



Salvador de Madariaga  
Institute

*EU Structural and Cohesion Funds  
in Spain and Portugal: Is Regional and  
National Inequality Increasing?*

- Pere Gomis-Porqueras and Enrique Garcilazo



Working Paper Series  
Vol. 3 No. 11  
December 2003

**This publication is sponsored by the EU Commission.**

## The Jean Monnet/Robert Schuman Paper Series

The Jean Monnet/Robert Schuman Paper Series is produced by the Jean Monnet Chair of the University of Miami, in cooperation with the Miami European Union Center.

These monographic papers address issues relevant to the ongoing European Convention which will conclude in the Spring of 2003. The purpose of this Convention is to submit proposals for a new framework and process of restructuring the European Union. While the European Union has been successful in many areas of integration for over fifty years, the European Union must take more modern challenges and concerns into consideration in an effort to continue to meet its objectives at home and abroad. The main issues of this Convention are Europe's role in the international community, the concerns of the European citizens, and the impending enlargement process. In order for efficiency and progress to prevail, the institutions and decision-making processes must be revamped without jeopardizing the founding principles of this organization. During the Convention proceedings, the Jean Monnet/Robert Schuman Papers will attempt to provide not only concrete information on current Convention issues but also analyze various aspects of and actors involved in this unprecedented event.

The following is a list of tentative topics for this series:

1. The challenges of the Convention: the ability to govern a supranational Europe or the return to intergovernmental cooperation?
2. How will the member states figure in the framework of the Convention?
3. The necessity to maintain a community method in a wider Europe.
4. Is it possible for the member states to jeopardize the results of the Convention?
5. The member states against Europe: the pressures on and warnings to the Convention by the European capitals.
6. Is it possible that the Convention will be a failure? The effects on European integration.
7. Similarities and differences between the European Convention and the Philadelphia Convention of 1787.
8. The role of a politically and economically integrated Europe in the governance of the world.
9. How important is European integration to the United States today?
10. The failure of a necessary partnership? Do the United States and the European Union necessarily have to understand each other? Under what conditions?
11. Is it possible to conceive a strategic partnership between the United States, the European Union and Russia?
12. Russia: a member of the European Union? Who would be interested in this association?

Miami European Union Center  
University of Miami  
1531 Brescia Avenue  
Coral Gables, FL 33146-3010  
Phone: 305-284-3266; Fax: 305-284-4875  
E-Mail: [jroy@miami.edu](mailto:jroy@miami.edu)  
Webs: [www.miami.edu/international-studies/euc](http://www.miami.edu/international-studies/euc)  
[www.euroy.org](http://www.euroy.org); [www.miamieuc.org](http://www.miamieuc.org)

**Jean Monnet Chair Staff:**  
Joaquín Roy (Director)  
Aimee Kanner (Editor)  
Roberto Domínguez (Research Assistant)  
Nuray Ibryamova (Research Assistant)  
Markus Thiel (Research Assistant)

---

## EU Structural and Cohesion Funds in Spain and Portugal: Is Regional and National Inequality Increasing?

---

Pere Gomis-Porqueras and Enrique Garcilazo\*

The Jean Monnet Chair  
Miami, Florida  
December 2003

---

\* **Pedro Gomis-Porqueras, Ph.D.** (University of Texas at Austin) is currently Assistant Professor in Economics at the University of Miami. His research explores the various aspects of the relationship between monetary policy, financial sector behavior, and macroeconomic performance. A particular focus is the extent to which the conduct of monetary policy and bank regulation may either enhance or reduce the scope for multiple equilibriums to be observed, as well as for fluctuations that arise purely from interactions of market participants, rather than from exogenous fluctuations that might impact the economy. His work has been published in the *Journal of Economic Theory*, *Journal of Economic Dynamics and Control* and the *World Bank Working Paper Series*. **Enrique Garcilazo** is a second year Ph.D. student at the LBJ School of Public Policy at the University of Texas at Austin under the supervision of Professor James K. Galbraith. In May 2001, he received his Masters of Science in Economics from the University of Texas at Austin, where he studied the economic consequences of the monetary union in Europe on financial markets. His current research interests are on issues related to the European integration process, specifically in understanding how monetary, regional and social policies affect the development of the poorer countries in the European Union.

## **EU STRUCTURAL AND COHESION FUNDS IN SPAIN AND PORTUGAL: IS REGIONAL AND NATIONAL INEQUALITY INCREASING?**

---

### **Introduction**

During the early years of the European Community (EC), policymakers envisioned a European model guided by a fundamental goal: to create an even closer union among the people of Europe. After hundreds of years of failed attempts to integrate Europe, the terrible consequences of both World Wars gave rise to a new phase in the European political scene. From this point on, the European countries and their respective leaders have been integrating their national economies and policies through the establishment of treaties and through intra-national agreements.

By the end of the 1940's, many European countries had been ruled by a dictator, suffered a fascist regime, or occupied by a foreign army. As a direct result of such failures, tens of millions of Europeans died at the hands of fellow Europeans. The economy was in ruin as the war destroyed infrastructures, factories, houses, and farms. The post-war restructuring process from the late 1940's to the mid 1950's was set forth to radically transform Europe's economy, as well as its political system.

Europeans realized their continent could not bear the consequences of another war. Treaties and policies were set forth to avoid this unwanted outcome. The first efforts to unify Europe were spurred by political grounds and had the full support of the United States, who wanted to create an allied western coalition in response to the threat imposed by the communist bloc. After some early treaties such as the European Coal and Steel Community (ESCS) in 1952, and the European Atomic Energy Community (EURATOM) in 1958, European leaders realized the economic gains of a common bloc. From that point on, the European integration process has been driven by political and economic goals. In particular, the preambles of the Treaties of Rome (1957) established the need to reduce the existing differences between the various regions. In order to meet these objectives the Community created the European Social Fund (ESF), the European Agricultural Guidance and Guarantee Fund (EAGGF) in 1958, and the European Regional Development Fund (ERDF) in 1975.

The harmonization process was strengthened by the Single European Act (SEA) in 1986 and the Maastricht treaty in 1992, which was ratified in 1993. The SEA designed the basis for a genuine cohesion policy with new articles on "economic and social cohesion" in order to develop a strategy of redistribution. Cohesion is not defined in the Treaty, however Article 158 of the Treaty makes it clear that cohesion requires, 'in particular', the reduction of disparities between the levels of development of the various regions. Six years later, the Maastricht treaty established "cohesion" as one of the main objectives of the Union and created the Cohesion Fund to support projects in the fields of environment and transport among the least prosperous members. The Structural Funds have, since the mid 1980's, provided the main instruments for promoting cohesion in the European continent.

In 1993, the Edinburgh European Council decided to allocate one third of the Community budget to cohesion policy and established a Financial Instrument for Fisheries Guidance (FIFG). In line with these developments, the budget was progressively modified to meet the increasing monetary demands. During the early years the budget was financed by three components: agricultural levies, customs duties, and a proportion of the base used for assessing value added tax in the Member States. In 1987 a fourth component was added after the ratification of the SEA, which began to relate contributions to capacity to pay. The capacity to pay was based on relative GNP figures for the member countries so that countries with a high GNP contributed more than those with a lower GNP. Once this fourth component was put into operation, the cohesion policy became a true mechanism of redistribution that created net contributors, the richer countries, and net recipients, the poorer countries. Even though the size of the European Union (EU) budget was and remains small in relation to the gross national product (GNP) of all member states, it is very important to those who receive extensive transfers since it operates as a multiplier effect on the economic and social factors likely to stimulate a region's economy.

Regional disparities in the EU and in the member states have always been regarded as barriers to what the original Treaty of Rome termed 'harmonious development', and to the cohesion policy established in the SEA. The Structural Funds are the mechanism through which the EU has tried to reduce inequalities across nations and regions in the last twenty years. The main objective of the funds is to reduce the disparities by redistributing resources according to four principles: (i) additionality, (ii) partnership, (iii) programming, and (iv) concentration; and seven objectives: (a) promoting development and structural adjustment in regions lagging behind, (b) aiding the conversion of regions in industrial decline, (c) combating long term unemployment and social exclusion, (d) promoting equal opportunities for men and women, (e) facilitating the adaptation of workers to industrial change, (f) promoting rural development and promoting development and (g) structural adjustment of regions with low population density.<sup>1</sup>

In 1988 the European institutions implemented important reforms. These reforms doubled the amount of funding allocated to the three Structural Funds in 1988 over the 1988-1993 period and in addition they stipulated that integration should take the form of 'operating programs' rather than the 'project by project' approach. This created the drafting of multi-year Regional Development Plans (RDP's) as a pre-requisite before the Community funds were allocated. The programming period for the RDP's is a five-year term period. Eligible member states produce and submit the RDPs to the Commission who thereafter revises and negotiates the plans with the Member States. The final version of the development plan includes the forms of intervention and the financial details, such as the amount of co-payment that each contracting party (public and private) has pledged. Each party is therefore legally bound to provide the financial contribution according to their commitment. This final document is called the Community Support Framework (CSF).

Reducing inequality among member states was a priority for the EU. As a result, the Maastricht Treaty (1993) upgraded the importance of regional policy by making economic and social cohesion one of the three pillars of the community reforms between 1994-1999, increasing the programming period from five to six years. Structural programming was made more flexible - member states had the option to assume a two-stage rather than the three-stage implementation

---

<sup>1</sup> See Delors (1989) for further details.

process. Under the new approach, each member state could draw up a RDP which included specific economic programs. The negotiations with the Commission produced the CSF which established the Single Programming Documents (SPDs). The end result allowed member states to develop detailed plans rather than general statements thus leaving the Commission with less room for maneuver.

The 1988 reforms merged the ERDF, the ESF, and the EAGGF under the label of ‘cohesion policy’. For the 1989-93 periods, funding came from these three funds, and five objectives were assigned to the Structural Funds (see Appendix - A). For the 1989-1993 programming period, a fourth and a fifth fund - the Financial Instrument for Fisheries Guidance (FIFG), and the Cohesion Fund (see Appendix - A) - were added. There was a sixth objective appended to the existing five (see Appendix - A).

Finally, the last financial program devoted to curve inequality is the Cohesion Fund (CF), established in 1993 after the Maastricht treaty was ratified. This fund provided financial assistance to particular projects of the member states - as opposed to the regions – with a GDP per capita below 90 per cent of the Community average. The main purpose of the CF was to facilitate the budgetary discipline required by the Treaty for the poorer countries – Greece, Ireland, Portugal and Spain. Only countries which are in line with the economic convergence to the monetary union are eligible. The CF provides two kinds of financial support: public or private investment projects. As we can see, reducing inequality among member states while curving disparities among regions of recipient states is one of the most important goals of the assistance funds.

There has been a long standing tradition within Europe that has been driven by political and economic considerations to reduce inequality and achieve convergence within Member States. To implement the “structural adjustment polices”, the attention of the Community officials has been devoted to a relatively small number of “development indicators”: (i) transportation, telecommunication and water supply, (ii) highly qualified labor force and high school attendance rate, (iii) the financial system and (iv) research and development activities.<sup>2</sup> The objective of this paper is to determine the effectiveness of the assistance funds in reducing economic inequality in the Iberian Peninsula. More specifically, to empirically capture how different regions in Spain and Portugal have been affected by the Structural and Cohesion Funds within the industrial and labor market context. This study will attempt to answer the following questions: (i) have these funds reduced economic disparities among and within the different regions of the Iberian Peninsula? and (ii) what sectors of the economy in the Iberian Peninsula have benefited the most?

The remainder of the paper proceeds as follows. Section 2 summarizes the findings on the importance of the structural funds on economic convergence. Section 3 describes the empirical approach that was employed in this paper as well as the findings. Section 4 discusses the challenges that the Commission faces when allocating the funds and section 5 offers some potential solutions to these problems. Finally, section 6 offers some conclusions.

---

<sup>2</sup> See European Commission reports 1991, 1994, 1996 and 1999.

## **Cohesion Policy: Convergence or Divergence?**

Economists have conflicting views on the relationship between economic integration and convergence. The differences in viewpoints are caused by diverging beliefs in the underlying assumptions on economic growth. The traditional views, which are based on comparative advantage, postulate improvements in economic convergence among countries or regions provided that the factors of mobility and diffusion of technology are not restricted. In other words, technological improvements operate so that the presence of free trade and unrestrained market competition allows for economic convergence to take place. Integration would lead to greater economic development through a convergence process. If convergence is not observed, this approach suggests that production factors are immobile or that prices are artificially determined and the full gains of economic integration cannot be reached.

An opposite view is the agglomeration theory developed by Krugman (1991), and the endogenous growth models of Romer (1986 and 1990). Both views stress that market-driven mechanisms cannot possibly induce economic convergence but are instead bound to increase and worsen existing economic inequalities. They argue that increasing returns to scale and externalities lead production factors to concentrate in the more developed areas. The nature of modern technologies is such that market forces - when left to themselves - lead to inequality and divergence in growth rates. As a result, economic integration widens economic divergence. This latter view interprets financial assistance –through programs such as the Structural Funds- as a system of transfers to the most lagging countries or regions and not necessarily to foster economic development, as suggested by Obstfeld and Peri (1998), and Boldrin and Canovas (2001).

The considerable amount of resources the Commission has devoted in assistance funds to curve inequality, raises the question whether these funds have been effective or not. There have been several studies that have attempted to empirically evaluate the impact of financial assistance in Europe, but these studies have not been conclusive. Bosca, Domenech and Taguas (1999) found that EU transfers contributed in reducing differences between the income per head of Portugal, Greece, Ireland and Spain and the rest of the Union. The European Commission has also conducted several studies that evaluate the impact of these funds. In 1997 they concluded that financial assistance had a significant effect in reducing disparities in economic performance across the Union. Two years later in 1999 they reported that EU structural assistance increased GDP, on average, from 0.4 to 0.9 percentage points in Greece, Portugal, and Ireland, and from 0.3 to 0.5 per cent in Spain. Similarly, Garcia and Maria-Dolores (2001) found that Structural Funds were able to increase the speed of economic convergence of the recipient regions.

In contrast, Boldrin and Canova (2001) showed that the economic behavior of the assisted regions was not particularly different from the rest of the Union. They found no evidence that: (1) the policies adopted were the most appropriate in terms of economic efficiency, and (2) the substantial amount of public resources funneled by the Community to lesser developed regions served any economic purpose other than redistributing income. The second point argues that the assignment of these funds is not enhancing or fostering economic growth but is rather politically motivated. Furthermore they argue that on average, uniform long-run growth rates are to be expected and relative differences will not disappear. They reject

the idea that divergence and polarization are driving the growth process. In their empirical findings they did not find any evidence that regions receiving aid from the Structural and Cohesion Funds are behaving any differently from those that are not.

### **The Case of Spain and Portugal**

Spain and Portugal did not join the EU until 1986, almost forty years after the European integration process originated. The longstanding authoritarian regimes in these two countries were the principle deterrents to join the Community, as having a democratic government was one of the unwritten rules of accession to the EU.

Under objective 1 of the Structural Funds, regions become eligible only when their GDP per-capita is below the 75<sup>th</sup> percentile of the EU average. As a result, Portugal and Spain have extensively benefited from EU assistance funds. For instance during the period 1988-1998, Spain received 22.25 per cent, and Portugal received 11.11 per cent of the total amount of structural funds allocated to all European countries during this period. Spain received 10,171 million ECU's during 1989-1999 and 26,300 million € during 2000-2006. Portugal, on the other hand received 8450 million ECU's during 1989-1999 and 13,980 million € during 2000-2006. With regards to the Cohesion Fund, Spain received 54.9 per cent of the total money allocated by this fund for the period 1994-1999 and Portugal 18.10 per cent. That is an additional 8809 million € for Spain and 2885 million € for Portugal. See Table 1 for a detailed decomposition of assistance funds by region for 1994-1999.<sup>3</sup>

The goal of these transfers is to attain the objectives set by the funds by means of improving physical infrastructure, capital stock, and the productivity of the labor force. However, not all the resources come directly from Brussels. Each region can also commit a certain amount of resources to their projects through co-payments. Table 1 presents the percentages co-financed by the regions to the total costs of the projects.

The data shows that regions with a *lower* GDP per capita tend to receive a *larger* amount of resources relative to regions with a *higher* income per capita. Given that the poorer regions are receiving more aid in relation to the richer regions, inequality should increase *ceteris paribus*.

---

<sup>3</sup> The regions in Spain are Galicia, Principado de Asturias, Cantabria, the Basque Country, Navarra, Rioja, Aragon, Madrid, Castilla & Leon, Castilla-la-Mancha, Extremadura, Catalonia, Valencia, Balearic Islands, Andalucia, Murcia, Ceuta & Melilla and Canary Islands. The regions in Portugal are North, Centre, Lisbon and the Tagus, Alentejo, Algarve, Azores and Madeira.

**Table 1: Funds to Total Cost and Co-payment to Total Cost by Region.**

Regions	Obj. 1	Obj. 2	Obj. 3	Obj. 5b	Reg. Co-pmt <sup>4</sup>	SF/GDP
<i>Galicia</i>	63.94%				36.06%	0.0127
<i>Principado de Asturias</i>	59.50%				40.50%	0.0101
<i>Cantabria</i>	62.61%				37.39%	0.0091
<i>Basque Country</i>		20.50%	44.99%	31.05%	77.37%	0.0038
<i>Navarra</i>		19.32%	44.99%	35.29%	70.40%	0.0035
<i>Rioja</i>		16.32%	45.11%	22.62%	79.43%	0.0031
<i>Aragon</i>		28.72%	45.01%	39.56%	64.39%	0.0048
<i>Madrid</i>		36.79%	45.00%	43.92%	60.88%	0.0007
<i>Castilla &amp; Leon</i>	54.67%				45.33%	0.0102
<i>Castilla-la Mancha</i>	49.53%				50.47%	0.0124
<i>Extremadura</i>	64.01%				35.99%	0.0196
<i>Catalonia</i>		16.16%	45.03%	41.04%	81.81%	0.002
<i>Valencia</i>	40.33%				59.67%	0.0049
<i>Balearic Islands</i>		19.32%	44.79%	32.50%	71.66%	0.0012
<i>Andalucia</i>	43.39%				56.61%	0.009
<i>Murcia</i>	41.87%				58.13%	0.0077
<i>Ceuta &amp; Melilla</i>	60.96%				39.04%	0.0143
<i>Canary Islands</i>	60.76%				39.24%	0.0109
<i>North</i>	72.09%				27.91%	0.0041
<i>Centre</i>	73.36%				26.64%	0.0049
<i>Lisbon and the Tagus Valley</i>	72.68%				27.32%	0.002
<i>Alentejo</i>	63.22%				36.78%	0.013
<i>Algarve</i>	67.50%				32.50%	0.0054
<i>Azores</i>	77.35%				22.65%	0.0812
<i>Madeira</i>	65.10%				34.90%	0.0421

The contribution of each region to the total cost of projects changes substantially from region to region, from a low of 18.19 per cent to a high of 77.35 per cent. Furthermore, we find that regions with a high GDP per capita tend to contribute (on average) more to the projects than regions with a lower GDP per capita. We observe that all Portuguese regions except Alentejo contributed no more than 37 per cent. In contrast, 11 out of 19 Spanish regions are committing more than 50 per cent to the total cost of the project.

<sup>4</sup> The amount of co-payment is obtained from the official reports on the Structural Funds (11<sup>th</sup> annual report). The total aggregated costs of the Programs and structural funds assistance were given from 1994-1999 for each region by objectives (objective 1, 2, 3, 5b for Spain, objective 1 for Portugal). The ratio of structural funds assistance to total costs yields the percentage of the total costs financed by the structural funds (one minus this ratio yields the co-payment amount). Once the percentage of co-payment is calculated, a value is estimated for each region and year which is obtained by using the co-payment ratio and actual payments received during a year. With this methodology we are assuming the amount of co-payment and SF assistance is constant during the cycle of each project.

## Measuring the Effects of the Assistance Funds in the Iberian Peninsula

There are various studies that evaluate the role of assistance funds in the Iberian Peninsula. These studies typically track the evolution of macroeconomic indicators such as GDP per capita, and unemployment rates by regions/gender/age. Bean, Bertola and Dolado (2000) described how Portugal has experienced a drastic change in the geographical pattern of its trade flow during the last decade. The article finds that the proportion of intra-EU trade has risen from 48 per cent to 75 per cent. In this respect it is important to emphasize the role of textiles, which contributes 30 per cent of export earnings. The combination of low labor costs, EU investment incentives, and a favorable local tax regime has provided an attractive environment for foreign investment. FDI flows in recent years averaged 3-4 per cent of GDP. The annual inflow of FDI has more than doubled as a share of total investment compared to the 1980-85 period. There has been selective FDI in some sectors with a strong export orientation (food and beverages, electrical engineering), which has affected the specialization within Portuguese manufacturing.

Spain on the other hand, had a highly diversified industrial structure and the importance of sectors sensitive to integration was lower than in Portugal and Greece. Intra-industry trade intensified particularly in products of medium and low quality and in sectors with strong or intermediate demand at the EU level. Western Europe has always been the most important market for Spanish trade. This fact was reinforced after the accession to the EU. Exports to the EU have increased their share from 52 per cent in 1986 to 67 per cent in 1991. On the exports side foodstuffs gradually lost their share, while durable consumer goods (especially cars) exported to the EU and capital goods to Latin-American countries increased in importance. With regard to imports, capital goods have raised their share in total imports from 11 per cent in 1985 to 24 per cent in 1996. FDI flows increased strongly after accession, growing from 1.2 per cent of GDP in 1986 to 4.2 per cent in 1991, and falling thereafter, being mostly concentrated in manufacturing (43 per cent) and the financial sector (35 per cent).

At first glance it seems that the Iberian Peninsula has indeed benefited from the Structural and Cohesion Funds, restructuring and modernizing its economy. Various studies from the Commission are finding that these funds are reaching their objectives.<sup>5</sup> A more interesting question is to determine if the economic changes that are taking place in the various sectors and industries are caused by the influx of these assistance funds. More precisely from objective 1, we would expect the gap -measured in per capita GDP- between lagging regions and the EU average to diminish. From objective 2-6 we would expect the unemployment rate in recipient regions to decrease as well. Regional data on industrial wages contains very useful information which will allow us to explore any relevant changes in the recipient regions and sectors caused by the Structural and Cohesion Funds.

In this paper we have examined the evolution of wage inequality in the recipient regions at different points of time. In principle there are two potential dimensions of inequality that can be studied: (1) the evolution of inequality in Spain, and Portugal with respect to Europe (the Commission has focused most of its attention to this dimension), and (2) the evolution of inequality within the different regions in the Iberian Peninsula. In the latter case we have measured pay inequality among the industrial sectors within each region. If the European

---

<sup>5</sup> For further details see the European Commission reports 1991, 1994, 1996 and 1999.

integration process leads to convergence we would expect to find convergence from individual countries to the European average and individual regions to the national average. In contrast, if integration actually leads to divergence due to agglomeration effects, then we should observe different patterns of inequality within the Iberian Peninsula and within Europe. By studying these two different aspects of inequality we will be able to better understand the convergence process in the Iberian Peninsula.

The data source that we have used to measure inequality is EUROSTAT, the official database used by the Commission for the evaluation of regional policy. EUROSTAT publishes a regional database called New Cronos Regio. In this database there are two main data sets produced by EUROSTAT labeled ESA 79 and ESA 95. The first data set includes data from the year 1983 to 1994 and the second data set from 1995 to 1999. In this paper we employ the Theil statistic as a measure of inequality.<sup>6</sup> In our analysis we classify regions by NUTS level 2 consistent with the Commissions methodology to declare regions as eligible recipients for financial aid funds.<sup>7</sup> The Theil statistics can be expressed as follows:

$$T = \frac{1}{n} \sum_{i=1}^n \frac{y_i}{\mu_Y} * \log \left[ \frac{y_i}{\mu_Y} \right] \quad (1)$$

where  $y_i$  denotes the income of an individual region indexed by  $i$ ,  $n$  is the number of individuals in the population and  $\mu$  is the average income. One of the most attractive features of this statistic is its decomposition property. As long as a distribution of income and a distribution of individuals are grouped into mutually exclusive and completely exhaustive (MECE) groups overall inequality can be decomposed into a between group component, and a within group component. After grouping individuals into  $m$  generic MECE groups we can decompose overall inequality into a between group component,  $T_B$ , and a within group component,  $\overline{T_W}$ . The between measure  $T_B$ , is derived from group means where only inequality between groups are considered, while the within measure,  $\overline{T_W}$ , is a weighted average of the Theil inequality indexes for each group.<sup>8</sup> We use the between group component  $T_B$  as an estimate for inequality as argued by Conceição and Galbraith (2000). The authors provide formal criteria under which the between group component of the Theil index tracks the overall movement of inequality, concluding that, under some very general conditions, the dynamics of overall inequality can be captured using only the between group component of the Theil index.

---

<sup>6</sup> Appendix A provides the list of provinces used in our analysis. Appendix B provides a list of the different industries from both classifications.

<sup>7</sup> EUROSTAT also produces its own geographical classification scheme for statistical purposes. Geographical European units are hierarchically categorized as Nomenclature of territorial units (NUTS). These hierarchical levels include four levels: NUTS level 0, NUTS level 1, NUTS level 2 and NUTS level 3. The first level NUTS level 0 corresponds to the European nations and the last level NUTS level 3 corresponds to counties (if it were the case of the US).

<sup>8</sup> See Appendix B for further details on the construction of the Theil statistic.

## National Inequality in the Iberian Peninsula

In this section we study the evolution of national inequality during the period 1989-1999. We calculate two types of inequality measures: pay (wage) inequality, and GDP inequality. The first measure – pay inequality– is constructed from 16 different sectors in each regional unit.<sup>9</sup> With this measure we calculate: (1) the Theil inequality statistic within each region, and (2) a regional contribution to Spain and Portugal. The information on wages and employees is taken from Eurostat’s REGIO database.<sup>10</sup> The second inequality measure –GDP– captures the inequality of industrial and non-industrial sectors; i.e, all the productive sectors in the economy. For this measure we calculate: (1) the regional contribution to Spain and Portugal, and (2) the regional contribution to the European average. The GDP at the regional level is also taken from Eurostat’s REGIO database.

When studying the regional contribution we use the between Theil index.<sup>11</sup> The sum of the between Theil components is used as a measure of the total inequality in Spain and Portugal. The same methodology is used for the within component, the only difference is the selection of groups. For the within component each sector is considered a group. The sum of the contribution from each group gives an inequality measure at the regional level. For the between component each region is a group. The sum of their contributions gives an inequality measure for Spain and Portugal.

In order to see the extent to which the Structural and Cohesion funds have affected regions we consider a pre and post funds period. Due to data limitations we split the periods into pre-structural funds, 1984-1989, and post structural funds, 1990-1999. We first examine inequality at the national level so we can determine how differences in industrial wages in Spain and Portugal have evolved over time. We then examine the overall GDP inequality between the different regions in Spain and Portugal, see Tables 2 and 3.<sup>12</sup>

**Table 2: Between Wage Theil.**

Country	Period	Mean ( $\mu$ )	Median
<i>Spain</i>	Pre S.F.	0.0028	0.0034
	Post S.F.	0.0052	0.0034
<i>Portugal</i>	Pre S.F.	0.0041	0.0030
	Post S.F.	0.0094	0.0088

---

<sup>9</sup> See Appendix B for the list of Sectors.

<sup>10</sup> We use the variable compensation = Wages and salaries + Employers’ social contributions + Employers’ actual social contributions + Employers’ imputed social contributions.

<sup>11</sup> For further details on this statistic see Appendix C.

<sup>12</sup> Data for the wage Theil is available from 1983-1999 for Spain and 1986-1999 for Portugal. For the GDP Theil data for Spain and Portugal is available from 1986-1999.

**Table 3: Between GDP Theil.**

Country	Period	Mean ( $\mu$ )	Median
<i>Spain</i>	Pre S.F.	0.0194	0.0194
	Post S.F.	0.0224	0.0200
<i>Portugal</i>	Pre S.F.	0.0366	0.0389
	Post S.F.	0.0233	0.0238

As we can see from Tables 2 and 3, overall wage inequality between the different regions in Spain and Portugal has increased since the assistance funds have been in place. More precisely, differences in wage compensation in Spain and Portugal were smaller when the Iberian Peninsula did not receive any assistance funds. In particular, the distribution of wages for industrial workers has become more unequal in the Iberian Peninsula over the past decade, while GDP inequality among the different regions in Portugal has decreased but has increased in the case of Spain. Assistance funds may have been successful at curving the regional GDP disparities in Portugal but may have worsened for the case of Spain. These findings suggest that non industrial sectors, the ones not previously considered in the wage analysis, in Portugal have benefited the most from the assistance funds.

In order to have a better idea about which regions have become the most unequal in the Iberian Peninsula we proceed with our analysis at the regional level. As resources are distributed across the various regions, one would expect regional inequalities to decrease. In Table 4 we present the evolution of wage inequality within the different regions in the Iberian Peninsula before and after the assistance funds. We compare the percentage change between these two time periods to determine the relative effect of the assistance funds in the various regions. The last column of Table 4 is the ratio of structural funds received relative to GDP.

The data reveal that all regions in Spain have experienced an increase in pay-inequality after receiving aid from the assistance funds. In particular, Galicia, Principado de Asturias, Basque Country, Madrid, Catalonia, Balearic Islands, Andalucia and Canary Islands have more than doubled their wage inequality. Workers in these regions were facing a smaller wage differential across sectors before the assistance funds were granted. A similar trend is observed in Portugal, where all Portuguese regions have increased their wages disparities.<sup>13</sup> In particular, Algarve and Centre have more than double pay inequality after the assistance funds have been in place.

The differential in worker compensation across the different industries in each region of the Iberian Peninsula has increased steadily over the years despite receiving large amounts of aid from the Structural Funds. This finding may suggest that the different industrial sectors in the Iberian Peninsula are growing at different rates exacerbating the differences among regions. Furthermore we find a positive correlation between the change in inequality and the amount of assistance funds received over the years. Thus regions that tend to experience an increase in inequality tend to receive a larger amount of assistance funds.<sup>14</sup>

<sup>13</sup> In the case of Portugal we can not determine the relative increase or decrease of within wage inequality in Azores and Madeira because of lack of data.

<sup>14</sup> The correlation between the percentage change in within wage Theil and the amount of structural funds over GDP by region received over the period 1989-1999 is equal to 0.1372.

**Table 4: Within Regional Wage Inequality**

Regions	Within Theil Wages		% Change	Struc. Funds/GDP
	'83-'88	'88-'99		
<i>Galicia</i>	0.0348	0.0963	176.96	0.0127
<i>Princ. De Asturias</i>	0.0263	0.0738	180.94	0.0101
<i>Cantabria</i>	0.023	0.0615	167.55	0.0091
<i>Basque Country</i>	0.0236	0.0529	124.15	0.0038
<i>Navarra</i>	0.0243	0.0464	90.43	0.0035
<i>Rioja</i>	0.0314	0.0462	47.24	0.0031
<i>Aragon</i>	0.027	0.0431	59.78	0.0048
<i>Madrid</i>	0.0242	0.0533	120.23	0.0007
<i>Castilla &amp; Leon</i>	0.0278	0.0463	66.43	0.0102
<i>Castilla-la Mancha</i>	0.0409	0.056	37.00	0.0124
<i>Extremadura</i>	0.0319	0.0593	86.30	0.0196
<i>Catalonia</i>	0.0308	0.0649	110.46	0.002
<i>Valencia</i>	0.0269	0.052	93.47	0.0049
<i>Balearic Islands</i>	0.0374	0.0769	105.65	0.0012
<i>Andalucia</i>	0.0232	0.0656	183.02	0.009
<i>Murcia</i>	0.0358	0.0672	87.60	0.0077
<i>Ceuta &amp; Melilla</i>	0.0294	0.0602	105.02	0.0143
<i>Canary Islands</i>	0.0353	0.0808	129.02	0.0109
<i>North</i>	0.0379	0.0744	96.29	0.0041
<i>Centre</i>	0.0385	0.0776	101.69	0.0049
<i>Lisbon &amp; Tagus</i>	0.0462	0.0513	10.96	0.002
<i>Alentejo</i>	0.059	0.0947	60.43	0.013
<i>Algarve</i>	0.0351	0.0848	141.84	0.0054
<i>Azores</i>	.	0.1589	.	0.0812
<i>Madeira</i>	.	0.113	.	0.0421

At a first glance it appears that the effectiveness of the Structural Funds in curving overall inequality in Spain and Portugal has had mixed results. It also seems that there has been a change in the industrial composition of the Iberian economy after Spain and Portugal joined the EU.

### **Industrial Inequality in the Iberian Peninsula**

In order to have a better understanding about which sectors are the main contributors to the increased regional pay inequality, we construct the between industrial Theil statistic for Spain and Portugal, see Table 4a and 4b.

We recall that the sum of the between Theil component can be used as an estimate for an overall measure of inequality. The individual components are the contributions from each group

included in the index. Some components will have a negative value while other components will have a positive value. When a particular component is equal to the average of the group – a situation of perfect equality – that particular contribution equals zero. Negative values suggest that a particular region is below the average, while positive values are for groups above the average. In particular, a region with the smallest negative or biggest positive between Theil components is a region that is furthest away from the average, thus contributing the most to inequality. By comparing the individual between Theil components from year to year we can determine whether a particular region is pulling away from the average. If a particular component is further away from zero, the increase can be caused by the following two cases: (1) the value of that particular group has increased/decreased further away from the group mean, or (2) the value of that particular region remains the same, and the group mean has increased/decreased. In either case that particular region will contribute more to inequality. If we want to measure whether a particular region or industry has contributed more or less to inequality across time, we compare the distance of that particular contribution to zero – a perfect equality case– from year to year to see whether it has increased/decreased in absolute terms.

We now examine the evolution of the industrial sectors in Spain and Portugal from 1983-1994. For each group analysis we include two tables. The first table displays the average of the between components for each group during both periods, and the absolute change among both averages. A positive absolute change represents a positive contribution to inequality while a negative change means it has contributed less to inequality. The second table is based on a ranking system. For each year we rank each group based on their between contributions. We assign the value of 1 to the lowest negative component and the value of 16 to the highest positive component and we then construct the average rank for the pre and for post Structural Fund period. Based on this average rank we sort each industry accordingly, from the lowest to the highest. We then can, on average, determine whether some groups have contributed more or less to inequality in the post Structural Fund era relative to other groups.

The data presented in Tables 4a and 4b show that industries that contributed the most to inequality in Spain during the pre-assistance period were transport and communications services; chemical products; fuel and power products; and service of credit and insurance institutions. The workers in these industries received higher wages relative to the other industries during the pre-funding era. Similarly, recovery, repairs, trade, lodging and catering services; textiles and clothing, leather and footwear; products of various industries; and non market services increased inequality since their wage was lower than the national average.

**Table 4a:** Absolute Change between Industrial Theil in Spain ESA 79.

<b>Sectors</b>	<b>'83-'88</b>	<b>89-'94</b>	<b>Absolute Change</b>
<i>Recovery, repair, trade, lodging and catering services</i>	-0.0277	-0.0366	0.0089
<i>Textiles and clothing, leather and footwear</i>	-0.0131	-0.0095	-0.0036
<i>Products of various industries</i>	-0.0068	-0.0063	-0.0005
<i>Non-market services</i>	-0.0036	-0.0044	0.0008
<i>Food, beverages, tobacco</i>	-0.0036	-0.0018	-0.0018
<i>Other market services</i>	-0.0029	-0.0048	0.0019
<i>Metal products, machinery, equipment and electrical goods</i>	-0.0013	-0.0007	-0.0006
<i>Non-metallic minerals and mineral products</i>	-0.0009	-0.0005	-0.0004
<i>Paper and printing products</i>	-0.0006	-0.0007	0.0001
<i>Building and construction</i>	0.0026	0.0060	0.0033
<i>Ferrous and non-ferrous ores and metals, other than radioactive</i>	0.0043	0.0034	-0.0009
<i>Transport equipment</i>	0.0046	0.0051	0.0005
<i>Chemical products</i>	0.0052	0.0050	-0.0002
<i>Transport and communication services</i>	0.0070	0.0115	0.0045
<i>Fuel and power products</i>	0.0144	0.0134	-0.0010
<i>Services of credit and insurance institutions</i>	0.0477	0.0493	0.0016

After the funds have been allocated, we find that textiles, and clothing, leather and footwear; and food, beverages and tobacco have reduced pay-inequality the most relative to their pre-fund era. On the other hand, transport and communication services; and recovery, repair, trade, lodging and catering services, have actually increased pay inequality. Among those industries with a negative Theil contribution –below the national average– textiles and, clothing, leather, and footwear; and food, beverages and tobacco have been catching up the most to the national average during the post Structural Funds era. In contrast, recovery, repair, trade, lodging and catering services have fallen behind the national average. Finally, transport and communication services have contributed to inequality the most by growing much faster than the national average.

From Table 4b we observe that wage inequality among the different industrial sectors has barely changed over the past decade. In particular, the group of industries that contributed the most to wage inequality during the post-assistance period is still basically the same with respect to the pre-fund era, except for transportation equipment. This suggests that the industrial composition of the most unequal and equal sectors in Spain has not evolved substantially over the last decade. However this does not suggest that the assistance funds have not been successful at transforming the industrial composition of Spain. The data reveal a dynamic composition of industries affecting wage inequality over the last decade since the value of the average ranking and the value of the sorting are not identical. In other words, the contribution to inequality by the different sectors has evolved over time.

**Table 4b:** Relative Ranking, Between Industrial Theil in Spain, ESA 79.

	Pre SF	Pre SF	Post SF	Post SF
Sectors	Av Rank	Rank	Av Rank	Rank
<i>Recovery, repair, trade, lodging and catering services</i>	1.00	1	1.00	1
<i>Textiles and clothing, leather and footwear</i>	2.00	2	2.33	2
<i>Products of various industries</i>	3.00	3	3.33	3
<i>Non-market services</i>	4.67	4	5.50	5
<i>Food, Beverages, tobacco</i>	5.33	5	5.50	6
<i>Other market services</i>	6.17	6	4.33	4
<i>Metal products, machinery, equipment and electrical goods</i>	6.83	7	7.67	8
<i>Non-metallic minerals and mineral products</i>	7.67	8	7.83	9
<i>Paper and printing products</i>	8.50	9	7.50	7
<i>Building and construction</i>	11.33	10	11.50	11
<i>Ferrous and non-ferrous ores and metals<sup>15</sup></i>	11.50	11	10.50	10
<i>Transport equipment</i>	11.83	12	12.33	13
<i>Transport and communication services</i>	12.50	13	14.17	14
<i>Chemical products</i>	12.67	14	11.67	12
<i>Fuel and power products</i>	15.00	15	14.83	15
<i>Services of credit and insurance institutions</i>	16.00	16	16.00	16

A similar trend is observed in Portugal, see Tables 4c and 4d. Fuel and power products; non market services; transport and communications and services; services of credit and insurance institutions contributed the most to wage inequality before the assistance funds were in place. In particular these sectors had a higher wage differential than the national average. In contrast, building and construction; textiles and clothing, leather and footwear; and recovery repair, trade, lodging and catering services had a lower wage differential than the other sectors that contributed to pay-inequality before the assistances funds were granted.

After the funds were in place, we find that building and construction; and transport and communication services decreased inequality the most. In particular, building and construction have a negative Theil component while transport and communication services have a positive component. The former industrial sector is catching up the most, while the latter sector is falling behind the most: the growth in the building and construction industry is increasing faster relative to the other sectors. On the contrary, non-market services have increased pay-inequality during the post structural funds era.

---

<sup>15</sup> other than radioactive

**Table 4c:** Absolute Change between Industrial Theil in Portugal ESA 79.

<b>Sectors</b>	<b>'83-'88</b>	<b>89-'94</b>	<b>Absolute Change</b>
<i>Building and construction</i>	-0.0320	-0.0217	-0.0103
<i>Textiles and clothing, leather and footwear</i>	-0.0242	-0.0345	0.0103
<i>Recovery, repair, trade, lodging and catering services</i>	-0.0231	-0.0270	0.0039
<i>Products of various industries</i>	-0.0093	-0.0097	0.0005
<i>Food, beverages, tobacco</i>	-0.0082	-0.0079	-0.0003
<i>Other market services</i>	-0.0062	-0.0066	0.0004
<i>Non-metallic minerals and mineral products</i>	-0.0013	-0.0031	0.0018
<i>Metal products, machinery, equipment and electrical goods</i>	0.0004	-0.0048	0.0044
<i>Paper and printing products</i>	0.0030	0.0025	-0.0004
<i>Ferrous and non-ferrous ores and metals, other than radioactive</i>	0.0034	0.0006	-0.0028
<i>Transport equipment</i>	0.0061	0.0043	-0.0018
<i>Chemical products</i>	0.0070	0.0089	0.0020
<i>Fuel and power products</i>	0.0138	0.0187	0.0049
<i>Non-market services</i>	0.0315	0.0549	0.0235
<i>Transport and communication services</i>	0.0384	0.0328	-0.0056
<i>Services of credit and insurance institutions</i>	0.0446	0.0491	0.0045

The data in Table 4d reveal that in Portugal service industries were reducing pay inequality the most after the assistance funds were in place. The data also show an even greater dynamic composition of industries affecting wage inequality over the last decade since the value of the average ranking and the sorting are not identical. In other words, the contribution to inequality by the different sectors has evolved through time suggesting an increased flexibility in the Portuguese labor market.

A common trend is observed in Spain and Portugal. The industrial sectors that have reduced inequality the most have been the service industries. This overall trend in Spain and in Portugal shows that the Iberian Peninsula is slowly moving towards a service oriented economy. In particular, since the service industries are growing at a faster rate, they will need to attract more workers by offering higher wages in relation to other industrial sectors. As the Iberian Peninsula becomes more integrated into the EU, competition among industrial sectors increases. As a result of this new externally driven competition, less efficient sectors are growing slower.

**Table 4d:** Relative Ranking, Between Industrial Theil in Portugal, ESA 79.

	Pre SF	Pre SF	Post SF	Post SF
Sectors	Av Rank	Rank	Av Rank	Rank
<i>Building and construction</i>	1.00	1	2.67	3
<i>Textiles and clothing, leather and footwear</i>	2.00	2	1.33	1
<i>Recovery, repair, trade, lodging and catering services</i>	3.00	3	2.00	2
<i>Products of various industries</i>	4.00	4	4.17	4
<i>Food, Beverages, tobacco</i>	5.00	5	5.33	5
<i>Other market services</i>	6.00	6	6.17	6
<i>Non-metallic minerals and mineral products</i>	7.00	7	7.50	8
<i>Metal products, machinery, equipment and electrical goods</i>	8.00	8	6.83	7
<i>Paper and printing products</i>	9.00	9	9.83	10
<i>Ferrous and non-ferrous ores and metals,<sup>16</sup></i>	10.00	10	9.17	9
<i>Transport equipment</i>	11.33	11	11.17	11
<i>Chemical products</i>	11.67	12	11.83	12
<i>Fuel and power products</i>	13.00	13	13.00	13
<i>Non-market services</i>	14.33	14	15.83	16
<i>Transport and communication services</i>	14.67	15	14.00	14
<i>Services of credit and insurance institutions</i>	16.00	16	15.17	15

As we can see, assistance funds in Spain and Portugal may have been playing a catalyst role in the industrial and labor market transformation of the Iberian economy.

### **National and Regional Contribution to Inequality**

In this section we examine how regional pay inequality has progressed relative to Spain and Portugal, and relative to Europe. We first examine in Table 5 how wage inequality between the different regions in Spain and Portugal has changed over time relative to: (1) the Iberian Peninsula and (2) Europe.

The data in Table 5 shows that there are some regions in Spain and Portugal that have increased wage inequality relative to their own country but all regions have reduced pay inequality when compared to the European average.

---

<sup>16</sup> other than radioactive

**Table 5: Between Wage Theil in the Iberian Peninsula.**

Regions	Wage Theil Relative to own country			Wage Theil Relative to EU		
	Av 83-88	Av 89-99	Absolute Change	Av 83-88	Av 89-99	Absolute Change
<i>Valencia</i>	-0.0093	-0.0106	0.0012	-0.0055	-0.0042	-0.0014
<i>Andalucia</i>	-0.0065	-0.0109	0.0044	-0.0064	-0.0048	-0.0016
<i>Galicia</i>	-0.0052	-0.0086	0.0034	-0.0032	-0.0026	-0.0006
<i>Castilla-la Mancha</i>	-0.0028	-0.0030	0.0002	-0.0018	-0.0013	-0.0005
<i>Murcia</i>	-0.0026	-0.0033	0.0007	-0.0013	-0.0010	-0.0003
<i>Extremadura</i>	-0.0016	-0.0019	0.0003	-0.0010	-0.0007	-0.0003
<i>Rioja</i>	-0.0007	-0.0003	-0.0005	-0.0004	-0.0002	-0.0002
<i>Balearic Islands</i>	-0.0005	0.0000	-0.0005	-0.0010	-0.0006	-0.0004
<i>Cantabria</i>	-0.0001	0.0000	-0.0001	-0.0006	-0.0003	-0.0003
<i>Canary Islands</i>	0.0000	-0.0010	0.0010	-0.0014	-0.0011	-0.0003
<i>Navarra</i> <sup>17</sup>	0.0005	0.0013	0.0008	-0.0006	-0.0003	-0.0003
<i>Ceuta &amp; Melilla</i>	0.0008	0.0005	-0.0003	0.0000	0.0000	0.0000
<i>Aragón</i>	0.0012	0.0017	0.0005	-0.0012	-0.0006	-0.0006
<i>Castilla &amp; León</i>	0.0013	0.0003	-0.0010	-0.0023	-0.0014	-0.0009
<i>Principado de Asturias</i>	0.0024	0.0008	-0.0016	-0.0009	-0.0005	-0.0004
<i>Catalonia</i>	0.0043	0.0086	0.0042	-0.0071	-0.0036	-0.0035
<i>Basque Country</i>	0.0068	0.0097	0.0029	-0.0019	-0.0003	-0.0016
<i>Madrid</i>	0.0147	0.0218	0.0071	-0.0045	-0.0014	-0.0030
<i>North</i>	-0.0381	-0.0434	0.0054	-0.0098	-0.0082	-0.0016
<i>Centre</i>	-0.0160	-0.0133	-0.0027	-0.0039	-0.0035	-0.0004
<i>Algarve</i>	-0.0029	-0.0025	-0.0004	-0.0007	-0.0007	0.0000
<i>Alentejo</i>	-0.0022	-0.0009	-0.0013	-0.0009	-0.0009	0.0000
<i>Lisbon &amp; Tagus Valley</i>	0.0674	0.0694	0.0020	-0.0116	-0.0084	-0.0031
<i>Azores</i>	.	0.0003	.	.	-0.0004	.
<i>Madeira</i>	.	0.0000	.	.	-0.0005	.

After the funds have been in place, we find that Valencia, Andalucia, and Galicia have contributed the most to wage inequality in Spain since their wage differential is lower than the Spanish average. On the other hand, Catalonia, Basque Country, and Madrid have contributed the most to inequality by means of higher pay. In contrast, Extremadura and Murcia have contributed the least to inequality. In the case of Portugal, we find that North and Lisbon and the Tagus Valley are the regions that have contributed the most to wage inequality after the funds have been in place. These regions have a higher wage than the Portuguese average. In contrast, Centre and Alentejo have decreased inequality. Thus the assistance funds have helped reduce the wage inequality within those regions when compared to the Portuguese average.

When comparing inequality with respect to the European average, we see that all regions in the Iberian Peninsula are below the EU average. Before the funds that had been granted the most negative Theil components occurred in regions with a large population share such as Andalucia and Catalonia. After the assistance funds were in place we see that the majority of regions reduced wage inequality. In particular, wealthier regions such as Catalonia, Lisbon and the Tagus Valley, and Madrid reduced inequality more than poorer regions. Only, Algarve, Alentejo and Ceuta & Melilla did not curve inequality. It seems then that the transfer of funds from other European nations through assistance funds has been successful at reducing inequality

<sup>17</sup> Comunidad Foral de Navarra.

with respect to Europe. This positive aspect of redistribution has not necessarily reduced regional inequality with respect to the Iberian Peninsula.

The data suggest that some sort of agglomeration forces and increasing return to scale operate in the Iberian Peninsula. Regions from the Iberian Peninsula with a higher GDP per capita tend to contribute the most to wage inequality. Regions with lower GDP per capita are the ones that tend to reduce inequality the most with respect to Europe. On the other hand, not all regions are catching up with Europe at the same rate and not all regions within the Iberian Peninsula are becoming more similar. The fact that we can observe some asymmetries with respect to the speed of convergence in wages among regions suggests that the impact of the assistance funds in these regions may exacerbate differences. Regions that can potentially grow faster might attract more resources from other industries and/or from other regions and widen the gap further. As a result, the wage distribution among industrial workers within the Iberian Peninsula has become more unequal and skewed.

Are these trends observed at a more aggregated level? Do we observe the same phenomena when we incorporate the non industrial sectors? In order to answer these questions we examine the evolution of regional inequality in industrial and non-industrial sectors, by constructing the regional GDP Theil contribution relative to Spain and Portugal and relative to Europe, see Table 6. We can then explore how aggregate inequality has evolved before and after the assistance funds.

The data show that the regions of Andalucia, Galicia and Extremadura increased the GDP inequality in Spain before the funds were even granted by growing at a slower rate. On the other hand, Basque Country, Catalonia and Madrid tended to increase GDP inequality by growing faster than the Spanish average. Since the regional composition is basically the same when examining wage and GDP between Theils, we may argue that the relative weight of the non industrial sectors in those regions can not change their growth experiences. Once the funds were granted, the composition of regions that contribute the most to inequality remain basically the same with the exception of Aragon which helped to increase inequality.

**Table 6: Between GDP Theil in the Iberian Peninsula**

Regions	Relative Own Av 86-88	Relative Own Av 89-99	Relative Own Absolute Change	Relative E.U. Av 86-88	Relative E.U. Av 89-99	Relative E.U. Absolute Change
<i>Andalucía</i>	-0.03677	-0.03948	0.0027	-6.6E-08	-7.2E-08	5.9809E-09
<i>Galicia</i>	-0.01444	-0.01341	-0.0010	-2.9E-08	-3E-08	1.14403E-09
<i>Extremadura</i>	-0.00789	-0.00751	-0.0004	-9.4E-09	-1E-08	1.07289E-09
<i>Castilla-la Mancha</i>	-0.00767	-0.00669	-0.0010	-1.7E-08	-1.9E-08	2.00299E-09
<i>Castilla &amp; León</i>	-0.00481	-0.00509	0.0003	-3E-08	-3.2E-08	1.56362E-09
<i>Murcia</i>	-0.00148	-0.00303	0.0015	-1.2E-08	-1.3E-08	7.9479E-10
<i>Principado de Asturias</i>	-0.00065	-0.00242	0.0018	-1.4E-08	-1.4E-08	-4.59274E-12
<i>Cantabria</i>	-0.00041	-0.0004	0.0000	-6.4E-09	-6.9E-09	4.122E-10
<i>Ceuta &amp; Melilla</i>	-0.00037	-0.00041	0.0000	-1.5E-09	-1.5E-09	-1.21329E-11
<i>Canary Islands</i>	-7.6E-06	-0.00156	0.0015	-1.8E-08	-1.9E-08	1.29006E-09
<i>Valencia</i>	0.000619	-0.00255	0.0019	-4.7E-08	-5E-08	3.20731E-09
<i>Rioja</i>	0.001085	0.000956	-0.0001	-3.6E-09	-3.9E-09	2.39593E-10
<i>Aragón</i>	0.003174	0.003396	0.0002	-1.6E-08	-1.8E-08	1.1245E-09
<i>Navarra</i> <sup>16</sup>	0.003633	0.003757	0.0001	-7.9E-09	-8.4E-09	4.62931E-10
<i>Balearic Islands</i>	0.005773	0.005283	-0.0005	-1E-08	-1.1E-08	9.7741E-10
<i>Basque Country</i>	0.014603	0.011418	-0.0032	-3.2E-08	-3.3E-08	5.92971E-10
<i>Catalonia</i>	0.032321	0.039025	0.0067	-8.8E-08	-9.6E-08	8.17033E-09
<i>Madrid</i>	0.032372	0.040863	0.0085	-7.4E-08	-8.1E-08	6.94719E-09
<i>North</i>	-0.04757	-0.04612	-0.0014	-2.4E-08	-2.8E-08	4.234E-09
<i>Centre</i>	-0.03881	-0.02907	-0.0097	-1E-08	-1.3E-08	3.00751E-09
<i>Alentejo</i>	-0.01748	-0.00788	-0.0096	-4.1E-09	-4.3E-09	1.92818E-10
<i>Madeira</i>	-0.00702	-0.00347	-0.0035	-1.5E-09	-1.9E-09	4.36184E-10
<i>Azores</i>	-0.00633	-0.00565	-0.0007	-1.4E-09	-1.7E-09	2.62182E-10
<i>Algarve</i>	0.001374	0.000707	-0.0007	-2.7E-09	-3.2E-09	5.545E-10
<i>Lisbon and the Tagus Valley</i>	0.144467	0.11528	-0.0292	-3.3E-08	-3.8E-08	4.74865E-09

A similar trend is observed in the regions that contribute the least to GDP inequality. In particular, Catalonia and Madrid have increased GDP inequality the most in the Structural Fund era, while Basque Country, Centre, and North (regions above the national average) have contributed less to GDP inequality after receiving financial aid. These regions have been getting closer to their respective national averages.

In terms of the poorer regions, Andalucía and Comunidad Valenciana have contributed more to GDP inequality in the post-assistance era. Furthermore, Catalonia and Madrid, the two biggest contributors to inequality (after the funds were implemented) have not received any financial aid under objective 1 in the post Structural Funds era (objective 1 focuses precisely on enhancing regional development or increasing GDP per capita to the EU average); while regions that have benefited the most from objective 1 – Andalucía, and Valencia – have lagged even further behind the national average. In other words, the funds under objective 1 in Spain are not working as they were intended. It seems that the assistance funds were not able to substantially change the growth experiences of the most backward and advanced regions in Spain. Furthermore, the correlation between the final sorting and the co-payment for each region is

positive, which suggests that a stronger financial commitment of the regions will lead to a higher contribution to inequality. On the contrary, a higher amount of resources received from Brussels tends to be associated with the regions decreasing inequality.

When we compare the relative performance with respect to Europe we find that all regions in Spain did reduce their inequality since all their between Theils were negative. In particular, before the assistance funds were in place, the regions that were contributing the most to GDP inequality were Extremadura, Navarra, Cantabria, Rioja and Ceuta & Melilla. The regions that contributed the least to inequality during this period were Catalonia, Andalucia, the Basque Country, Madrid and Valencia. Once the funds were in place, the composition of regions that contributed the most and the least to inequality did not change over time; suggesting that not all regions are catching up with Europe at the same rate. The regions that are contributing the most to the Spanish inequality tend to contribute the least to the European average because of their rapid growth experiences. On the other hand, the regions that are contributing the least in Spain are increasing GDP inequality with respect to Europe. Furthermore, the correlation between the final sorting and the co-payment for each region is positive, which suggests that a stronger financial commitment of the regions will lead to a higher contribution to inequality. Similarly, a higher amount of resources received from Brussels tends to be associated with regions that tend to decrease inequality.

Are these trends being observed in Portugal as well? The data shows that there are some regions in Portugal that have experienced a reduction in GDP inequality relative to Portugal while other regions have experienced an increase.<sup>18</sup> The data show that before the assistance period the regions of Lisbon and the Tagus Valley, Algarve and Alentejo were the regions that contributed the most to GDP inequality in Portugal. In contrast, North and Centre contributed the least. The data also reveals that regional contribution to the Portuguese GDP inequality has changed within this period since the average ranking and the final rankings are not the same. The regional composition that contributed the most after the assistance funds have been in place did not change from the previously examined period. A similar trend is observed in the regions that contributed the least to GDP inequality. This suggests that different regions in Portugal are growing at different rates in terms of GDP, and the regions that were lagging behind with respect to Portugal are still lagging behind after the funds have been in place. It seems that the assistance funds have not benefited all regions. Furthermore, the correlation between the final sorting and the co-payment for each region is positive, which suggests that a stronger financial commitment of the regions will lead to a higher contribution to inequality. Similarly, a higher amount of resources received from Brussels tend to be associated with regions that tend to decrease inequality.

If we now compare the GDP inequality with respect to Europe the data shows that all regions have decreased inequality since all their between Theils were negative. Moreover, before and after the assistance funds were in place the regions that were contributing the most to GDP inequality were Algarve, Madeira and Azores. The regions that contributed the least to inequality during this period were North, Centre and Lisbon and the Tagus Valley. The regions that are contributing the least are catching up with respect to Europe and the ones that are increasing

---

<sup>18</sup> There are some regions that have positive and some negative between Theil. Thus some regions are contributing to greater inequality and some others are indeed reducing it.

inequality are lagging behind. It seems that the transfer of funds from other European nations through the assistance funds has been successful at reducing inequality with respect to Europe. This positive aspect of redistribution has not necessarily reduced regional inequality with respect to Portugal. This suggests that there may be some kind of agglomeration forces and increasing return to scale operating in Portugal. Furthermore, the correlation between the final sorting and the co-payment for each region is positive, which means that a stronger financial commitment of the regions will lead to a higher contribution to inequality. Similarly, a higher amount of resources received from Brussels tends to be associated with regions that tend to decrease inequality.

Finally, if we compare industrial and GDP inequality measures we find some common experiences. We recall that wage Theil is derived from wages in the 16 sectors included in NACE and NACE-CLIO, while GDP Theil captures the productivity of industrial and non-industrial segments of the economy. For the regions of Spain we find Basque Country, Catalonia, and Madrid have the highest national Theil components for both GDP and wages, while Andalucia, Galicia, Extremadura and Castilla la Mancha have the lowest Theil component in both indices. In the case of Portugal, Lisboa is also the highest in both, while North and Centre are the lowest. There is a group of regions however – Comunidad Valenciana, Rioja, Islas Baleares, and Algarve – that have a positive GDP Theil component and a negative Theil wage component. This means that the non-industrial sectors are driving the economies of this particular group. On the other hand, we find Castilla & Leon with a positive wage Theil component but a negative GDP Theil component. This means that in terms of wages, Castilla & Leon is contributing to inequality from above but in terms of GDP it is contributing from below. The favorable labor market conditions, in terms of wages, are not translated into the productive sector for this particular region.

Why have regional development funds not been more helpful in reducing inequalities among the Iberian regions? Several explanations have been advanced in the literature. One possibility is that the agglomeration forces at work may be so powerful that giving a small advantage to a poor region will not alter the stability mechanism, see Krugman (1991) and Faini (1983). A second explanation is that in Spain and Portugal the most important part of EU funds (40 per cent) has been used to finance new transportation infrastructures, its gap in infrastructure endowments with other EU members being even larger than the per capita income.

An alternative possibility is that rich regions are able (through leveraging) to triple or quadruple the amount of regional funds allocated by the Commission in the financing of a particular project, see Fayolle and Lecuyer (2000) and Dall'Erba (2003). As a result, the total amount of investment in some rich regions may be much higher than in poor ones. Finally, the last potential explanation for divergence in regional economic performance may be the physical differences in locations, as Parker (2000) has suggested: focusing more on spatial correlations on performance measures of economies that share the same latitude and political system than on the correlation of performance measures of the economies of regions that are physically proximate. The physical differences in rich and poor regions of the same country may be important.

## Challenges of the Current Funding System

Even though the economic agents responsible for supplying the funds - the Council, the Commission, and European Parliament - benevolently try to achieve the most efficient mechanism to redistribute the available funds, they must unfortunately confront the fact that people are rational agents that respond to incentives and who in many cases, will not necessarily act in good faith but rather in self-interest.

A large body of literature in economics has been devoted to understand how to efficiently allocate limited resources when there are potential sources of asymmetry of information between the principal and the agent. In our case the principle is the Council, the Commission, and European Parliament, and the agent is the recipient of the funds. These problems can be classified as moral hazard or post-contractual problems, and adverse selection or pre-contractual problems. These types of asymmetries of information are indeed crucial when studying the Structural and Cohesion Funds.

When deciding to allocate funds, the Commission often encounters a situation where one party cannot observe the quality of the projects of the other party.<sup>19</sup> This adverse selection problem is magnified when the future is uncertain. In this case neither party knows what the other party knows. This situation causes incentives for parties to distort what they know, thus differences in information held by the parties will matter. Parties have an incentive to conceal negative information; therefore potential projects with a lower return could drive out projects with a higher return.

Similarly, when allocating the funds we find situations where one party cannot observe the actions of the other; therefore the cost of complete contracting is prohibitive. The main cause of this type of problems is that one of the parties in the agreement has to make specific investments that are sunk. These sunk investments and sharing arrangements give rise to incentive conflicts. The presence of specific investments enables parties to behave opportunistically.<sup>20</sup>

The funds that are being redistributed across the European regions seem to suffer from both problems mentioned. On the one hand, the EU suffers from adverse selection since it is unable to recognize the good projects from the bad projects in the proposals submitted by the member states or regions, who might have personal interests in particular projects.<sup>21</sup> On the other hand, it also suffers from moral hazard problems. The Commission cannot adequately monitor the required completion of the agreed actions even though their payment mechanisms are tied to the completion of actions as they are fixed in annual installments. A first installment is fixed following the decision to adopt a program. Subsequent installments are based on the financing plan and the completion of actions. The same problem applies in this case: member states or regions are the parties responsible of monitoring and reporting the progress of programs to the Commission. The monitoring agencies are given guidelines to produce assessment and

---

<sup>19</sup> See Varian (1996) for further details.

<sup>20</sup> An investment is specific if it has more value in the relationship than the alternative use.

<sup>21</sup> Especially if there are personal gains attached to these projects.

evaluation reports without a third party overseeing the claims and facts of the reports.<sup>22</sup> Finally, regions eligible for funds are usually those with high inequality and ethnic polarization, which makes it even more likely that national and regional monitoring agencies may act in the interest of a particular class, ethnic group, or even on behalf of their own benefit and not in the interest of the region or nations. Once the project is completed, the monitoring agencies submit a certificate, ‘the certificate of expenditure’, to the Commission where this report specifies how the funds have been spent. These reports might seem helpful at first but they are problematic since they do not consider potential incentives to report truthfully.

### **Proposed Modifications to the Current Funding Mechanisms**

The debate on the forthcoming enlargement has mainly focused on implementing and managing the Common Agricultural Policy (CAP) and the Structural and Cohesion funds to the newly admitted Member States since most newcomers are eligible for financial aid. In order to avoid the potential misuse of money, the Commission needs to reform structural policies and the CAP. This potential misuse could be partially avoided if the Commission establishes a truly independent third party that would monitor and verify the different claims in the certificate as well as the different reports associated with every project. We propose a monitoring agency that has two separate entities. The monitoring agency would establish a reward system for the teams that find irregularities in the projects, specifying the penalties for falsified items in the certificate and establish a procedure for settling potential disputes.

The main objective of the first entity would be to monitor all the projects that have been funded, and would be formed by different teams of all the regions that have applied for funds and have not initially received them. These regional teams would be in charge of verifying the claims in the reports and the certificate. If they find irregularities in the certificate and/or other related documents, they should report their findings to the second entity. The regional teams that find irregularities should be rewarded. In particular, the Commission should increase the likelihood of the team’s region of obtaining funds in the future. On the other hand, the regions that had falsified the claims in the certificate would not be eligible for future funds.

The main objective of the second entity would be to review the findings of monitoring teams. This entity would also resolve any potential conflicts between the monitoring teams and the alleged falsified project. This entity should have members of all regions that are eligible to receive funds from the EU.

Finally, we propose the necessity of imposing a minimum co-payment percentage for all funded projects in order to improve efficiency in the allocation of limited funds. It should be mandatory that all projects have co-payments in order to reduce the incentives to overspend and misuse resources. These co-payments (by the regions) would be used to start the project while subsequent resources from the different funds would be given once a large fraction of co-payment is spent.

---

<sup>22</sup> Eight criteria specified in MEANS (*Methods d’Evaluation des Actions de Nature Structurale* MEANS) guidance document *Common Guide on Monitoring and Interim Evaluations*.

## Conclusions

In this paper we empirically examine how different regions in Spain and Portugal have been affected by the structural and cohesion funds within the industrial and labor market context. In particular, this study addresses the following questions: (i) have these funds reduced economic disparities among and within the different regions of the Iberian Peninsula? and (ii) what sectors of the economy in the Iberian Peninsula have benefited the most?

We find that wage inequality between the different regions in Spain and Portugal has increased after the assistance funds have been in place. In other words, regional differences in wage compensation between Spain and Portugal were smaller when the Iberian Peninsula did not receive any assistance funds. The distribution of wages for industrial workers has become more unequal in the Iberian Peninsula over the past decade. Especially all regions in Spain are more unequal relative to themselves after being recipients of the assistance funds in terms of their industrial wage compensation across sectors. Galicia, el Principado de Asturias, the Basque Country, Madrid, Catalonia, Balearic Islands, Andalucia and the Canary Islands have more than doubled their wage inequality. Workers in these regions are thus facing the greatest wages differentials in Spain. A similar experience is observed in Portugal.

A common trend is observed in Spain and Portugal. The industrial sectors that have reduced the inequality the most have been in the service industries. This overall trend in Spain and in Portugal may suggest how the Iberian Peninsula is slowly moving towards a service oriented economy. As the Iberian Peninsula becomes more integrated into the European Union, competition in the industrial sectors has increased. As a result of this new externally driven competition, less efficient sectors are growing slower. In particular, if the service industries are growing at a faster rate then they will need to attract more workers by offering higher wages relative to other industrial sectors. The data suggests that the comparative advantage of Spain and Portugal is in the service industries since they are the ones that are growing the fastest. Assistance funds in Spain and Portugal may have been playing a catalyst role in the industrial and labor market transformation of the Iberian economy.

At a more aggregated level GDP inequality between the different regions in Portugal has decreased but has increased in the case of Spain. Similarly, the contribution of other member states through the assistance funds, have helped reduce GDP inequality of the Iberian Peninsula with respect to the European average.

Finally, the data suggest some sort of agglomeration forces and increasing return to scale operating in the Iberian Peninsula. Regions from the Iberian Peninsula with a higher GDP per capita tend to contribute the most in wage inequality. Regions with lower GDP per capita tend to reduce inequality the most with respect to Europe. Furthermore, not all regions are catching up with Europe at the same rate and not all regions within the Iberian Peninsula are becoming more similar to each other. The fact that we can observe some asymmetries with respect to the speed of convergence in wages among regions suggests that the impact of the assistance funds in these regions may exacerbate the differences among regions. Thus regions that can potentially grow faster might attract more resources from other industries and from other regions and make their

gap even greater. As a result, the wage distribution among industrial workers within the Iberian Peninsula has become more unequal and skewed.

## Bibliography

- Bean, C., Bentolila, S., Bertolli, S. and Dolado, J. (1998) "Social Europe...one for all" *Monitoring European Integration* 8, Centre for Economic Policy Research.
- Boldrin, M. and Canova, F. (2001) "Inequality and convergence: Reconsidering European regional policies" *Economic Policy*, 32, 207-253.
- Bosca, J., Domenech, R. and Taguas, D. (1999) "La política fiscal de la unión económica y monetaria" *Moneda y Crédito*, 206, 267-324.
- Conceição, P. and Galbraith, J. (2000) "Constructing long and dense time-series of inequality using the Theil index" *Eastern Economic Journal*, Winter, 61-74.
- Dall'Erba, S. (2003) "Distribution of regional income and regional funds in Europe 1989-1999: An explanatory spatial data analysis" *Discussion Paper REAL 03-T-01*, University of Illinois at Urbana-Champaign.
- Delors, J. (1989) Report on Economic and Monetary Union in the European Community, report to the European Council by a Committee chaired by J. Delors, Brussels Commission of the European Community.
- European Commission. (1991) Fourth Periodic Report on the Social and Economic Situation and Development of the Regions of the Community, Brussels, Commission of the European Communities, July.
- European Commission. (1994) Fifth Periodic Report on the Social and Economic Situation and Development of the Regions of the Community, Brussels, Commission of the European Communities, July.
- European Commission. (1996) First Cohesion Report, Brussels, Commission of the European Communities, November.
- European Commission. (1999) Sixth Periodic Report on the Social and Economic Situation and Development of the Regions of the Community, Brussels, Commission of the European Communities, February.
- Faini, R. (1983) "Cumulative process of deindustrialization in an open region: the case of Southern Italy: 1951-1973" *Journal of Development Economics*, 12, 277-301.
- Fayolle, J. and Lecuyer, A. (2000) "Croissance régionale, appurtenance nationale et fonds structurels Européens, un bilan d'étape" *Revue de l'OFCE*, 73, 165-196.
- Garcia, J. and Maria-Dolores, R. (2001) "The impact of European structural funds on economic convergence in European countries and regions" in *Convergence in the European Union*. Edited by Meeusen, W. and Villaverde, J. Edward Elgar Publishing, U.K.

- Krugman, P. (1991) "Increasing returns and economic geography" *Journal of Political Economy*, 99, 483-499.
- Obstfeld, M. and Peri, G. (1998) "Regional non-adjustment and fiscal policy." *Economic Policy*, 26, 207-247.
- Romer, P. (1986) "Increasing returns and endogenous growth." *Journal of Political Economy*, 94, 1002-1037.
- Romer, P. (1990) "Endogenous technical change." *Journal of Political Economy*, 98, 71-102.
- Parker, P. (2000) *Physioeconomics: The Basics for Long-Run Economic Growth*. MIT Press, Cambridge.
- Varian H. (1996) *Intermediate Microeconomics: A Modern Approach*, Norton & Company, New York.

## **Appendix A - Objectives of Structural & Cohesion Funds**

### **Structural Funds**

#### **Objective 1:**

Geared towards regions with an income below 75% of the EC average in order to promote the development and structural adjustment of regions whose development is lagging behind. It encompasses four Funds: ERDF, ESA, EAGGF, and the FIG. Beneficiary regions include all of Greece, Ireland, Northern Ireland, Portugal, most of Spain, the Mezzogiorno, the overseas departments and Corsica (in the post 1993 period the new Eastern German Lander are also included).

#### **Objective 2:**

Programmes are geared to converging regions that are affected by industrial decline. Its eligibility is linked to an unemployment rate above the community average, a percentage share of industrial employment exceeding the community average, and a decline in this employment category.

#### **Objective 3:**

Focuses on long term employment and facilitates integration into the working life of young people and those excluded from the labor market. Financed by the ESF.

#### **Objective 4:**

Facilitates adaptation of workers to industrial changes and changes in the production systems. Draws from the ESF.

#### **Objective 5:**

*Objective 5a*, geared to regions in need of adjustment of their agricultural structures and facilitates structural adjustment of the fisheries sector. Funded by the EAGGF and FIG.

*Objective 5b*, aimed at development and structural adjustment of rural areas - eligible areas are those having a low level of socioeconomic development. Draws on the ERDF, the ESF, and the EAGGF.

#### **Objective 6:**

Geared to promote the development of regions with an extremely low population density. Draws from the ERDF, ESF, EAGGF, and the FIG.

### **Cohesion Funds**

Operates outside of the Structural Funds. Created to support environmental and transport projects for these member states having a per capita less than 90% of the EU average. Recipient member states are Greece, Spain, Portugal and Ireland

## **Appendix B - Data Sources**

Data to calculate the Theil statistic is drawn from two sources: ESA-79 and ESA-95. The regional classification is broken down by Nomenclature of Territorial Units for Statistics (NUTS) at level 2.

ESA 79 includes data from the years 1986-1994 and ESA-95 includes from 1995-1998

Compensation data equals wages and salaries + employer's social contributions + employer's actual social contributions + employer's imputed social contributions

Sectors for ESA-79 include: Fuel and power products - Ferrous and non-ferrous ores and metals, other than radioactive - Non-metallic minerals and mineral products - Chemical products - Metal products, machinery, equipment and electrical goods - Transport equipment - Food, beverages, tobacco - Textiles and clothing leather and footwear - Paper and printing products - Products of various industries - Building and construction - Recovery, repair, trade, lodging and catering services - Transport and communication services - Services of credit and insurance institutions - Other market services - Non-market services

Sectors for ESA-95 include: Agriculture, hunting and forestry – Fishing - Mining and quarrying – Manufacturing - Electricity, gas and water supply – Construction - Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods - Hotels and restaurants - Transport, storage and communication - Financial intermediation - Real estate, renting and business activities - Public administration and defense; compulsory social security – Education - Health and social work - Other community, social, personal service activities - Private households with employed persons.

## Appendix C – Calculating the Theil Statistic

The Theil statistic is composed of two elements a between group inequality component and a within group inequality component. The sum of the two equals the total Theil thus:

$$T \equiv T_B + \overline{T_w} \quad (1)$$

where:

$T$  = Total Theil

$T_B$  = Between group Theil component

$\overline{T_w}$  = Within group Theil component.

The between group component can be represented by the following two equations:

$$T_B = \sum_{i=1}^n \left( \frac{w_i}{\sum_{i=1}^n w_i} \right) \bullet \ln \left[ \frac{w_i / \sum_{i=1}^n w_i}{e_i / \sum_{i=1}^n e_i} \right] \quad (2)$$

$$T_B = \sum_{j=1}^n \frac{e_j}{\sum_{j=1}^n e_j} \frac{\overline{w}_i}{\overline{w}_Y} \ln \left( \frac{\overline{w}_i}{\overline{w}_Y} \right) \quad (2)'$$

The within group component equals:

$$\overline{T_w} = \sum_{i=1}^n \left( \frac{w_i}{w} \right) \bullet T_w \quad (3)$$

$$T_w = \left( \frac{w_{ij}}{w_i} \right) \bullet \ln \left[ \frac{w_{ij} / w_i}{e_{ij} / e_i} \right] \quad (4)$$

If we index regions with the subscript  $i$  and sectors with the subscript  $j$  then

$w_{ij}$  = the total compensation received in region  $j$  and sector  $i$

$e_{ij}$  = total people employed in region  $j$  and sector  $i$

$\overline{w}_i$  = average income of region  $i$

$\overline{w}_Y$  = average income of all regions

**Appendix D – Proof of equivalence between equation (2) and (2)'**

We want to show:

$$T_B = \sum_{i=1}^n \frac{e_i}{\sum_{i=1}^n e_i} \frac{\bar{w}_i}{\bar{w}_Y} \ln\left(\frac{\bar{w}_i}{\bar{w}_Y}\right) = T'_B = \sum_{i=1}^n \left( \frac{w_i}{\sum_{i=1}^n w_i} \right) \bullet \ln \left[ \frac{w_i / \sum_{i=1}^n w_i}{e_i / \sum_{i=1}^n e_i} \right]$$

let

$$\bar{w}_i = \frac{w_i}{e_i} \quad \text{and}$$

$$\bar{w}_Y = \frac{\sum w_i}{\sum e_i}$$

we have:

$$T_B = \sum_{i=1}^n \frac{e_i}{\sum_{i=1}^n e_i} \frac{\frac{w_i}{e_i}}{\frac{\sum w_i}{\sum e_i}} \ln \left( \frac{\frac{w_i}{e_i}}{\frac{\sum w_i}{\sum e_i}} \right) =$$

$$T_B = \sum_{i=1}^n \frac{e_i * w_i * \sum e_i}{\sum_{i=1}^n e_i * \sum w_i * e_i} \ln \left( \frac{w_i * \sum e_i}{e_i * \sum w_i} \right) =$$

$$T_B = \sum_{i=1}^n \frac{w_i}{\sum w_i} \ln \left( \frac{w_i / \sum_{i=1}^n w_i}{e_i / \sum_{i=1}^n e_i} \right) = T'_B$$

(QED)