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The macro-environment for liquid biofuels in the US mass media, science and government[1]

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Abstract

In this paper we analyse the alignment between US mass media news, scientific publications and official government documents regarding the macro-environment configuration for liquid biofuels and its correlations with the ethanol production in the United States. Text mining procedures and techniques were applied to a set of 2,016 mass media news, 455 scientific papers and 854 governmental documents from 1997 to 2006. The results suggest that US public policies for the liquid biofuels sector is more aligned to the scientific knowledge than to the journalistic texts. However, this pattern seems to be changing along the time, with the alignment between public policies and mass media contents presenting a convergent tendency.

Key-words: Bioenergy, Strategic Planning, Business Environment, Environmental Scanning, Text Mining, Macro-environmental Dimensions.

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1. Introduction

The economic interest for renewable fuels production and consumption has increased considerably in the last decade. In the liquid biofuels field, the main interest is being driven to biodiesel and ethanol production and consumption. Therefore liquid biofuels has become a new opportunity for investment allocation. Biodiesel and ethanol production has risen worldwide, mainly in United States, Brazil, Germany, France, Italy and Spain (IEA, 2006). In the United States, ethanol production has been strongly supported by government. From 2000 to 2009 the US ethanol production has expanded from 54 to 170 biorefineries online, which increased the production capacity from 1,748 to 10,569 million gallons per year (RFA, 2009). The US ethanol production capacity more than five-folded in the last ten years.

That means that the liquid biofuel businesses are attracting more and more investments along the production chain, from farmers to processors and distribution stages. So that the decision makers of the US liquid biofuels sector and outside of it might want to scan the industry macro-environment properly as a way to support their strategic planning and the decision making. The macro-enviromental scanning is a first and important stage in the strategic planning process through which the decision makers would look out for the patterns and changes in the industry environment as a way to gather informations which help them in the decision making process (Johnson et al., 2008; Grant, 2008; Wheelen and Hunger, 2008; Thompson et al., 2009; David, 2009).

The macro-environment for a specific industry or sector affects the businesses once it may be configured through the interaction between a wide range of stakeholders, mainly policy-makers, scientists and journalists, along the public and the industry/sector actors. As a new field of interest and investments, the liquid biofuels sector demands for a set of particular public policies to regulate, to create incentives and/or to put some restrictions on it. In such a case, the US government can be seen as an important player in the liquid biofuels macro-environment configuration (Yacobucci, 2007; Talamini et al., 2009; Tilman et al, 2009). Scientists can influence the macro-enviroment configuration by their interaction with policy-makers and journalists, suggesting a new set of public policies accordingly to their scientific findings (Jasanoff, 1987; Sabatier, 1991; IPCC, 2004; Kalil, 2006; Nature, 2007). On the other hand, journalists have powerful influence on public and on policy-makers and so they are able to contribute for the macro-environment configuration as well (Gamson and Modigliani, 1989; Strömberg, 2001, 2004; Moirand, 2003; Kim, 2007).

Taking into account that, firstly, the liquid biofuels industry in US has been attracting many investments, and new opportunities in this sector are latent; and, secondly, the description of the macro-enviroment configuration of such a sector is relevant for decision makers in deciding whether or not to be part of it, this paper aims to answering the following questions: under which dimensions journalists, scientists and policy-makers have been configuring the macro-environment for liquid biofuels in US? When scanning for the macro-environment for liquid biofuel in US, should the decision-makers pay more or any attention on the mass media events,

on the scientific knowledge or on the public policies? How do the investments and the liquid biofuels production in US react to the mass media, science and government agendas?

Objectives:

- To scan the macro-environment for liquid biofuels in US from mass media news, scientific publications and government official documents;
- To identify the dimensions under which journalists, scientists and policy-makers have configured the macro-environment for liquid biofuels in US;
- To check for the alignment between US mass media, science and government in configuring the macro-environment for liquid biofuels; and,
- To correlate the number of publications from US mass media, science and government with investments in the sector and liquid biofuels production.

Following this introduction, the next section presents a brief description of US liquid biofuels sector, presenting some data about the biofuels production and investments. Regarding its relative importance, more attention is addressed to the ethanol industry. In the third section the methods and procedures are described. The main findings are shown and analyzed in the fourth section, which is followed by conclusions and recommendations.

2. The US liquid biofuels industry and policy

The history of liquid biofuels production around the globe is closed related to the oil price levels. When the oil price arose in the middle 1970s renewable fuels were introduced as a possible alternative. Some years later, with the oil prices returning to lower levels, a desinvestment in renewable fuels production was observed while US and Brazil have maintained investments in biofuels production, especially of ethanol. In the last decade, however, liquid biofuels became a worldwide hot topic again. In US ethanol has been more important than biodiesel taking into account its production and the prospects defined by the Energy Act 2007 (Hoekman, 2009).

Some argue that this new surge in the liquid biofuels production is a result of environmental issues, but according to Tyner (2008) the liquid biofuels production in US, specially ethanol, increased in the last years by a set of economic and political phenomena, like the rise of oil prices, subsidies, corn supply, corn price, ethanol price and/or geopolitical reasons, like the dependency of foreign oil, as stated by Bush (2003) and the RFA (2009), and also environmental ones (RFA, 2007).

One can affirm that the ethanol is a product of politics and that the US government and its public policies regarding ethanol are the causes of the increased production of such renewable fuel. Agreeing with such line of thought, the Table 1 shows a historical view of US ethanol legislation. Along the last thirty years of ethanol legislation it is possible to point out a subsidy-based policy from US government to the ethanol sector. Besides the subsidies, the inclusion of ethanol in the US energy agenda in the last decade is a clear incentive to investments in ethanol production. It is

apparent that biodiesel is a less important source of renewable fuel in US. In a total of 36 billion gallons of renewable fuels projected by the Energy Independence and Security Act of 2007, just one billion gallons are biodiesel (less than 3%). Tyner and Taheripour (2007) suggested that US biofuel policies need to be better analized regarding the possibilities and consequences of incentives like subsidies. Khanna et al. (2008) argue that, although the support to ethanol production has been invoked in the name of many current policy concerns, including national security, farm income security, and climate change, the ethanol subsidy has the potential to increase carbon emissions and lower social welfare, among other negative consequences.

Table 1 - History of ethanol subsidy legislation in US

Year	Legislation	Description
1978	Enrgy Tax Act of 1978	$0.40 per gallon of ethanol tax exemption on the $0.04 gasoline excise tax.
1980	Crude Oil Windfall Profit Tax Act and the Energy Security Act	Promoted energy conservation and domestic fuel development.
1982	Surface Transportation Assistance Act	Increased tax exemption to $0.50 per gallon of ethanol and increased the gasoline excise tax exemption to $0.09 per gallon.
1984	Tax Reform Act	Increased tax exemption to $0.06 per gallon.
1988	Alternative Motor Fuels Act	Created research and development programs and provided fuel economy credits to automakers.
1990	Omnibus Budget Reconciliation Act	Ethanol tax incentive extended to 2000 but decreased to $0.54 per gallon of ethanol.
1990	Clean Air Act amendments	Acknowledged contribution of motor fuels to air pollution-oxygen requirements for motor fuel.
1992	Energy Policy Act	Tax deductions allowed on vehicles that could run on E85.
1998	Transportation Efficiency Act of the 21st Century	Ethanol subsidies extended through 2007 but reduced to $0.51 per gallon of ethanol by 2005.
2004	Jobs Creation Act	Changed the mechanism of the ethanol subsidy to a blender tax credit instead of the previous excise tax exemption. Also extended the ethanol tax exemption to 2010.
2005	Energy Policy Act	Established the renewable fuel standard starting at 4 billion gallon in 2006 and rising to 7.5 billion in 2012. Eliminated the oxygen requirement for gasoline, but failed to provide MTBE legal immunity.
2007	Energy Independence and Security Act of 2007	Established a renewable fuel standard totaling 36 billion gallons (1 billion biodiesel) by 2022.

Source: adapted from Tyner (2008, p.647)

The macro-environment for liquid biofuels as configured by US government seems to be positive for the expansion in the liquid biofuels industry, putting more emphasis on dimensions related to economic, environmental and energy. This encouraging environment might have been decisive in attracting new investments to the sector, which have resulted in new biorefineries and an increase in the ethanol production capacity. In fact, the data presented on the Table 2 shows that US public policies from 2004 (Jobs Creation Act), 2005 (Energy Policy Act) and 2007 (Energy Independence and Secutrity Act) were efficient in promote the ethanol sector. From 2004, when Jobs Creation Act has passed, the biorefineries sizes have enlarged significantly which may imply more jobs. Since 2005, when the Energy Policy Act was launched, the number of new ethanol refineries in US increased more than in the previous years, as showed in the Table 2. Such set of public policies was decisive to the fact that the number of ethanol refineries more

than three-folded along the ten-year period. As a consequence, the ethanol production capacity increased, but more than proportionally, confirming the enlargement in the plants size.

Table 2 - US ethanol industry expansion

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Biorefineries Online	54	56	61	68	78	81	95	110	139	170
Capacity (mgy)	1,748.7	1,921.9	2,347.3	2,706.8	3,100.8	3,643.7	4,336.4	5,493.4	7,888.4	10,569.4
Refineries capacity (mgy/biorefinery)	32.38	34.32	38.48	39.81	39.75	44.98	45.65	49.94	56.75	62.17

Source: adapted from RFA (2009)

Another aspect of investments in the US ethanol industry is the spatial distribution of new plants. The Figure 1 shows the geographical location of ethanol plants throughout the US in 2002 (a) and after the ethanol boom, in 2008 (b). Although the main allocation of investments continues to be driven to the Center-West Region, close to the Corn Belt, in 2008 it was possible to see that some new plants were under construction in other North-American States, where there were not refineries before.

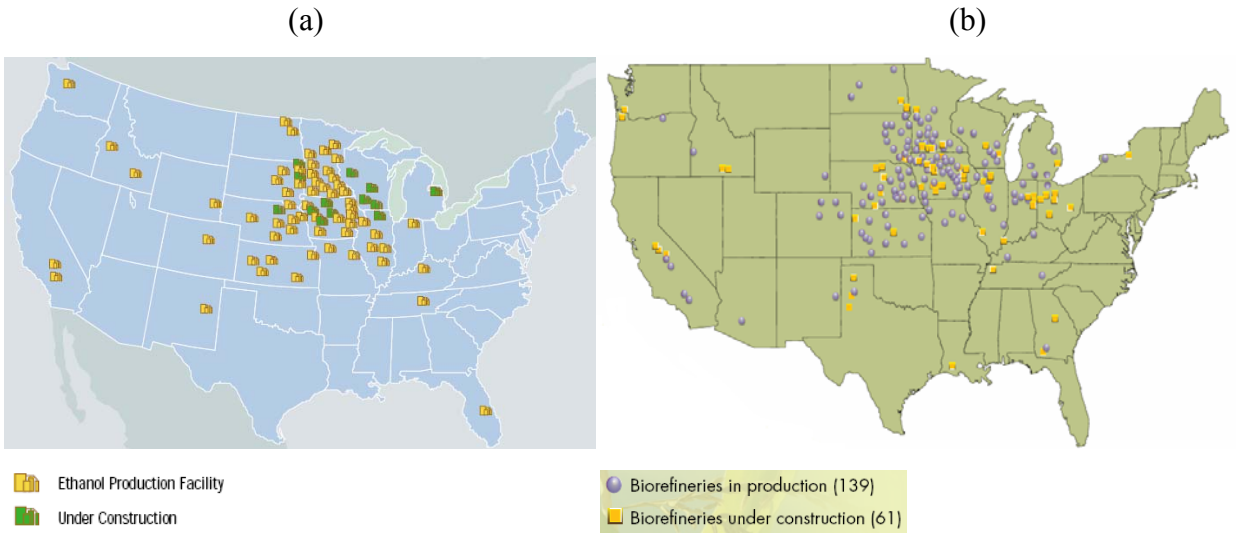

Figure 1 - US Ethanol Biorefinery Locations – 2002 (a) and 2008 (b)
Source: RFA (2002, 2008)

In face of the increasing number of ethanol refineries and its spatial distribution, a problem can be pointed out in the US ethanol industry. According to Koplow (2006), the US ethanol industry has historically been very concentrated, with a handful of large firms controlling most of the production capacity. In 1990, the largest firm, Archer Daniels Midland (ADM), owned 55 per cent of total ethanol production capacity, with 13 firms in the industry overall. Although the industry concentration has dropped in the last years (in 2004 ADM owned 43 per cent of ethanol production), the problem is in the market and related to the political power of a group of firms in influencing public policies and market practices. As the key-actors in the US ethanol production chain, such firms can appropriatte a large share of the subsidies provided by US government.

Meanwhile, as a consequence of the growth in the number of refineries and in the installed capacity, the US ethanol production rose. Figure 1 presents the US ethanol production from 1980, when the production was not greater than 175 million gallons, to 2008, with a projected production of 9 billion gallons. Further, the US ethanol production changed dramatically in the last six years. Along this period, the production almost three-folded. Such data can reflect the government incentives offered to the ethanol industry.

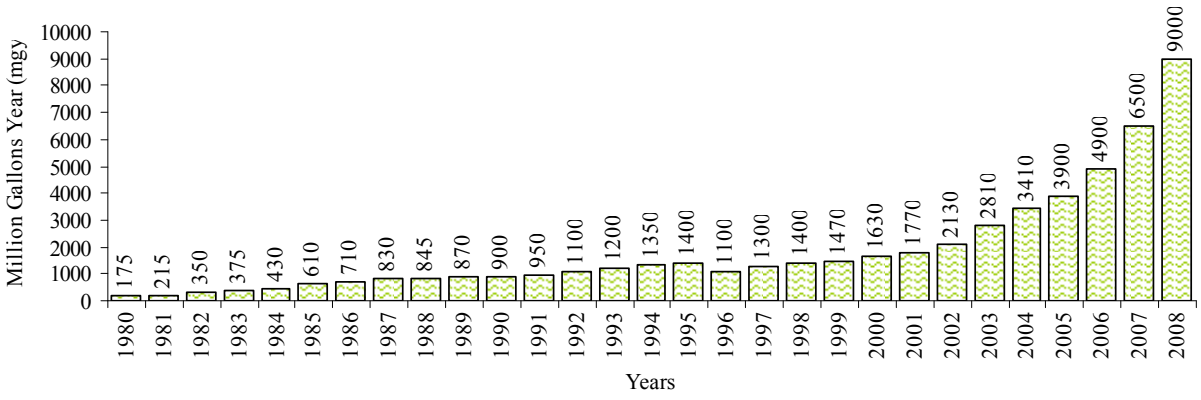

Figure 2 – US ethanol production
Source: RFA (2009)

Inspite of the increase in ethanol refineries, capacity and production, the US ethanol sector presents others interesting aspects relevant for the North-American economy. According to RFA (2009), ethanol represents about 9% of US gasoline supply, a value close to the 10% recommended by US government in 1979. Ethanol market could expand very fast with the production of Flex Fuel Vehicles - FFVs. Today, just 3% of US vehicles are FFVs. More FFVs leads to more gas station selling E85. Currently, there are just about 2000 gas stations selling E85. The largest part of the fuel used by North-American cars is E10. In 2008 the US ethanol industry contributed with 494,177 jobs; US$65.6 billion to the GDP; US$20 billion to householders; and generated a US$20.7 billion of tax revenue.

3. Methods and Procedures

In order to scan the macro-environment for liquid biofuels in US, a documental analysis of mass media news, scientific papers and government official documents was accomplished by using Text Mining techniques and procedures (Hippner and Rentzmann, 2006). The United States was chosen as the geopolitical space for our analyses because it became the biggest ethanol producer around the globe and investments in new plants and the ethanol production continues rising up.

The documents were selected by using a list of key-words (see Figure 3) representative of the "liquid biofuels" subject, considering the frequency of their occurrence in the literature dealing with matters related to bioenergy, biobased economy and biofuels.

BIOFUEL, BIOFUELS, BIO-FUEL, BIO-FUELS, BIODIESEL, BIO-DIESEL, ETHANOL, BIO-ETHANOL, BIOETHANOL, BIO-OIL, ALCOHOL

Figure 3 – Key-words related to liquid biofuels.
Source: prepared by the authors

The stated key-words were used to search and trace mass media news, scientific papers and governmental documents in US. The searching for governmental documents was conducted from the main US government website (http://www.usa.gov). From this one other websites of Ministries, State Secretariats, Departments and Self-Governing Entities were visited. Using the search engines available in the related homepages, the documents were located and gathered. It is important to note that the information available in "Press Room" sections of searched sources was excluded from consideration. In this way the impact of ordinary political discourses was minimized, and the search was focused on documents that were representative of the official policies and programs of the US government. Scientific papers were searched in the Web of Science database (http://www.webofknowledge.com). From the list of papers found using the liquid biofuels key-words were selected those, written by authors affiliated to US institutions. For representing the mass media sources, three important North-American newspapers were chosen: *The New York Times* (http://www.nytimes.com), *The Washington Post* (http://pqasb.pqarchiver.com/washingtonpost), and *The Wall Street Journal* (http://online.wsj.com/public/us). Search engine was used to retrieve the news from newpapers archives.

The search and collection of documents, and the construction of the preliminary database began on the first week of February 2007, and were completed by the last week of June 2007. The ten-year period 1997-2006 was analyzed. The documents were stored in three different textbases: mass media, science and government. By the end of this process the databases were composed by 2,016 mass media news, 468 scientific papers and 865 governmental documents, totaling 3,349 documents (Figure 4).

In the following step, the electronic contents of the documents were transferred into a specific document base built with the aid of the QDA Miner® software, preparing the documents for subsequent application of the Text Mining process. As QDA Miner® uses Rich Text Formats (*.RTF) to build the database while most documents were collected as PDF-formats with their content blocked, 13 scientif papers and 11 government documents were lost. Therefore, the final composition of the database was made up of 2,016 mass media news, 455 scientific papers and 854 governmental documents, totaling 3,325 documents.

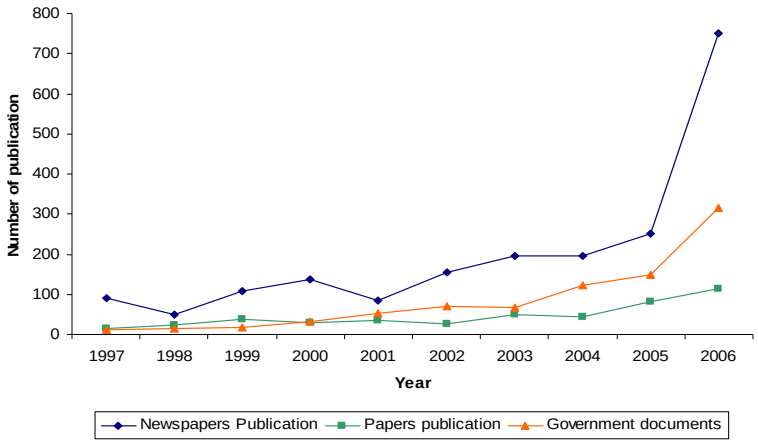

Figure 4 – Number of publications on biofuel gathered from US mass media, science and government
Source: research data

In order to discovery the knowledge contained in the files, it was necessary to build an analytical structure (dictionary) capable of extracting the relevant information, because there is no unique and specific method applicable to this analysis. A list of words is often used for this purpose, as seen in Vincent (2006), Crawley (2007) and Singh et al. (2007). The first step to build the specific structure is associated to the definition of the macro-environmental dimensions. According to the literature on macro-environmental analysis, the most frequently used dimensions are those related to the PESTEL acronym, i.e., Political, Economic, Sociocultural, Technological, Environmental and Legal (Walsh, 2005; Johnson et al., 2008). The number of dimensions and their denominations vary from one study to another, depending on the specific interest, the studied macro-environment and/or the activity focused, allowing for some flexibility. Considering the specific characteristics of this search, the agronomical and geopolitical dimensions were included, and the sociocultural dimension was split up, thus totaling nine macro-environmental dimensions to be explored: Agronomical, Cultural, Economic, Environmental, Geopolitical, Legal, Political, Social, and Technological.

After the macro-environmental dimensions were established, the following step was to identify the set of key-words representative of each dimension, which will be referred to here as "dimension-words" or "*d-words*". The set of "*d-words"* is made up of relevant terms that best discriminate a certain macro-environmental dimension. Therefore, nine macro-environmental dimensions imply nine different lists of "*d-words*". At this point, the core issue was: how to identify the set and number of "*d-words*" for each dimension? Which and how many "*d-words*" would discriminate the economic dimension, for example?

Firstly, in order to determine the set of "*d-words*" for each of the nine dimensions, the words were identified that occurred more frequently in academic journals in each of the knowledge fields, associated with a specific macro-environmental dimension. For the purpose, a number of academic journals with high Impact Rates were selected. For instance, the following journals were selected for the economical dimension: *Quarterly Journal of Economics* (Impact rate 3.938), *Review of Economic Studies* (2.000), *Oxford Economic Papers* (1.132), *Journal of Economic Theory* (1.046), and *Cambridge Journal of Economics* (0.571). From each journal one issue was randomly selected from the volumes of the following years: 1998, 2000, 2002, 2004

and 2006. This covers a period equivalent to the stated research period (1997-2006). The same criteria and procedures were used for each of the other macro-environmental dimensions.

Titles, abstracts and key-words were collected from all published scientific articles in the selected issues. The contents of these text elements were transferred onto a textbase prepared with the aid of the QDA Miner® software. Next, by using the WordStat module of SIMStat®, a counting of words was obtained, as well as their frequency and the TF*IDF[2] rate. The resulting list with thousands of words was displayed in descending order of the TF*IDF Rate. It indicates the decreasing relevance of the words in the scientific documents published in academic journals of the knowledge fields related to the respective macro-environmental dimensions (Aizawa, 2003; Jing et al., 2002).

Secondly, the number of "*d-words*" under each dimension was determined applying the percentile measures on the list of all words, selecting the number of "*d-words*" that best discriminated each dimension. An average of 14.2 "*d-words*" was used for each dimension. For "*d-words*" that were common to two or more dimensions, rules were added to the knowledge analysis and extraction structure. The rules took into consideration the co-occurrence of terms within the same document. Jaccard's Coefficient was used for determining these rules (Chung and Lee, 2001). An example of "*d-words*" can be seen in the Figure 5.

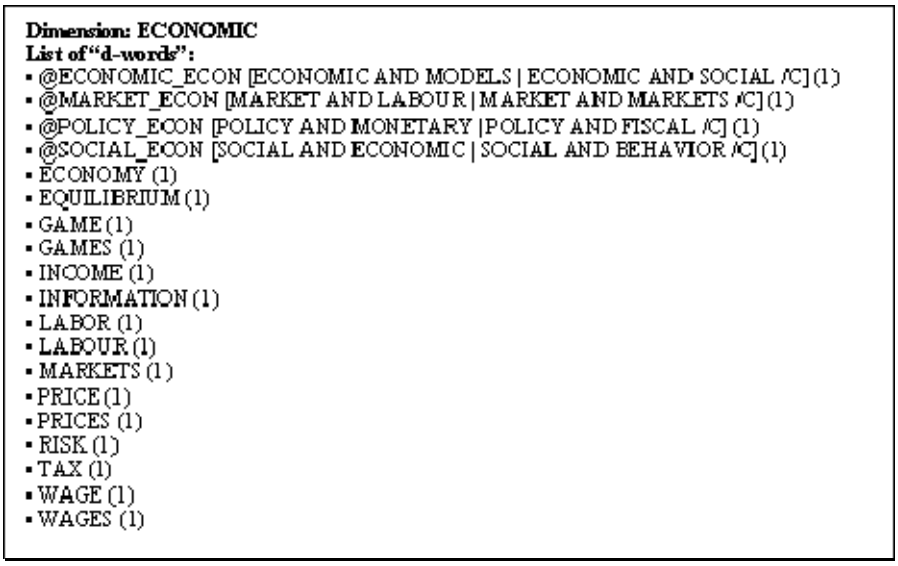

Figure 5 – "d-words" for the Economic Dimension
Source: obtained by authors by means of the research procedures

Text Mining was carried out by using the textbases in electronic format and the knowledge analysis and extraction structure were built from the macro-environmental dimensions and their respective "*d-words*". By using the WordStat module of SIMStat®, it was possible to count the frequency with which each "*d-word*" occurred in mass media news, scientific papers and governmental documents. Consequently the frequency is established by which each of the macro-

[2] TF*IDF = Term Frequency multiplied by Inverted Document Frequency.

environmental dimensions were used indicating the configuration of liquid biofuels macro-environment by the US journalists, scientists and policy-makers.

Finally, the frequencies of the occurrence of the macro-environmental dimensions were used for the analysis of the results. Based on the frequencies, adherence and homogeneity tests were conducted to verify the alignment between mass media, science and government. Pearson's coefficient was applied to analyze the correlation between the US mass media, science and government agenda, and the ethanol production.

4. Results and Discussions

The results obtained from text mining procedures have shown that some macro-environmental dimension occurred with no significant frequency in the US mass media, science and government documents. Therefore, those dimensions were excluded from the analysis.

The analysis of the macro-environmental dimensions expressed in the US mass media discourse, measured by its relative frequency, has shown the predominance of four main dimensions. The most frequent dimensions used by mass media when publishing news about liquid biofuels were the economical, environmental, geopolitical and political ones. Agronomical, cultural, legal, social and technological aspects of liquid biofuels production and consumption seem to be less relevant and were not included in this discussion. During the ten-year period the economical dimension was the most frequent dimension in six of the ten years, while the environmental dimension predominated in three years and the political dimension in one year (Figure 6). That is, when publishing news about liquid biofuels the US mass media have emphasized economical aspects.

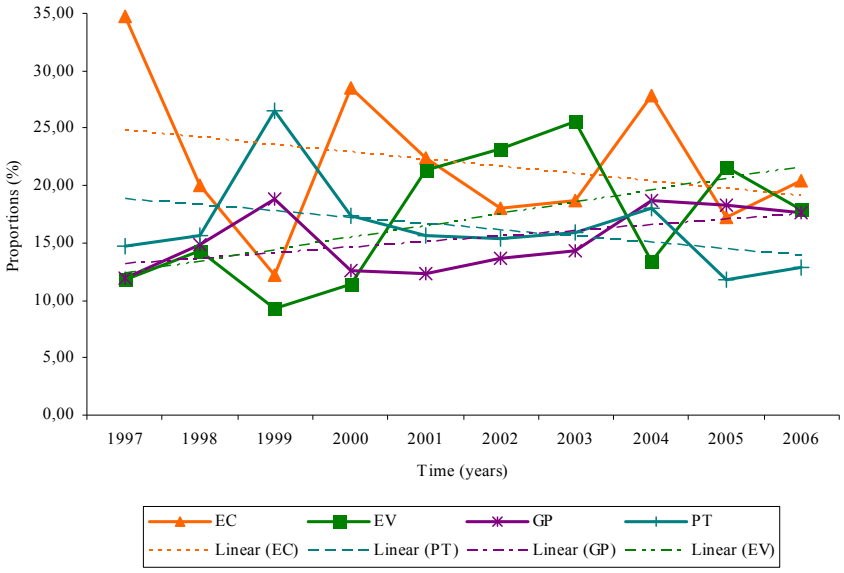

Figure 6 – Main dimensions under which the US mass media has been configured the macro-environment for liquid biofuels. Source: research data

Since 1997 economical dimension was the most frequent observed in the US mass media news in the years 1997, 1998, 2000, 2001, 2004 e 2006. The environmental dimension was the most frequent in the years of 2002, 2003 and 2005. Political aspects were the most relevant in 1999. Although the predominance of economical dimension along this period, the tendencies show a possible inversion in the relative relevance of macro-environmental dimensions on the mass media discourse. The lines of each dimension indicate that economics and political matters seem to have lost importance along the analyzed period of time, while the environmental and geopolitical aspects related to liquid biofuels seem to be gaining power in the mass media discource. Regarding the geopolitical aspects it is important to note the increasing relative importance of such dimension since 2001. Environmental aspects have grown from 1999 on. During the time one can notice that the amplitude of the frequencies of the dimensions has decreased. That is, no specific dimension dominates the mass media discourse.

In the US science, on the other hand, the environmental, agronomical and technological were the three main dimensions used by North-american scientists in their scientific papers on liquid biofuel. A widely predominance of the environmental dimension along the ten-year period was found, followed by the technological and agronomical ones, which for a while alternated as second and third most frequently used dimension. In the last four years of time series analyzed the agronomical dimension overcame the technological dimension as the second main dimension used by US scientists when writing about liquid biofuels matters (Figure 7). Given the lower relative presence in the scientific discourse, the results regarding the cultural, economical, political, geopolitical, legal and social dimensions were not considered in the US science analysis.

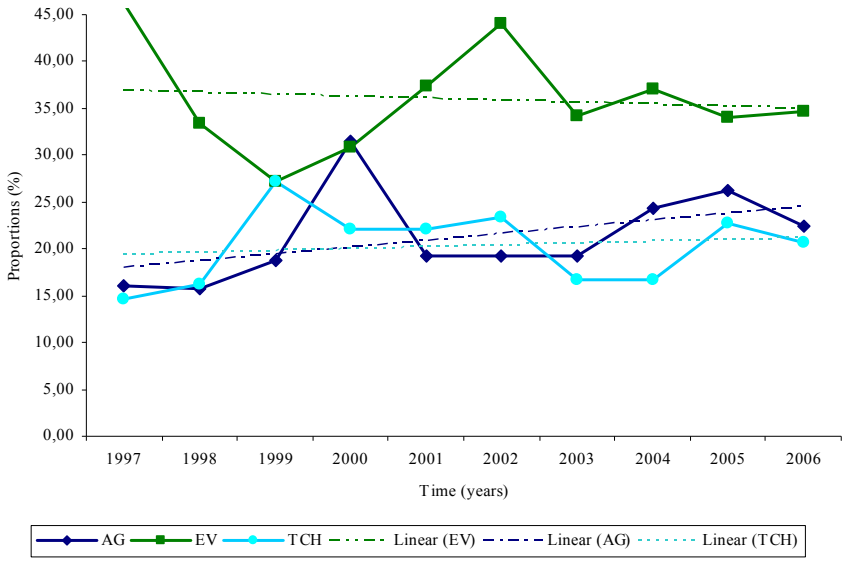

Figure 7 – Main dimension under which the US science has configured the macro-environment for liquid biofuels. Source: research data.

In spite of their wide dominance, the trend line along the period is indicating that environmental aspects of liquid biofuels are losing its relative importance in the science discourse. On the other side, the trend line of agronomical aspects indicates an increasing importance of such matters in the scientists' agenda, while the trend line of technological dimension appears to be constant along the period. Compared with the US mass media, the north-amercian science seems to be

more stable regarding the marco-environment configuration for liquid biofuels, maintaining its approach based mainly upon three dimensions with relative constant rate of occurrence along the time.

The findings suggest that the content of US government discourse is a fair composition derived from US mass media and from scientific discourse. Differently from mass media and science analysis, in the US government analysis one can not ignore the occurence of a larger set of dimensions used in configuring the macro-environment for liquid biofuels. The government approach includes all the main dimensions present in both sciencific papers and mass media news. The two main dimensions used by US policy-makers have been the environmental and technological, followed by the technological one at the first four years, and thereone dividing its importance with economical and geopolitical ones (Figure 8).

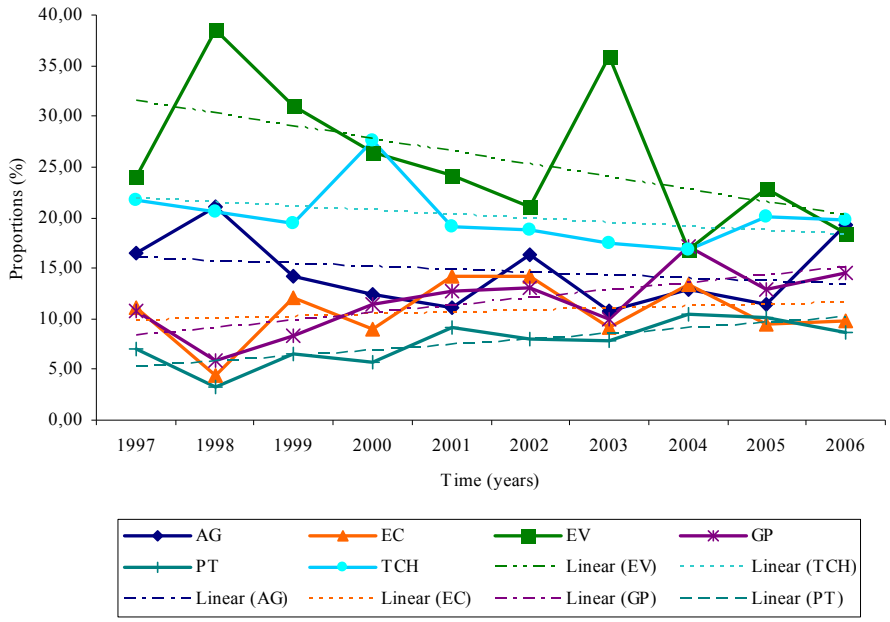

Figure 8 – Main dimensions under which the US government has configured the macro-environment for liquid biofuels. Source: research data.

The results of this analysis suggest a progressive changing in the balance of the mass media and the science influences on the North-american public policies regarding liquid biofuels. According to results shown in Figure 8, all dimensions most present in US science presented a decreasing relative participation in the content of public policies. On the other hand, all dimensions most used by US journalists in configuring the macro-environment for liquid biofuels (excluding environmental dimension which is present in both mass media and science) present an increasing trend in its relative presence in the US public policies. It is possible that the US policy-makers are more interested in the mass media approach about liquid biofuels than in the scientific knowledge produced by US scientist about such matter. In other words, it can suggest that the US public policies about liquid biofuels are more mass media-based than science-based.

The previous descriptive analysis fulfils partially the third objective of this study, signaling some dissimilarity between US mass media and science and some similarity (and changes on it along the time) in the US government related to mass media and science. For ckecking the alignment

between US public policies content, mass media news discourse and scientific knowledge, adherence and homogeneity tests were carried out and the results are show on Tables 3 and 4.

Table 3 - Adherence Test for US mass media, science and government

Adherence Test of... to …	**Chi-square Value**
Government and Mass Media	152635,6
Mass Media and Government	16566,6
Government and Science	117221,4
Science and Government	13327,3
Mass Media and Science	63980,1
Science and Mass Media	64165,3

df = 8; α = 0,01; *p < 0,01

Table 4 – Homogeneity Test for US mass media, science and government

Homogeneity Test between...	**Chi-square Value**
Mass Media and Government	14256,9
Science and Government	11597,9
Science and Mass Media	24755,1

df = 8; α = 0,01; *p < 0,01

For checking for the level of adjustment between pairs of stakeholders regarding the absolute frequency which they have used each dimension along the time in configuring the macro-enviroment for liquid biofuels, the adherence of the US government to the mass media standard was tested and the Chi-square statistics is presented in the first row of the Table 3. The result of adherence test of the US mass media to the government standards is presented in the second row of Table 3, and so on. This finding suggests that there is no signifitive adherence between US mass media, science and government regardins its standards in frequency of use of the set of macro-environmental dimensions. The lower value for Chi-square statistics was returned to the adherence of the US science to the US government standards, indicating that the adherence between these two stakeholders is better than the between other pairs, although not significant statistically.

The alignment between between US mass media, science and government was also tested by mean of homogeneity test between pairs of stakeholders. In the first of row of Table 4 is presented the value of Chi-square statistic for the homogeneity between US mass media and government, followed by science and government and science and mass media in rows below. The homogeneity test shows how good the proportions in the use of the macro-environmental dimensions by a specific stakeholder fit to the proportions observed in another stakeholder. As smaller the values observed for the statistics Chi-square are, higher will be the homogeneity among a pair of stakeholders. The results of the homogeneity test have been derived from absolute frequencies observed for each macro-environmental dimension along the time. Although not significant statistically, the results suggest a higher homogeneity in the use of macro-environment dimensions between US science and US government. Between US mass media and US government was observed a medium level of homogeneity. US science and US mass media was the pair of stakeholders in which the lower level of homogeneity can be perceived.

The obtained results imply that there was no close alignment between the three groups of stakeholders analyzed, although we can assume that the similarity between government and science seems to be higher than between government and mass media and science and mass media. Such findings corroborate the first findings in suggesting that the US public policies regarding liquid biofuels are more based on scientific knowledge than on the journalistic approach about the liquid biofuels.

At last, to fulfill the fourth objective of this study, one searched for correlations between the number of publications from US mass media, science and government, and the liquid biofuels production. We have used the ethanol production (million gallons of ethanol per year) as a proxi for investments and liquid biofuels production, once the biodiesel production in US is less developed. It was also assumed that the increase in US ethanol production was widely influenced by investments in new refineries and by enlargement of previous refineries capacity.

The Pearson's coefficient indicates a high level of correlation between the variables used in the analysis (Table 5). Although the correlations are significant, the presence of liquid biofuels on the US government agenda is closer correlated to the mass media agenda than to the scientific one. In fact, the correlation between the number of scientific publications and the number of news in the mass media was the lowest, while the correlation between the number of scientific publications and the number of governmental documents presented intermediate value. That suggests that the US policy-makers and the journalists may be closer engaged to each other than to scientists, although the power of influence can not be explained from this analysis.

Table 5 - Correlations, means and standard deviations for selected variables

Variable	Variable			
	(1)	(2)	(3)	(4)
Mass Media Agenda				
(1) Newspapers publications	1.00			
Scientific Agenda				
(2) Papers publication	0.909*	1.00		
Government Agenda				
(3) Official Government publication	0.960*	0.944*	1.00	
Liquid Biofuels Production				
(4) Ethanol Production (mgy)	0.859*	0.935*	0.949*	1.00
Mean	201.6	45.5	85.4	2,472.0
Standard Deviation	191.7	28.8	88.3	1,173.6

Note: Variables are measured from 1997 to 2006
*p<0.01

On the other hand, the ethanol production in US is close correlated to the number of official government documents and scientific publications, and less correlated to the mass media news about liquid biofuels. That means that the increasing presence of liquid biofuels subjects in the US public policies could be associated to the growth of the US ethanol production. The public policies content, however, must be more important in explanning the growth of US ethanol production than just the number of public policies published. As argued by Tyner and Taheripour (2007), Khanna et al. (2008) and Tyner (2008), the increasing in US ethanol production could be largely explained by the subsidies incentives to production and consumption of such a fuel. Therefore, after mining the subject "subsidy" from the root SUBSID* in the content of US government documents, the results indicated that a significant and continuos increasing in the

frequency of such matter has occurred from 2004, when the Job Creation Act and the Energy Policy Act have passed (Tyner, 2008). The Person's correlation index indicates a significant correlation between the presence of "subsidies" matter in the US public policies and the ethanol production ($r = 0.823^*$; $^*p<0.01$). Such findings corroborate the arguments that the US liquid biofuels industry is expanding as a result of a public policy widely based on subsidies, as stated by Koplow (2006).

5. Conclusions

Three main questions were addressed in this paper regarding the macro-environmental configuration for liquid biofuels in the US mass media, science and government and its implications for investments on the liquid biofuels sector; and, also whether business managers should look into such stakeholders' sources of information when planning strategically or when in decision making processes. The main conclusions of this work can be addressed to both, business managers and scholars.

In general, the US journalists have been configured the macro-environment for liquid biofuels differently from US scientists. While journalists have focused more on the economical, environmental, political and geopolitical dimensions, the scientists have put more emphasis on environmental, agronomical and technological aspects. Policy-makers, on the other hand, can be seen as users of a mix of both scientific and journalistic approaches. The results also suggest that the public policies for liquid biofuels in US seem to be more a science-based process than a mass media-based one. However, this may be changing once the trends show that the dimensions emphasized by journalists present a positive growth in the content of government documents, while the dimensions focused by scientists present a negative trend in the government discourse.

To business managers one can say that: firstly, journalists, scientists and policy-makers have been affecting positively the investments and the production of liquid biofuels in the United States through their agenda and macro-environment configuration; secondly, the macro-environment configuration is a result of interactions between stakeholders. In this process one group of stakeholders may have more influence than the others; thirdly, the macro-environment configuration is a dynamic process, that is, changes frequently. So, one suggests to managers that all stakeholders (journalists, scientists and policy-makers) are important sources of information on which the scanning process should be carried out constinuosly. Regarding the time-lag between a scientific recommendation and its adoption as a public policy, one could suggest that managers should search for information in science in advance, as a way to prospect possible public policies in the future.

Finally, one can say to business managers that the macro-environmental scanning process can be considered as a primary and very important step in strategic planning processes. The advances in Information Technology make now the environmental scanning easier. Today, there is a wide range of softwares that can be used to scan the industry or firm environment, by quickly accessing the content of a high number of documents and analyzing them from different perspectives, according to the decision-taking requirements.

From a scholar perspective, one can concludes that the macro-environmental scanning in the liquid biofuel sector seems to be a useful tool in strategic planning process, agreeing with the strategic planning theory and with the results found by previous studies in the same direction.

Regarding the public policy-making process in the US liquid biofuels sector, the US policy-makers and scientists seem to work in relative close cooperation between each other. On the other hand, scientists and journalists remain quite distants from each other. It implies that US science plays an important role in liquid biofuel matters. The findings suggest also that US policy-makers are moving more towards the journalists' direction, sharing their points of view regarding the macro-environment under which they frame the liquid biofuels policies. US scientists could share more of their points of view and their research findings with journalists and with policy-makers as a way to amplify their contribution to the US liquid biofuels sector, and for justifying the public research budget allocated on this subject as well.

Taking into account the results of this study, one can suggest some future investigation for analyzing this topic wider and deeper. For instance, to analyze the perception of the stakeholders about the liquid biofuels and to correlate it to the investments and production of ethanol and/or biodiesel; and, by using regression models to analyze in what extend the use of a certain macro-environmental dimension explains the liquid biofuels production; and, further, to identify the gap between a scientific topic prescription and its real adoption by policy-makers when including it into public policies.

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