TF	average error
AND	33.37	55.09	48.46	19.68	31.08	78.14	44.30
ARA	12.54	22.52	116.81	58.46	85.29	65.58	60.20
AST	95.61	93.42	90.94	77.46	58.81	123.20	89.91
BAL	32.68	14.29	37.64	62.60	56.01	79.05	47.04
CAN	48.08	51.65	203.42	55.23	29.57	74.90	77.14
CLE	97.63	109.32	102.03	74.44	72.98	51.86	84.71
CMA	14.61	9.28	69.09	54.36	72.97	72.09	48.73
CAT	83.55	107.77	22.80	74.80	87.60	110.62	81.19
CV	34.24	55.49	109.54	43.07	46.77	103.25	65.39
EXT	59.31	73.47	99.78	79.16	99.46	108.37	86.59
GAL	69.16	76.15	137.62	7.66	82.49	104.91	79.67
MAD	153.69	182.89	98.78	85.74	13.80	82.22	102.85
NAV	6.55	39.98	87.72	37.69	34.74	78.39	47.51
PVS	14.70	43.69	27.37	58.12	79.27	34.68	42.97
average error	53.98	66.79	89.43	56.32	60.77	83.38	68.44

Note: Percentage deviation between the measured and predicted factor content of trade divided by the predicted net factor of trade.

Table 5: Regression analysis for equations (4) and (5). Dependent variable: Factor content of net exports.

		Constant	Excessive endowment supply	R-squared
Model I (W-FPE and W-IHP)	(a)	-3.03 (2.23)	0.033 (0.49)	0.01
	(b)	-	0.023 (0.21)	0.01
Model II (R-FPE and R-IHP)	(a)	-0.545 (1.32)	0.098 (1.76)	0.42
	(b)	-	0.106 (1.78)	0.43

Note: Number of observations: 14x6=84 (pooled across regions and factors). t-statistics in brackets.

Table A.3. Net factor content of trade and domestic demand of Spanish regions and regional endowments

Variable	Factor	AND	ARA	AST	BAL	CAN	CAT	CLE	CMA	CTN
Factor content of net exports	Stock of capital	-14550821	-5739947	126288	-7071582	-3567500	n.a.	-207035	-3086756	-2336912
Factor content of net exports	Skilled labour	-58481	-30370	-2170	-33326	-19082	n.d.	9632	-17475	17005
Factor content of net exports	Unskilled labour	-116777	-34812	-4954	-59899	-44266	n.a.	-6676	-5894	36294
Factor content of net exports	Stock of R&D	-3113	-272	-138	-590	-661	n.a.	-550	-1000	404
Factor content of net exports	Arable land	1399491	-44895	-186526	-902889	-348046	n.a.	849219	772300	-163517
Factor content of net exports	Forest land	-766595	-259871	-70510	-138081	-272205	n.a.	-198250	-117659	517920
Domestic demand	Skilled labour	1059736	280225	178740	215753	266230	n.a.	395127	245769	632464
Domestic demand	Unskilled labour	974008	264717	168217	240224	268165	n.a.	360019	230778	629405
Domestic demand	Stock of R&D	16305	4041	2672	2670	3524	n.a.	6568	3996	9227
Domestic demand	Arable land	3189831	800674	696231	978002	1015602	n.a.	1883517	705285	3005252
Domestic demand	Forest land	680267	470762	109122	167501	215424	n.a.	287055	142732	595746
Endowment	Stock of capital	70709487	17447498	19559166	10533227	19340181	4154992	33370453	21641734	116251596
Endowment	Skilled labour	267495	49936	37308	38008	66527	13999	71202	54116	273939
Endowment	Unskilled labour	1411864	376799	164247	163952	402116	158962	844400	471209	1961497
Endowment	Stock of R&D	8679	2428	1658	501	2049	749	3530	1017	19868
Endowment	Arable land	375325	199790	38435	18062	21928	22302	392725	331022	111021
Endowment	Forest land	457029	210779	1018589	20426	38459	697336	1392193	620880	712335

Variable	Factor	CV	EXT	GAL	MAD	MUR	NAV	PVS	RIO	OCDE
Net Factor content of net exports	Stock of capital	-8890342	-637903	-15697181	36174302	n.a.	-3570581	-3080664	n.a.	n.a.
Net Factor content of net exports	Skilled labour	-48531	-4853	-89928	354680	n.a.	-18865	-30015	n.a.	n.a.
Net Factor content of net exports	Unskilled labour	-30179	-10400	-127440	185814	n.a.	-15731	-15960	n.a.	n.a.
Net Factor content of net exports	Stock of R&D	-1710	-184	-1964	1521	n.a.	-210	-109	n.a.	n.a.
Net Factor content of net exports	Arable land	-1018364	8480	-181486	-2157170	n.a.	156765	-930790	n.a.	n.a.
Net Factor content of net exports	Forest land	86061	-44754	-294049	-874795	n.a.	187139	494568	n.a.	n.a.
Domestic demand	Skilled labour	661644	92438	354522	942099	n.d.	103162	410814	n.d.	n.d.
Domestic demand	Unskilled labour	660139	95609	405057	864507	n.d.	99755	373807	n.d.	n.d.
Domestic demand	Stock of R&D	9322	1314	5659	14554	n.d.	1628	6337	n.d.	n.d.
Domestic demand	Arable land	2320223	486194	2377616	2715179	n.d.	393156	1426189	n.d.	n.d.
Domestic demand	Forest land	517868	53317	586758	533125	n.d.	74881	265086	n.d.	n.d.
Endowment	Stock of capital	51709118	10304763	29449353	92372891	7620061	8401461	39974103	2124937	21700000000
Endowment	Skilled labour	168739	32498	115891	268276	28658	16886	95223	5299	85212000
Endowment	Unskilled labour	1129854	261672	809741	1575987	338061	203355	587460	113826	303286000
Endowment	Stock of R&D	5824	696	3414	27635	1630	1469	5268	401	19617850
Endowment	Arable land	81383	178010	98387	26188	41231	45898	29210	21584	40392500
Endowment	Forest land	143070	1043398	7645492	43594	12419	264693	1499813	97859	929531000