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"THE ESTIMATION OF THE INTERREGIONAL TRADE IN THE CONTEXT OF AN INTERREGIONAL INPUT-OUTPUT MODEL FOR THE SPANISH ECONOMY"

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In this paper we introduce the first version of INTERTIO, a Multiregional-Multisectoral model for the Spanish Economy. The model combines the spatial and sectoral dimensions assuming the theoretical and empirical possibilities and limitations of the interregional INPUT-OUTPUT model. The research tries to use most of the regional information available at that time, using non-survey techniques for the estimation of incomplete data. The model is based on the following two pillars:

- A complete set of 17th regional input-output tables built (or updated) for 1995 (one for each of the 17th Spanish regions-NUT2). All of them coherent with the National input-output Table.
- A set of interregional trade matrices, estimated indirectly for each kind of product and developed from the interregional transport flows, and valued using export prices.

Apart from a brief description of the main underpinnings of INTERTIO, we will focus on the strategy used for the estimation of this set of interregional trade matrices, using transport flows and value/weight relations indirectly deduced from detailed international trade statistics. As a consequence, we obtain a full estimation of a total Balance of Goods for the 17 Spanish regions with considerable sectoral detail.

1. INTRODUCTION

On June 8th 1999, 26 children from one school in Belgium developed nausea, headache, fatigue, (...) after having drunk bottled Coca-Cola (...) On June 15th 1999, the Coca-Cola company announced that they had identified two causes for this outbreak: In the bottles from one Belgian plant, "bad carbon dioxide" was to blame and a "fungicide" applied on transport pallets had contaminated the outside of some cans from another plant. Belgium banned all Coke products on Monday 14th and Luxembourg, France and The Netherlands followed with a similar ban on Tuesday 15th. The first reaction of Spanish Health Ministry was to assure the well quality of the products explaining the "local" characteristics of the crisis. On Wednesday, The Spanish government froze a shipment of 8,000 bottles of Belgian-produced Coke and other Coca-Cola brands in the northern province of Zamora (...): some bars buy sodas "bottled" in Belgium rather than in the local company located no more than 20 Km far because they could save x pesetas per bottle.

Since in this example the intensity of the economic interactions among countries was involved as a channel for the international infection, it would be expectable that the Health Ministries of The Netherlands, Luxembourg or France would be more worried about the effects of the "local" crisis than their Spanish counterpart. In principle, it will be rare that the "Trade, lodging, and reparation" sector of Castilla-León, or the whole economy of this region, would interact more with Belgium than with the other Spanish regions, or the regions of the contiguous Portuguese and French economies.

This example could illustrate considerably the possible relations between integration and trade, and their consequences in growth: the exposure to external shocks and the depth of either international or interregional spillovers in terms of growth, (income, employment or efficiency gains) is related to the existence of channels for the transmission of these shocks. In that sense, it is clear that trade relations between countries and regions provide a measure of economic integration, and will consequently play a major role in the spatial "*infection" of positive or negative impulses*.

With the progressive fulfilment of the EMU stages and the introduction of the EURO as a single currency, the international transactions between European countries will take place in almost the same way as they do between different regions within one country. As a consequence, it is expected that some of the Spanish regions will open

their economies even more, re-orienting their sales and purchases to foreign markets, breaking the frontiers of spatial proximity and contiguity. The effects of such openness and trade diversion will depend mostly on sectoral specialisation.

Although our example expresses just how deeply inter-European relations have developed to date, it is commonly accepted that regional economies are more closely integrated with each other than their national counterparts. Apart from peculiar small and open economies (such us Belgium; see Oosterhaven et al., 1995; Dietzenbacher et al. 1997; Llano C. 1998), most of inter-sectoral and final trade relations takes place among national agents. As a consequence, although regional dependence on international trade is increasing in most Spanish regions, a large part of regional growth should be explained by national behaviour.

Some recent work has illustrated the existence of deep inter-country relations between clusters of sectors (Dietzenbacher 1997), where the international dependence is stronger than their corresponding inter-sectoral relations within the national economy (Kollmann, 1995; Costello, 1993). As a consequence, sectoral specialisation of regions could induce deeper backward or forward relations with foreign economies than with their *natural partners*, imposing stronger synchronicity of the regional economy with the foreign cycle than with the national one.

With this new and more integrated market structure, the capability of detecting and valuing the spatial and sectoral effects of regional, national and supra-national shocks seems to be an important part of any strategic information system. Additionally, the evidence of “spatial clubs” and “sectoral clusters” interacting in most of current debates on integration, growth and convergence have also influenced the interest in the spatial and sectoral dimensions of these questions in Europe. As a consequence, we find new efforts by economic model designers to develop new and more realistic tools for economic analysis, one that would be able to simulate inter-sectoral relations, within inter-regional (Benvenuti et al., 1996; Hewings et al, 1993) and inter-national (Oosterhaven et al, 1995) systems.

Apart from the European integration process, Spain is facing a parallel evolution towards a more decentralised kind of government, where regions absorb increasing quotas of power. As a consequence, the role of central planners is moving towards an intermediate position between supranational policies and local expenses, with an increasing need to anticipate and justify sectoral and spatial effects of any policy using powerful analytical tools.

In this paper we introduce the first version of INTERTIO, a multiregional-multisectoral model that combines the spatial and sectoral dimensions assuming the theoretical and empirical possibilities and limitations of the interregional input-output model (Isard, 1951), using most of the regional information available at that time.

The paper begins with a brief description of the input-output model and its main spatial extensions. Then, we introduce the main underpinnings of our model, starting with a brief description of the regional statistics already available and the principal steps followed in the process of construction. Most of our attention will focus on the estimation of the interregional trade matrices, that have been deduced indirectly using interregional transport flows, and valued through export prices. As a consequence, we obtain a full estimation of a total and bilateral balance of goods for the 18 Spanish regions with a considerable sectoral detail.

2. SPATIAL EXTENSIONS OF THE INPUT OUTPUT MODEL.

The interregional input-output model was originally developed by Isard, who in 1951 suggested a new version of the Leontief model where the USA inter-sectoral relations were split in three big areas : EAST, SOUTH and WEST (Isard, 1951). The basic structure of this interregional input-output model was similar to the "one-region" input-output one. The main difference lies on the disaggregation of every intermediate and final flow that takes place between each pair of sectors not just within one area (region or nation) but also among different areas (set of regions or nations).

After this first theoretical work of Isard, where the main underpinnings of the model were established, some multi-regional input-output projects have navigated towards this "ideal" where the spatial and sectoral origin and destination of the inter-industry flows where perfectly and directly known. Probably, the best known derivation from this ideal is the so called multiregional or Chenery-Moses model, where instead of splitting the sectoral and spatial origin and destination of each flow, it propose a combination of single-region tables and commodity trade matrices (Miller&Blair, 1989).

2.1. The estimation of interregional trade: methods and examples

One of the critical elements that determine the kind of model to be estimated is the availability of information related to the interregional flows. Usually, neither national statistical systems nor regional ones could satisfy the sectoral and spatial detail

for inter-sectoral and final flows that is required for the pure interregional input-output model. As a consequence of this important gap, a large number of researchers have look for less-expensive approaches, watering down some theoretical assumptions (Chenery-Moses approach, Leontief Pool-approach...), or developing non-survey techniques for the estimation of regional and interregional technical and trade coefficients (see Batten 1983; Oosterhaven, 1984, for a deep description). Next we offer a brief classification of the some approaches used in the specification of those interregional flows:

Table 1: Possible approaches for the estimation of interregional flows within the context of Multirregional input-output models

	TECHNIQUE USED FOR THE ESTIMATION	MODELS
A POSTERIORI → A PRIORI	**INDIRECT ESTIMATION**	
	Use of Gravitational model	TIM, (Funck et al. 1975)
	Use of Entropy Maximising Paradigm	Batten (1983)
	Pool-Approach of Leontief	Leontief (1977) INTERREG (Martellato et al, 1996)
	DIRECT ESTIMATION BASE ON REAL DATA	
	Use of International trade flows	EU-IRIO (Oosterhaven et al., 1995)
	Use of Transport flows	MRIO-HERP (Polenske 1980), INTERTIO, (Llano, 2000)
	Use of surveys designed ad-hoc for producers and consumers.	JAPAN IRIO TABLES (1960-70)
Note: Classification proposed by the author based on previous work (Batten 1983; Oosterhaven, 1984)		

In our case, the combination of direct Regional input-output Tables with non survey ones and the use of indirect estimation for the interregional flows takes INTERTIO into a mixed position between *pure-survey vs pure-non-survey* approaches, "as an hybrid between the so-called *"multi-regional-columns-only input-output table"* and its *"inter-regional-columns-only"* equivalent (Oosterhaven, 1984).

3. INTERTIO: THE FIRST COMPLETE MULTISECTORAL MULTIREGIONAL FRAMEWORK FOR THE SPANISH ECONOMY.

According to what it has been established in the introduction, not only Spanish central planners, but also regional Governments and Supranational statements are highly interested in the spatial and sectoral effects of their policies. At this moment, there are several examples of applied models valid for different simulation exercises in the Spanish national and regional context: structural econometric models of different sizes

both for the whole range of Spanish regions (MORES, Hispalink Project,...) and for single ones (LANERE,...); Regional-VAR-models; Regional-SAMS,...Most of these models do not combine sectoral and spatial dimensions in the way it would be required to simulate interregional-intersectoral spillovers, and none of them offers the complete detailed view of the eighteen Spanish regional economies. In fact, none of the Spanish models have dealt with the problem of covering the gap of information corresponding either to the interregional trade flows of products and services or their counterpart in financial assets.

As we have seen above, the Interegional input-output framework offers the basic structure where intersectoral and interregional relations of supply and demand could interact with the required detail. Obviously, we are also aware of the limitations in the use of input-output model (Oosterhaven, 1996), and even more so in the interregional spatial extension (Miller and Blair, 1985). If the input-output model has been considered as the basic foundation for the multi-sectoral analysis, we expect that this first version of the Spanish interregional one will serve as a base for further developments, where supply and demand will interact in a more realistic way (Beaumont, 1990).

3.1 Main features of the model:

Next we enumerate some of the methodological priorities that have determined the process of construction of the model and consequently some of its strengths and limitations :

- **Accumulate disperses efforts**: Spain has a large tradition in the generation of survey and non-survey Regional input-output Tables. Unfortunately, some of these tables have been developed independently, using different methodologies and economic criteria making comparisons and integration difficult. Our purpose is to take advantage of every piece of information that could fit into the whole puzzle.
- **Complete regional context:** The proper tool for simulation of interregional interactions should include the whole regional economies: the model observes 18 regions (using NUTS2 EUROSTAT specification) plus an Extra-regio zone.
- **Concordance with National and Regional Official Figures**: All the sectoral and regional variables incorporated in INTERTIO should be compatible and coherent with the sectoral and aggregated information published by the **INE** (Spanish

National Institute of Statistics), namely the National input-output Table (**TIOE-95**), and the Spanish Regional Accounts (**CRE**).

- **Modern economic structure:** we use 1995 as the base year for INTERTIO.
- **Flexible and Provisional:** The decision of referring **INTERTIO** to 1995 introduced the additional problem of non-availability of new and *definitive* information. As a consequence, the present work should be consider as a *0.0 version*, where most of the steps followed in the process of construction were developed with a *flexible* structure that allow us to introduce new or definitive pieces of information that will be published in the future.

3.2. Brief description of the regional information available.

Unfortunately, most of regional input-output tables available have been developed as autonomous efforts of *Regional Governments*, sometimes without the desired co-ordination in terms of different methodological issues: economic concepts, valuing criteria, basic statistical sources and years of reference.

Attached to this relative anarchy in the Spanish regional information, the project has suffered from additional and radical changes in the methodology and way of understanding **National** and **Regional Accounts** in Spain and most part of Europe: the introduction of the new **SEC-95**, changes in the annual base of **Spanish National** and **Regional Accounts**, the new definition of **NACE-93**...

The Set of Regional input-output Tables Available:

Our purpose of reproducing a *complete* multi-regional input-output model force us to use a complete set of 18 input-output tables, one for each Spanish region. While some regions have a large tradition in the estimation of Regional Accounts and Regional input-output Tables, others have no antecedents at all:

- Up to date, the largest collection of input-output corresponds to period 1990-92 where 9 regions developed their input-output tables with some co-ordination in terms of methodological criteria (CNAE-73, SEC-73, and inclusion of VAT...).
- In 1995, just five regions have already published their Regional input-output Table: Navarra, País Vasco, Asturias, Castilla-León and Andalucía: **IEA (Andalucía´s Institute of Statistic)** is the only institution that has *strictly* applied the SEC-95´s recommendations, including new value criteria, sectoral disaggregation and "Make-

and-Use" methodology. The other four have adopted a mix-approach, combining some SEC-95 criteria with the traditional "Industry-by-Industry" methodology.

Table 2: Set of regional input-output tables used in the model

REGION (NUTS-2)	YEAR	OBSERVATIONS
ANDALUCÍA	***1995***	*AVAILABLE SINCE: May 1999.*
ARAGÓN	**1992**	Updated according to CNAE93 criteria
ASTURIAS	***1995***	*AVAILABLE SINCE: February de 1999*
BALEARES(1)	**NA**	Indirect estimation using "non-survey" techniques
CANARIAS	**1992**	Updated according to CNAE93 criteria
CANTABRIA	**NA**	Indirect estimation using "non-survey" techniques
CASTILLA y LEÓN	***1995***	*AVAILABLE SINCE: June 1999*
CASTILLA-LA MANCHA	**NA**	Indirect estimation using "non-survey" techniques
CATALUÑA(2)	**1987**	Updated according to CNAE93 criteria
COM. VALENCIANA(3)	**1990**	Updated according to CNAE93 criteria
EXTREMADURA	**1990**	Updated according to CNAE93 criteria
GALICIA	**1990**	Updated according to CNAE93 criteria
MADRID	***1996***	*AVAILABLE SINCE: March 1999. (Adjusted backwards)*
MURCIA	**NA**	Indirect estimation using "non-survey" techniques
NAVARRA	***1995***	AVAILABLE SINCE: October 1998
PAIS VASCO	***1995***	*AVAILABLE SINCE: January 1999*
LA RIOJA	**NA**	Indirect estimation using "non-survey" techniques
TIO-ESPAÑA-SEC95	***1995***	*MAY 1999*
CRE-SEC95-A31 (Current/Constant prices)	***1995***	*AVAILABLE JUST IN CURRENT PRICES 5 SECTORS-SEC95-1995 ANNUAL BASE*

(1) There is a forthcoming input-output Table based on 1997 that follows SEC-95 criteria.

(2) There is a forthcoming input-output Table based on 1995 that follows SEC-95 criteria. Some delayed in its publication has forced us to use an updated version of Catalonian 1987 TIOR and a more recent non-survey version built by Tomillo Foundation&IDESCAT based on 1995 (CNAE-74 criteria).

(3) There is a forthcoming input-output Table based on 1995 that follows SEC-95 criteria. Some delayed in its publication has forced us to use indirect estimations based on Valencia´s 1990 TIOR

- Although there is another group of regions developing new input-output tables based on 1995 or posterior years (Cataluña, Valencia for 1995; Baleares, for 1997;

and Galicia for 1998) the timing of our project has forced us to use, *provisionally*, updated versions of old tables until the new ones were effectively finished.

- The **TIOR** for the rest of regions should be updated or estimated using **RAS techniques** based on the economic structures of similar regions and the proper regional totals:

After an intensive study of the methodological underpinnings of each component of this heterogeneous set of Regional input-output Tables, we have established some features of the system that should be based on the *maximum common factor of information*, such as the sectoral detail (26 sectors based on the A31 of SEC95) and common categories for the Final Demand and the Primary Inputs.

The frame: Regional and National information available

The other main features of our model, that of "homogeneity" and "concordance" with the "official" information, induces us to use the main regional and sectoral data published by the **INE** (Spanish National Institute of Statistics) as a solid base to establish the "control figures" that will perform as a "frame" for the whole "picture".

It is important to notice that on different occasions during the project we considered whether every Regional input-output Table or just the up-dated or non-survey Tables should be forced to concordance with the official figures. Finally, the need for an equilibrated view of every region oblige us to impose restrictions to each piece of the system, including those Regional Tables that have been estimated for 1995 and probably use better regional information than the one used for INE's **CRE**.

The 1995 National input-output Table:

- The **INE**, following recent **EUROSTAT** directives, has firmly adopted the methodological recommendations of **SEC-95**. Apart from the use of the "Make-and-Use" approach and other important changes in economic concepts, value criteria and sectoral classifications, the **INE** has decided to change the base year of the whole *National System* from 1986 to 1995.
- While the **INE** has not published the complete and definitive **Square National input-output Table for 1995**, the one used in our model as a constraint for the whole system is based on our estimation of the "square" matrices (from the Make-and-Use provisionally published by the **INE**), and should be considered as a provisional one.

The Spanish Regional Accounts (CRE):

The information already available in the CRE does not fulfil all statistical requirements for the use of regional-sectoral "control totals" *needed* in the process of "non-survey" estimation/actualisation of input-output tables and also *desired* as constraints for the whole regional input-output pieces:

- Currently, the regional figures published correspond to the *old CRE*, based on the old SEC-73 methodology, with a sectoral disaggregation equivalent to the R-17 of the old CNAE-73, and with 1986 as annual base.
- Traditionally, Spanish CRE mostly focuses on the supply side, almost reducing its statistics on the demand side to the Regional Private Consumption figures without the required sectoral detail.
- Although the INE is working on the estimation of a new complete version of CRE (SEC-95), until now it has just published a reduced range of information: regional Value Added in current prices for only 5 sectors:
  - On the one hand, since those figures have been estimated using the new SEC-95 using 1995 base year and a sectoral disaggregation based on the new CNAE-93, they will be directly compatible with 1995 National input-output Table.
  - On the other hand, while we wait until the publication of the definitive version of CRE with its expected 31 sectors, we had to expand the reduced sectoral detail of the R-5 provisional version until the 26 sectors of the whole system.

Table 3: Principal steps on the process of construction of INTERTIO

STEP	ACTIVITY
1.	Estimation of a complete data set to be use as constrains for sectoral and regional figures
2.	Homogenisation of the "official" Regional input-output Tables available for 1995
3.	Actualisation and Homogenisation of the "official" Regional input-output Tables available for other years: 1987, 1990, 1992, 1996.
4.	Estimation of the non-available Tables (total figures) by RAS technique using the structure of similar-regions with input-output tables and the control figures estimated in the first step.
5.	Estimation of the corresponding Domestic, Rest of Spain and Rest of the World matrices, using different approaches depending on the existence of official, up-dated or pure-non-survey Table for each region.
6.	Estimation of the 26th interregional flows matrices for different products and services. Developed in parallel to the rest of the model, and detailed reviewed in the following paragraphs.

7.	Re-estimation of the interregional flows matrices adjusting rows and columns sums to the control totals that remain in the "National Net Consumption" row and column estimated in the first step.
8.	Assignation of the specific geographic origin/destination to the Region-Rest of Spain flows (both, inter-industry and final ones) contained in the harmonised set of Regional input-output Tables:

4. THE ESTIMATION OF INTERREGIONAL TRADE.

4.1. Possible approaches based on the information available.

In **Table 4** we sum up the principal accounts that offer some information related to interregional flows and the corresponding statistical sources in which they used to be based. Apart from the partial information (Region-Rest of Spain) published on our incomplete set of Regional input-output Tables, there are some other accounts systems and statistical sources that could contribute to the estimation of the required data.

Table 4: Statistics containing data related to the Spanish Interegional trade

	ACCOUNTING SISTEM	STATISTICAL SOURCES
TOP-DOWN APPROACH	**Macro-economic balance** (Alcaide-BBV)	interregional trade is deduced as "a rest" by comparing different variables from both sides of the Economy, Inputs and Outputs
	input-output Tables **Regional Accounts.** (Most of the Spanish Regional input-output Tables)	Information base on ***direct Survey to producers, and/or consumers***: • The use of ***"available official" statistics***, such as National Industry, Agricultural or Mining Surveys...(INE) • Conduct other ***surveys designed "ad-hoc"*** for the input-output table.
DOWN-TOP APPROACHE	**Regional Balance of Payments** (Parellada, 1982; Oliver, 1997).	The use of ***interregional transport flows data***, with detailed information about the geographic origin and destination of the flows: • The use of regional and national transport statistics in terms of volume. • Estimation of domestic prices using extra information to value transport flows.
	NOT AVAILABLE BECAUSE OF STATISTICAL SECRET (Santiso, 2000)	The use of ***fiscal information*** contained in some administrative documents: Mod. 347 of the Spanish Taxation over Economic Activity: • Declarations of economic transactions done with other economic agents specifying its regional code.

With the exception of using ad-hoc surveys or a-priori estimations based on different techniques (see Table 1), the only way to estimate the specific origin and destination of interregional flows from real information lies on the use of transport and, probably, fiscal data. We say "probably" because, as a consequence of the "*statistical secret*", there is no previous experience in the use of such information for the quantification of the Spanish domestic trade. Obviously, it is an interesting line to be explore in the future. Next we resume the main steps followed in the process of estimation of the interregional trade of products and services.

4.2. The estimation of the interregional trade of goods.

According to **Table 4** most of Spanish experiences on the use of transport data for the estimation of interregional trade correspond to few studies related to the calculation of some Regional Balance of Payments (Parellada 1980, 1982; Oliver 1996). We find also abroad some precedents in the use of transport data to approximate the inter-state trade flows within the context of a large multiregional input-output models: (Polenske, 1980). Following some of these approaches we will combine the use of transport flows with some complementary data referred to regional-sectoral production.

The use of transport flows as a proxy of the real interregional trade provide significant contributions to our goals:

- Most of the Spanish transport statistics are disaggregated by products.
- Most of them allow also take into account the geographic origin and destination of its flows that, in general, could be identified with the producing and consuming spots of the economic transactions. Some of them offer even higher spatial disaggregation than what is strictly required for our analysis (NUTS-2). This fact will allow further developments and different exercises of data verification (see point 4.2.3-III)

4.2.1. Statistical Information Available on interregional Transport Flows.

Table 5: Transport statistics used in the estimation of Spanish interregional trade

MODE	DESCRIPTION AND MAIN FEATURES
ROAD	***Permanent Survey of Goods Transported by Road.*** **Source:** Spanish Ministry of Public Works **Data:** Annual/quarterly-Municipal/Provincial/Regional. **Product Disaggregation:** 160 products (class.NST/R-3 digits) **Available since:** 1993... **Observations:** • Permanent survey on a large sample of heavy trucks operating by themselves or in service: they are request about their travels, specifying origin, destination, type of product, volume, km... • It could include international or insular goods in transit that are moved from ports or airports to final locations. • It is important to notice that the figures obtained surveying lorries may not be consistent with figures on production or purchases obtained surveying firms and households.
RAILWAY	*RENFE statistics on Complete Wagon and Containers flows.* **Source:** information from the *Statistics Department of RENFE* **Data:** Annual **Product Disaggregation:** aprox. 40 categories (own classification) **Observations:** • Registration of every domestic flow: High quality, low product detail. • Problems: no information on the product disaggregation of the movements into containers (30% of rail flows). Each flow in container was split in product categories according to the product specialisation of rail flows in *complete wagon* with origin in each region.
SHIP	*Indirect estimation of interregional flow matrices using RAS (Polenske et al., 1987) and two different sources of information:* a) *Tons loaded/Unloaded by Principal Spanish Ports, kind of flow, and type of product.* **Source: Statistical Yearbook.** Puertos del Estado. • **Data:** Annual-by 26 Spanish principal ports. • **Product Disaggregation:**. 40 products (own class.) b) *Set of Spanish Domestic flow matrices with Ports of Origin and Destination.1989.* **Source: *Domestic maritime flows by Origin and Destination.1989*.** Puertos del Estado: • **Data:** Annual- by 38 Spanish principal ports. • **Product Disaggregation:** 52 products (CSTE) **Observations:** • Due to the absence of an up-dated set of Inter-port matrices of maritime domestic flows, we have estimated a collection of 40 matrices O/D, one for each kind of product, using RAS on the most modern O/D information available (1989) and the product-port detailed totals for loaded/unloaded tons (1995)

AIRCRAFT	*O/D Matrices of Domestic flows of goods by airport of Origin and Destination 1995. AENA.* **Source:** AENA**&**Spanish Ministry of Public Works. **Data:** Annual-Principal Airports. **Product Disaggregation:** None **Observations:** • Product disagreggation of the unique matrix available of total domestic flows is deduced using the product specialisation of international flights (available) per airport of origin in 1995.
PIPE	*O/D matrix of oil flows using pipe 1995* **Font:** CLH (main oil distributor in the Spanish market). 1993. **Data:** Not available for 1995 **Product Disaggregation:** None **Observations:** • Non available data on O/D flows after sector liberalisation. • Indirect estimation using O/D matrix obtained by Ministry of Public Works&TEMA-Consulting Group from CLH. Data from 1993 are re-scaled to 1995 figures. • Due to the special characteristics of oil distribution where *pipe* is often used as an approach to consumer locations, the *pipe* information should be used just for the re-allocation of road (capillary distribution) flows of energetic products *apparently* loaded in regions without refinery, that have been fed by other regions using Pipe.

4.2.2. Limits of transport information

Spanish transport statistics are usually designed not with economic purposes but with the goal of covering different needs of engineers and transport planners. As a consequence, they do not satisfy all the information desired for our analysis:

a) As transport flows are expressed in physical units (Tn, Km.*Tn...) rather than in monetary ones, they should be valued using some kind of "value/volume" relations.

b) Information for each mode of transport (truck, rail,...) is collected by different institutions, with different strategies, specific product classifications, and incompatible methodologies. This fact introduce additional difficulties to the conciliation and harmonisation of different sources, both between them and as regards to the economic information (input-output Tables, National and Regional Accounts, International trade data...).

c) Additionally, the lack of co-ordination in collecting data for each mode of transport introduces serious problems in the capability to follow multi-modal flows. Due to the current proliferation of multi-modal combinations in logistics, the inattentive use of transport statistics could introduce the wrong assignment of the origin/destination and accumulate problems of double-counting.

d) Other limitations come from the complex strategies currently displayed on product distribution. For instance, the existence of "central purchase centres" and "transport platforms" could over-estimate imports and exports of some big markets, inducing infra-estimation of peripheral ones: after the reception and consolidation of different transport flows (with different origins), a large part of the stock will be re-exported to the final spot of consumption in response to its demand.

e) Another important limitation on transport information comes from the special characteristics of road data, that almost represents the 90% of total interregional flows in Spain: although the survey is a reliable, interpretation needs to be made with care when it is used at lower levels of aggregation in space and products. In fact, we have checked the existence of important conflicts between some flows of product x with origin in one region and the economic information on the available resources (production+imports) of such products in the region. This fact forced us to introduce a new data screening system that is briefly described in point 4.2.3.-VIII

4.2.3. Methodology used for the estimation of interregional trade flows of goods

I. Harmonisation of physical transport flows obtained from different sources.

II. Estimation of non-available data: Bringing up to date the available Maritime Domestic flows; disaggregating the Total Domestic Air and Rail flows moved using containers according to the most probable product categories.

III. First screening procedure for transport flows in tons:

- *Identification of international trade in transition along the Spanish peninsula using road statistics: the* EPTMC survey allows the identification of detailed road flows (split by 160 types of products) between the 18 regions and the municipalities where the main maritime ports are located. Then we confront such flows with the detailed information on international goods (40 categories measured in tons) loaded/unloaded into/from ships in those ports, with production data of the region and also with different information on known inertial practices on the logistic management of some international exports and imports (Ministerio de Fomento, 1995, 1996). Following this exhaustive approach, we detect some unbelievable interregional flows that are then eliminated.
- Re-allocation of multi-modal flows: with a similar approach we identify and re-allocate possible interregional flows that use ships and trucks complementarily.

V. Estimation of value/weight relations from International trade statistics.

Due to the total absence of a perfect statistical source that contains domestic prices for every kind of product, we have to deduce them from alternative information. Following previous works on the estimation of Regional Balance of Payments (Oliver, 1997), we use value/weight relations deduced from very detailed statistics on International Trade (exports) split by value and weight, region of origin, and about 1300 types of products (NC-4 digits). In contrast to other previous works we have estimated 18 different vectors of export prices (one for each possible region of origin) instead of only two (one for imports one for exports) with the purpose of capturing price differences derived from the sectoral specialisation of each region. As the inter-regional comparison of deduced prices shows high volatility, we decide to introduce previous debug in the *rough* regional export data:

- First we estimate a unique *debugged-price-vector* containing the *statistical median* for the 18 different original prices and each of the 1300 items available. In that way we eliminate extreme values.
- Then we deduce a set of 18 *definitive-price-vectors* (one for each mode of transport an its classification) as weighted means of the *"debugged-price-vector" (the weigh comes from the amount of tons exported for each product and region):*

$$PRICE_I^{\mathrm{Re}\,gion} = \left(\frac{Exports\_Tns_i^R}{\sum_{i=1}^{i=n} Exports\_Tns_i^R} * \mathrm{Pr}\,ice_i^{Debbuged} \right) + ... + \left(\frac{Exports\_Tns_n^R}{\sum_{i=1}^{i=n} Exports\_Tns_i^R} * \mathrm{Pr}\,ice_n^{Debbuged} \right)$$

PRICE of "R" region and "I" category (i.e.: Road NST/R class.). I= range from i=1 to n (NC class) R= range from 1 to 18 regions	=	Weighted mean of the *"single-debugged price vector" using Tons exported for each "i" product (included in I category) and "R" region of origin*

VI. Translation of O/D debugged matrices measured in Tons into Monetary Units using the whole set of vector prices deduced in the previous step.

VII. Aggregation of the different sets of O/D-product-matrices valued in current ESP. into the common INTERTIO´s classification, where 16 out of the 26 activities produce primary or manufactures goods of any kind.

VIII. Final screen of the 16 O/D matrices of Goods expressed in ESP.:

Although we have noted significant correspondence between our total exports and imports and those published in regional input-output tables for some regions, we have also detected some remarkable divergences:

- In general, interregional trade deduced exclusively from transport flows (without any constraint from regional/sectoral production) appear overvalued.
- Coincidence between different sources increase, both from export and import sides, when we introduce additional restrictions for each regional/sectoral export based on the capability of the region to produce (and export) each kind of product.

At this stage we have applied two different options:

1. According to the needs of INTERTIO our matrices are submitted to marginal totals deduced *"as a difference"* from known information deduced in the *first step* of our third point.
2. With the purpose of analysing interregional trade databank outside the restrictions imposed by INTERTIO we adopt an additional option: now our collection of 16 O/D trade matrices, are harmonised by "sums along rows" (exports only) with the detailed information on the *"Sales to the Rest of Spain"* that is generated from the **Industrial Survey (INE)** for all of our regions and industrial activities. As a consequence, any activity of any region will not be able to export to other regions more than what this survey establishes as *"Production sold to the Rest of Spain"* for this region/activity. The lack of information on the imports side encourages us to leave "sums along columns" without restriction.

4.3. Interregional trade of services.

The estimation of the interregional trade on the "building" and "services" sectors is considerably more complicated. The complete absence of direct statistics on this kind of flows and the difficulty to use proxy variables as in the case of goods forced as to adopt *an a-priori indirect approach* using a some kind of a **gravity model:**

$$D^{i}_{rs} = X_{rs} * \frac{(VA^{i} pb_{r} / POP_{r})}{(VA^{i} pb_{s} / POP_{s})} \qquad 1$$

$$F^{i}_{rs} = D^{i}_{rs} / \sum_{r}\sum_{s} D^{i}_{rs} \qquad 2$$

The bilateral flow (standardised) of service *i* ($F^{i}rs$) is related to the intensity of interregional trade flows of goods between each pair of regions (X_{rs}), and the relation

between the size of both spots in terms of Population and VA on this service ***i***. As it has been tasted, since (X_{rs}) behave following the gravity model (Llano, 2000) it is not needed to explicitly consider "distance" (somehow, implicitly included in X_{rs}).

5. DATA ANALYSIS

Given the sectoral and spatial disaggregation of our trade matrices we could conduct almost the same kind of analysis that have been developed for international trade. Due to the corresponding limitations in terms of space and time we propose some brief examples to illustrate the capabilities that this databank offers.

Table 6: Intra, intereg and international Spanish trade flows of goods.

MAIN RATIOS FROM THE INTERREGIONAL TRADE MATRICES. GOODS (ITEMS 1-16 FROM INTERTIO CLASS.). BILLIONS OF ESP.								
1995	**INTRA REGION***	**EXPORTS**		**IMPORTS**		**BALANCE**		**OPENESS RATIO*****
		SPAIN	**WORLD**	**SPAIN**	**WORLD**	**SPAIN**	**WORLD**	
	(1)	(2)*	(3)**	(4)*	(5)**	(6)=(2-4)	(7)=(3-5)	(2+3+4+5) /(1+2+3)
ANDALUCIA	1.895	2.297	1.021	2.540	1.026	-243	-5	132%
ARAGON	612	1.254	705	1.777	564	-523	**141**	167%
ASTURIAS	675	684	166	712	170	-28	-4	114%
BALEARES	248	*96*	*110*	487	134	-391	-23	182%
CANARIAS	493	315	111	525	386	-211	-275	145%
CANTABRIA	227	440	133	605	169	-165	-36	168%
C-LEON	1.380	1.878	685	2.235	709	-357	-24	140%
C-MANCHA	768	1.604	151	1.452	245	**152**	-94	137%
CATALUÑA	4.965	5.342	2.947	2.994	4.277	**2.348**	-1.330	117%
C.VALENCIA	2.207	2.636	1.633	2.989	1.165	-354	**468**	130%
EXTREMADURA	236	375	61	522	33	-146	**27**	147%
GALICIA	1.289	1.459	567	1.014	646	**446**	-80	111%
MADRID	1.691	2.540	1.147	3.078	2.993	-538	-1.846	181%
MURCIA	357	699	284	940	218	-241	**66**	160%
NAVARRA	302	991	474	843	286	**147**	**188**	147%
PAIS VASCO	972	2.111	1.044	1.883	961	**228**	**83**	145%
LA RIOJA	95	456	74	433	58	**23**	**16**	163%
CEU/MEL	172	52	5	199	60	-147	-56	138%
TOTAL	18.584	25.229	11.316	25.229	14.100	0	-2.784	

Source: Own calculation based on our Interregional Trade Matrices. 1995
**Interregional Exports and Imports are deduced from own calculations.*
*** Flows with the Rest of the World are obtained from Custom data.1995*
**** Since data does not include "services", Openess ratio is different than the usual (X+M)/PIB.*

- With the exception of Aragón, the highest openness ratio appear in the economies with smaller surface: Madrid, La Rioja, Baleares, Navarra, Cantabria.

- The highest intra-regional flows occurs within the regions that combine a large territorial size (Andalucía, Castilla-León), with high population ratios (Cataluña, Andalucía, Madrid, C. Valenciana) and high shares of the economic activity (Cataluña, Madrid, Andalucía).
- According to our figures we confirm the expected fact that most part of the regional trade relations takes place among other Spanish regions, both from import and exports sides. The rankings of regions in terms of international and interregional trade remains stable. Just Galicia and Castilla-León seems to be more focus on foreign markets.
- Just six regions register positive balances in terms of interregional trade while seven in the international one. The highest superavit appears in Cataluña trade relations with the rest of Spain, followed by the positive balance of Galicia and País Vasco.
- It is interesting to notice some changes in the sign of some balances when we move from the interregional to the international trade: while some regions -Cataluña, Galicia and Castilla-La Mancha- show positive balances in the national market and deficits in the international one, others as –Aragón, Valencia, Extremadura y Murcia- register just the opposite relation among their two balances.

Table 7: The highest interregional Flows.

RANKING OF THE STRONGESTS INTERREGIONAL TRADE FLOWS.1995. AS % ON THE CORRESPONDING TOTAL OF INTERREG. FLOWS.MILL.PTAS.							
	TOTAL		R1-AGRICULTURE		R3-FOOD&DRINKS		
	ORIG-DEST	%	ORIG-DEST	%	ORIG-DEST	%	
1	CATALUÑA-VALENCIA	4,1	C.MANCH-ANDALUCIA	5,4	CATALUÑA-MADRID	3,8	
2	CATALUÑA-ARAGÓN	3,2	ARAGÓN-CATALUÑA	4,1	CATALUÑA-VALENCIA	3,6	
3	CATALUÑA-MADRID	3,0	C.MANCHA-VALENCIA	4,0	ANDALUCIA-MADRID	3,4	
4	CATALUÑA-ANDALUCIA	2,2	CATALUÑA-ARAGÓN	3,1	CATALUÑA-ARAGÓN	3,4	
5	ARAGÓN-CATALUÑA	1,8	VALENCIA-C.MANCHA	2,2	CATALUÑA-ANDALUCIA	2,9	
6	CATALUÑA-P.VASCO	1,7	CATALUÑA-BALEARES	2,1	ANDALUCIA-EXTREM	2,0	
7	MADRID-ANDALUCIA	1,7	C.MANCH-MADRID	2,1	VALENCIA-ANDALUCIA	2,0	
8	MADRID-C.MANCHA	1,7	P.VASCO-CANTABRIA	1,9	ANDALUCIA-CANARIAS	1,9	
9	P.VASCO-C.LEÓN	1,6	CATALUÑA-VALENCIA	1,9	VALENCIA-C.MANCHA	1,7	
10	C.MANCHA-MADRID	1,5	ANDALUCIA-MURCIA	1,7	C.LEÓN-MADRID	1,7	
Source: Own calculations based on our set of Interregional Trade Matrices.							

Figures in Table 7 help to understand the possible relations between different features of the regional economic structure (as geographic situation or sectoral specializacition) and their role generating intense trade flows with the rest of Spain. For example, when we rank the largest interregional flows (with different origin and destination) for total goods, the 10 first positions include at least one of the most

industrialised economies, namely Cataluña, Madrid or País Vasco. By contrast, the most intense flows of products related to Agriculture and Food&Beverages industries, take place among regions with hard specialisation in each of these complementary activities, showing interesting linkages between theirs structures. Ej: Aragón-Cataluña; Valencia-Cataluña, Castilla-La Mancha-Madrid...These ratios will be useful in order to identify possible interregional linkages derived from inter-sectoral clusters and, as a consequence, will help detecting the most important channels for the inter-sectoral and inter-regional spillover in terms of growth, prices, and percapita income.

6. CONCLUSIONS

In this paper we have described the main steps of the methodological approach developed for the first version of INTERTIO, a Multiregional-Multisectoral model for the Spanish Economy, that explicitly includes the spatial and sectoral interrelations. Apart from the utility that INTERTIO will receive as a tool for the simulation of detailed effects of different political decisions, its process of construction implies the estimation of important pieces of information that are worthy in and of themselves.

We have specially focused on the strategy followed during the process of estimation of a complete set of interregional trade matrices, using transport flows and value/weight relations indirectly deduced from detailed international trade statistics. Finally, we propose some key-figures that summarise the complete database, illustrating some new possibilities that arise for the analysis of spatial and sectoral interrelation where trade of goods and services is involved: identification of external effects, analysis of the main mechanism performing in the propagation of supply and demand shocks space-wide.

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