

MACROENVIRONMENT FOR LIQUID BIOFUELS IN A GOVERNMENTAL  
PERSPECTIVE: A COMPARATIVE ANALYSIS OF PUBLIC POLICIES IN GERMANY,  
BRAZIL AND THE UNITED STATES OF AMERICA<sup>1</sup>

Edson Talamini<sup>2</sup>

Professor of the Administration, Accounting and Economics School/FACE, Federal  
University of Grande Dourados - UFGD  
Address: Rodovia Dourados-Itahum, Km 12 – Caixa Postal 533 – Dourados/MS – Brazil  
CEP 79804-970  
e-mail: [edsontalamini@terra.com.br](mailto:edsontalamini@terra.com.br)  
Tel.: (5567) 3411-3863  
Fax: (5567) 3411-3869

Dr. Emiel F. M. Wubben

Associate Professor of the Department of Business Administration, Social Sciences Group, Wageningen University  
Address: Hollandseweg 1, Wageningen, 6706 KN, The Netherlands  
Email: [emiел.wubben@wur.nl](mailto:emiел.wubben@wur.nl)  
Tel: +31 317 484160/428

Antônio Domingos Padula

Professor of the Management School and Centre for Agribusiness Studies, Federal University of Rio Grande do Sul -  
UFRGS  
Address: Rua Washington Luis, 855– Porto Alegre/RS – Brazil  
CEP 90010-460  
e-mail: [adpadula@ea.ufrgs.br](mailto:adpadula@ea.ufrgs.br)  
Tel/Fax: (5551)3308-3991

Homero Dewes

Professor of the Department of Biophysics, Biosciences Institute, and Centre for Agribusiness Studies, Federal  
University of Rio Grande do Sul - UFRGS  
Address: Av. Bento Gonçalves, 9500 – Porto Alegre/RS – Brazil  
CEP 91500-970  
e-mail: [hdewes@ufrgs.br](mailto:hdewes@ufrgs.br)  
Tel: (5551)3308-7608

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<sup>1</sup> This work was supported by CNPq and FAPERGS/FINEP/Projeto Estruturante em Agroenergia RS/Brazil and executed at Federal University of Rio Grande do Sul (Br.) and Wageningen University (NL).

<sup>2</sup> Corresponding author

The author acknowledges CAPES/Brazil for the scholarship granted.

# MACROENVIRONMENT FOR LIQUID BIOFUELS IN A GOVERNMENTAL PERSPECTIVE: A COMPARATIVE ANALYSIS OF PUBLIC POLICIES IN GERMANY, BRAZIL AND THE UNITED STATES OF AMERICA

## **Executive Summary**

This study aimed to identify the dimensions that the German, Brazilian and American Governments used to configure the macroenvironment for liquid biofuels over time and to test for similarities between the Governments in the configuration of this macroenvironment. Documentary research was carried out on official public policies and program documents on the topic of liquid biofuels. Documents covering the ten year period from 1997 to 2006 were collected into a data base. This base consisted of 168 documents from the German Government, 624 from the Brazilian Government and 854 from the American Government. Text Mining was used to extract knowledge from the texts by the application of a specific analysis structure built on macroenvironmental dimensions as expressed by their respective dimensional words (*d-words*), which were previously selected based on their usage frequency in the knowledge fields related to each dimension. The results indicate that the macroenvironments for liquid biofuels, as considered by each of the analyzed Governments, differ in their respective macroenvironmental dimensions. The Technological, Geopolitical and Environmental dimensions are those most used by the German Government. The Brazilian Government favors the Technological and Geopolitical dimensions. On the other hand, the Environmental and Technological dimensions are most frequently used by the American Government. The macroenvironment configuration also showed variations over the analyzed period in the three Governments. Homogeneity Tests confirm the existence of differences between the dimensions considered by each Government. Some managerial implications are suggested. It was possible to use new Information Technologies to extract useful knowledge on the liquid biofuels macroenvironment from a large quantity of text information. This means that organizations related to biofuels and to other fields as well may use such resources to carry out environmental scanning, making such data relevant for strategic planning of their activities.

Keywords: Bioenergy, Business environment, Environment scanning, Text Mining, Macroenvironmental Dimensions.

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Abstract

This study had the purpose of identifying the dimensions under which the Governments of Germany, Brazil and the United States have configured the macroenvironment for liquid biofuels and testing for similarities between the Governments in the configuration of this macroenvironment. Research was carried out on official Government documents on the topic 'liquid biofuels'. Text Mining was used to extract the required knowledge. The results indicate that the macroenvironments for liquid biofuels configured by the analyzed Governments differ in the use of the macroenvironmental dimensions both to the peculiarities of each geopolitical space, and over time.

Key-words: Bioenergy, Business environment, Environmental Scanning, Text Mining, Macroenvironmental Dimensions.

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## INTRODUCTION

The global warming attributed to the burning of fossil fuels seems to be one of the main causes for the contemporary emergence of liquid biofuels, in particular ethanol and biodiesel, as a renewable energy source. However, there is evidence to suggest other influential areas of perception and expressions of society, the understanding of which may be relevant for the growth and consolidation of regional or international markets for liquid biofuels. The configuration of the business environment for the emergence of liquid biofuels may be expressed by means of macroenvironmental dimensions, categorizing liquid biofuels, are categorized by the Governments of different countries. The macroenvironment configuration for liquid biofuels in each country may be influenced by the contents of the governments' discourse as a means of social expression and the impacts it has by means of interactions with the society.

For public offices and companies alike it is important to know what directs the development of a sector. When monitoring the business environment under which to carry out their strategic plans concerning biofuels, the organizations involved identify macroenvironmental dimensions, categorize information accordingly, and direct their investment strategies accordingly. In this regard, the Government plays a paramount role in the supply of information to support decision-taking in companies' strategic planning. Companies interpret the signals of the government's prospects on a certain matter, as the direction and orientation of public policies.

According to the IEA data (2004a,b), the growth in the liquid biofuels production has changed differently between countries. The main liquid biofuel producers are: Brazil (12,342 million tons), United States (10,847 million tons) and Germany (1,138 million tons). In recent years, even though the liquid biofuel production has increased everywhere with recognition of environmental problems related to fossil sources, different macroenvironmental dimensions seem to affect the investments in biofuels in the different countries.

In Brazil, for instance, it could be argued that the initial macroenvironmental configuration for the liquid biofuel production was based on the political dimension, considering the public policies focused on the replacement of petroleum byproduct, which resulted in the implementation of the National Alcohol Program – PROALCOOL in 1975 (Decree no. 76,593, 1975). However, the recent public policies of the Brazilian government may indicate a change in the macroenvironmental configuration for liquid biofuels within the country, more focused on the social dimension, as evidenced by the strategic priorities of the Agroenergy Program (Brazil, 2005).

Regarding the United States, the environmental dimension seems to be absent from the macroenvironmental configuration for the liquid biofuel production as far as determined by the American Government. Although the United States has the highest greenhouse gas emission levels on the planet, it was the only developed or industrialized country to refuse to sign the Kyoto Protocol for greenhouse gas emission reduction (Kintisch & Buckheit, 2006; PK, 1997). Other macroenvironmental dimensions, such as economical, political and geopolitical could be more relevant in their context of discussions on liquid biofuel production. According to IEA data (2007), in 2005-2006 the United States imported more than twice its domestic petroleum production. Recent conflicts within the Middle East could be closely related to this high oil import dependency, making geopolitical issues relevant to the American biofuel macroenvironment. At least, this, can be derived from the goals of the Bush Government, in a statement of the President to the Congress, when he stressed the need to "...promote energy independence for our country... urge to pass these matters (*use of biofuels*), for the good of both our environment and our economy" (Bush, 2006).

Finally, in Germany, one may expect the liquid biofuel production to be associated with environmental and cultural dimensions, as European consumers concerned with environmental issues are moving to environmentally-correct products, as stated by Reusswig, Lotze-Campen and Gerlinger (2003), Büttner and Grübler (1995), Rimal, Moon and Balasubramanian (2005) and Willer and Yussefi (2005). Alternatively, it may as well be associated with the political and economical dimensions as represented by the following events: first, the passage of the *Renewable Energy Act* on April 1<sup>st</sup> 2000, the target of which is to increase the use of renewable energy sources to 12.5 %-point by 2010 and 20 %-point by 2020 (Germany, 2000); second, the Directive 2003/30/EC dated May 8<sup>th</sup> 2003, which established the target of using 2 % of biofuels

added to fossil fuels until 2005 and 5.75 % (later 4%) by 2010 (EC, 2006); and third, Germany has the largest tax incentive in the European Union for the production of liquid biofuels, which amounted to €0.47/liter in 2004 (Frondel & Peters,2006).

These three examples illustrate that, even though the expansions in the production and use of liquid biofuels has emerged under the environmental banner in the global macroenvironment, other macroenvironmental dimensions may explain the increment in the production of different countries, depending on specific characteristics of each geopolitical space. Therefor this paper is based on the following three presumptions: first, economic agents decide on their investments by means of a strategic plan; second, strategic plans, oriented at the growth of liquid biofuel production are directly related to the initial macroenvironmental analysis and interpretation stage; and third, the Government, as an important means of social expression, participates in and strongly influences the macroenvironmental configuration. Given these presumptions the paper answers the question, under which macroenvironmental dimensions have the Governments of Brazil, United States and Germany configured the macroenvironment for liquid biofuels over time? Are there similarities in the macroenvironment configuration accomplished by the Governments of these countries? This study had the purpose of (1) identify the dimensions under which the Governments of Germany, Brazil and United States have configured the macroenvironment for liquid biofuels over time, and (2) test for similarities between the Governments of these countries.

In order to achieve the proposed purposes, the remainder of the article is structured as follows. Following this introduction, section two presents a literature review on the Macroenvironment Analysis, highlighting the environment concept in the business field, the dimensions which compose the macroenvironment, the steps of macroenvironmental analysis, with prominence for the scanning step and the use of new technologies of the information for the accomplishment of this process. The third section describes the methods and procedures, emphasizing the documental research as the method and the gathering of documents and the Text Mining process as procedures. In the fourth section the results are presented and analysed, putting emphasis on the performance of Government of each country over time and on the analysis of similarities between Governments. Finally, the fifth section presents the main conclusions from the study.

## MACROENVIRONMENT ANALYSIS

In their widely-used book on strategic management, Johnson, Scholes and Whittington (2008) identify the presence of three basic and required core elements for the strategic planning process: strategic position, strategic choice and strategy into action. The first core element concerns the evaluation of impacts of the external environment, internal resources and competences of firms, and expectation and stakes of interest groups on the strategy to be adopted. The analysis of the environment in which the organization is located is actually the first step of strategic planning for all reputed writers of strategy-handbooks, like Grant (2008), Wheelen and Hunger (2008), Thompson and Strickland (2009), David (2009), and Leidecker and Bruno (1984).

This prioritizing of the environment in strategic analysis goes back to Dill (1958). In his study, the author stated that the influences of the restrictions imposed by the environment were essential for the science of management, since the behavior of firms depend on autonomous environmental circumstances in which the firms are located, and how these are interpreted and turned into action by managers. Likewise, Terry (1977) states that the environment is the prime determiner of the form and behavior of an organization. Although criticized by adherents of the resource-based view in management (e.g. Rumelt, 1991, Barney & Hesterly, 2008) the environment is still the starting-point in almost all strategic planning.

But what is the environment? What are the variables that compose it? A widely accepted definition in the literature is that proposed by Hall (2004), for whom the environment represents all those elements existing beyond the limits of the organization that may influence, directly or indirectly, the organization. In the management field, Thomas (1974) comments that the term environment should be understood as in the open systems approach. According to the writer, one should attach great importance to the idea that, since organizations exist in a dynamic environment, their resources are strongly affected by the forces of this environment.

As for the variables that make up a certain environment, it is necessary to identify which environment level is being analyzed. Thomas (1974), and in a similar manner Leidecker and Bruno (1984), proposes three different environment levels: general environment, operational environment and internal environment. In other words, the environment of a firm is made up of

layers ranging from generic to specific. The general environment is made up of social, political, regulatory, economic and technological conditions existing in a national or global context.

With the purpose of utilizing macroenvironment analysis for strategic planning, the variables found at the level of the general environment are usually grouped in factors or dimensions. When defining which dimensions or factors make up the general or macroenvironment, some writers use additional or supplementary dimensions to those originally proposed by Thomas (1974). A summary of the macroenvironmental dimensions used by some writers is presented in Figure 1.

As a conclusion about the dimensions that make up a given macroenvironment, it could be said that a single or preferred set of dimensions does not exist. The variety and number of dimensions seem to depend on the line of business of a certain industry. However, a specific set of dimensions is found to be recurring among the consulted writers: the dimensions represented by the PESTEL acronym (see Figure), as proposed by Walsh (2005) and Johnson, Scholes and Whittington (2008), seem to cover most classifications of a macroenvironment. We confer to this standard.

<b>Writers</b>	<b>Macroenvironment Dimensions</b>
Thomas (1974)	Social, Political, Regulatory, Economic and Technological
Fahey and King (1977)	Economic, Political, Regulatory, Social, Cultural, Technological, Energy, Marketing/Industrial and Financial
Preble, Rau and Reichel (1985)	Legal, Economic, Political, Competitive, Technological and Cultural
Ginter, Duncan and Capper (1991)	Economic, Political, Social, Technological and Regional
Costa (1995)	Political, Economic, Social and Technological – PEST
Leonidou (1997)	Physical, Demographic, Sociocultural, Economic, Political/Legal and Technological
Fleisher and Bensoussan (2002)	Social, Technological, Economic, Ecological and Political or Legal – STEEP
Walsh (2005); Johnson, Scholes AND Whittington (2008)	Political, Economic, Sociocultural, Technological, Environmental and Legal - PESTEL

Figure 1 – The different macroenvironment dimensions according to different writers  
Source: prepared by the authors based on the consulted writers.

Following the determination of the concept and dimensions that make up the macroenvironment of firms, it should next be understood how the macroenvironment investigation process for the preparation of the strategic planning is carried out. Ginter and Duncan (1990) and Ginter, Duncan and Capper (1992) state that the macroenvironmental analysis process is made up of four interrelated activities:



- a) *scanning* – scanning the macroenvironment means to investigate the threat signals and possible opportunities that may affect the business;
- b) *monitoring* – the activity of monitoring the macroenvironment is associated to the process of tracing the issues identified in the investigation process;
- c) *forecasting* – it is the process of estimating forecasts of directions, scope, speed and intensity of environmental changes on a plausible basis; and,
- d) *assessment* – the process of assessing the projected trends for the organization in terms of its relationship with the external environment.

These steps are also present in the strategic planning model proposed by Bates (1985)<sup>3</sup>. Based on these four steps in the macroenvironmental analysis, it can be concluded that the scanning process is the first step and one of the main elements of strategic planning. This paper focuses on this scanning of the macroenvironment. Therefore, it is important to understand how firms carry out this scanning: What kind of information is usually accessed? What are the information sources? And, how is this information processed?

By studying the strategic planning processes, the first conclusion one reaches is that there are different levels for the deployment of scanning techniques by firms, and even the intensity of use by the same firm may vary over time (Fahey & King, 1977; Fahey, King, & Narayanan, 1981; Stubbart, 1982). However, in an environment marked by speed and intensity of changes, macroenvironmental scanning is highly recommended to monitor the strategy of firms. Costa (1995) highlights some of the reasons why the deployment of a systematized analysis of the environment of the organization is relevant. In its essence, 'scanning' is a process based on the search and treatment of information on a certain macroenvironment.

Ginter, Duncan and Capper (1992) illustrate clearly how the macroenvironment scanning process captures and treats information. Figure 2 shows that, before scanning, the various pieces of information about the general macroenvironment and the specific sector environment are dispersed. Although the information may be available, the identification of any pattern turns out to be a daunting task. After the scanning process, the result is a set of categorized, organized, accumulated and assessed information. The illustration demonstrates that scanning is a sorting filter for the pieces of information accessed by the firms or industry, so that, after its application, the macroenvironmental patterns may be identified and assessed.

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<sup>3</sup> The author defines the model as MAPing: *Monitor, Analyze and Predict*.

What are the different information sources used for the purpose of the macroenvironment scanning process? Figure 2 shows that information is the raw material which feeds the monitoring process. By analyzing different studies in this field, it was possible to detect the presence of two information sources: company internal and external, which in turn can be subdivided into: personal and impersonal sources. The studies of Keegan (1974), Ginter and Duncan (1990), Ngamkroekjoti and Johri (2000) and Jogaratnam and Law (2006) show that the main information sources are still the people inside or outside the organizations.

However, evidently more recent studies in the scanning field have drawn the attention to the importance of the World Wide Web as an information source. The Internet has promoted a significant growth in the information volume available for decision-taking. Auster and Choo (1993, 1994), Choo (1994, 1999), Liu (1998), Choo, Detlor and Turnbull (2000), Liu, Turban and Lee (2000) and Decker, Wagner and Scholz (2004) are just some of the studies conducted in recent years drawing attention on the importance of electronic information sources for business executives.

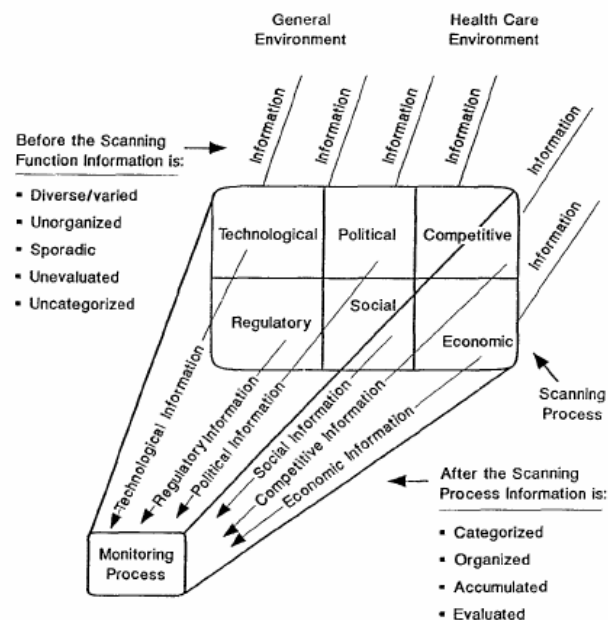


Figure 2 – Treatment of information through the 'scanning' process  
Source: Ginter, Duncan and Capper (1992, p. 255)

If on the one hand access to information was made easier, we find that, on the other hand, there is the difficulty of analyzing such a large volume of data and information so as to extract

the essential elements for planning the organizations' activities. The solution to this problem seems to be the combination of: (i) the theory and concept of scanning the macroenvironment; and (ii) new information technologies (ITs) developed for electronic data treatment so as to extract a reduced and structured set of pieces of information. The studies of Liu (1998), Myers (1999), Wei and Lee (2004), Decker, Wagner and Scholz (2004), Aasheim and Koheler (2006) are examples that the electronic 'scanning' of macroenvironmental dimensions tends to be a powerful tool to better understand the current global environment, where information is in abundance, and in digital form.

Within the set of new techniques and technologies for macroenvironmental scanning, the use of Text Mining is being discussed and presented as one of the intelligent techniques for the treatment of a large amount of information. In his book on this topic, Halliman (2001) discussed the use of Data Mining in depth and shows practical applications both to determine macroenvironmental forces and to analyze scenarios. We will take up Data Mining, in line with Halliman (2001) and Lau, Lee and Ho (2005) who used Text Mining as an analysis tool to identify macroenvironmental dimensions associated to the business environment in the communication and hotel industries.

## METHODS AND PROCEDURES

In order to identify the dimensions under which the Governments of Germany, Brazil and United States have configured their macroenvironment for liquid biofuels over time, a documental analysis was made of related official documents of the Governments of these three countries. Karanikas and Theodoulidis (2002) and Hale (2005) have confirmed that the information contained in several kinds of written documents is representative of the documented phenomenon. In order to turn such information into manageable knowledge, the concept of Knowledge Discovery in Text, and Text Mining techniques were used (Halliman, 2001). The Text Mining procedures adopted followed a structure based on the studies of Liddy (2000), Karanikas and Theodoulidis (2002), El Wakil (2002), Silva et al. (2004) and Hippner and Rentzmann (2006). As stated, Germany, Brazil and United States were chosen as the geopolitical spaces for our macroenvironmental analyses, because they are the main liquid biofuel producers, according to IEA (2004a) data.

The selection of governmental documents from each country was conducted by using a list of key-words (see Figure 3) representative of the "liquid biofuels" research matter, 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
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Figure 3 – Key-words related to liquid biofuels.  
Source: prepared by the authors

The listed key-words, plus some related key-words were used in the document collection step. It will be self-evident, that in the case of Brazil and Germany, the equivalent key-words were also used from Portuguese and German idiom, respectively.

The stated key-words were used to search and trace relevant governmental documents in various sources of the German, Brazilian and American Governments available in the World Wide Web. Therefore, homepages from most if not all Ministries, Federal Secretariats and Self-Governing Entities, were visited, plus search engines available in the related homepages themselves. It is important to note that any information available in "Press Room" sections of searched sources was excluded from consideration. The reason is that we wanted to minimize the impact of ordinary political and electoral discourses, and focus our search on documents that were representative of the official policies and programs of the Governments.

What did the data gathering entail? The search and collection of Government documents, and the construction of the preliminary database began on the first week of February 2007 and was completed by the last week of June 2007. A ten-year period was analyzed in this research: 1997-2006. Taking into accounting the volume of scientific publications verified along the last decades, it is noticed that liquid biofuels has outstanding in the last ten years. The documents were stored in three different textbases: Germany, Brazil and United States. By the end of this process we had collected 170 documents from the German Government, 673 documents from the Brazilian Government and 865 documents from the American Government, totaling 1,708 government documents.

In the following step, the electronic contents of the documents were transferred to 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, 2 documents of the German Government, 49 documents of the Brazilian Government and 11 from the American Government were lost, as their contents were blocked. Therefore, the final composition of the database was made up of 168 documents of the German government, 624 documents of the Brazilian government and 854 documents of the American government, totaling 1.646 documents. The 168 documents of the German government were obtained between the years of 2001 and 2006. In the previous years was not found any document in the German Government websites.

In order to discovery the knowledge contained in the files, it was necessary to build an analytical structure capable of extracting the relevant information, once there is no a 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, Hu and Roehl (2007). The first step to build the specific structure is associated to the definition of the macroenvironmental dimensions. As stated earlier, according to the literature on macroenvironmental 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, Scholes & Whittington, 2008). The number of dimensions and their denominations vary from one study to another, depending on the specific interest, the studied environment and/or the activity, allowing for some flexibility. Considering the characteristics of the research matter, we added the agronomical and geopolitical dimensions, and splitt up the dimension Sociocultural, thus totaling nine macroenvironmental dimensions to be explored: Agronomical, Environmental, Cultural, Economic, Geopolitical, Legal, Political, Social and Technological.

Once the macroenvironmental dimensions were established, the purpose of the following steps was to identify the set of key-words representative of each dimension, which will be treated here as "dimension-words" or "*d-words*". The set of "*d-words*" is made up of relevant terms that best distinguish a certain macroenvironmental dimension. Therefore, nine macroenvironmental 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? For example, which and how many "*d-words*" satisfactorily characterize the economic dimension?

First, in order to determine the set of "*d-words*" for each of the nine dimensions, we tried to identify the words that occurred more frequently in academic journals in each of the knowledge fields, associated with a macroenvironmental dimension. Some academic journals with high Impact Rates were selected. For instance, the following journals were selected for the economic dimension: *Quarterly Journal of Economics* (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 volume 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 the other macroenvironmental dimensions.

Titles, summaries and key-words were collected from all published scientific articles in the selected issues. The contents of these text elements were transferred to a textbase prepared with the aid of the QDA Miner® software. Next, by using the WordStat module of SIMStat®, a word count was obtained, as well as their frequency and the TF\*IDF<sup>4</sup> 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 macroenvironmental dimensions (Aizawa, 2003; Jing, Huang & Shi, 2002).

Second, 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 distinguished 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 joint occurrence of terms within the same document. Jaccard's Coefficient was used for determining these rules (Chung & Lee, 2001).

Text Mining was carried out by using the textbases in electronic format and the knowledge analysis and extraction structure build from the macroenvironmental 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 each set of governmental documents. Consequently the frequency is established by which each of the macroenvironmental dimensions

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<sup>4</sup> TF\*IDF = Term Frequency multiplied by Inverted Document Frequency.

were used indicating the configuration of liquid biofuels macroenvironment by the Governments of Germany, Brazil and the United States.

Finally, the absolute and relative frequencies of the occurrence of the d-words under each of the macroenvironmental dimensions were used for the analysis of the results. Based on the frequencies, dendrograms were built grouping the dimensions with greater Jaccard Similarity Coefficients (Provalis Research, 2005), to analyze the joint occurrence of the dimensions in the Government documents. Homogeneity Tests were conducted to verify the similarities or differences regarding the frequency of use of the nine dimensions for the macroenvironment configuration for liquid biofuels between the Governments (Field, 2005).

## RESULTS

In this section the obtained results will be presented, comparing the nine macroenvironmental dimensions under which the liquid biofuels have been configured by the governments in the different countries. We will present descriptive statistics of relative frequencies that different macroenvironmental dimensions get attention in publications per period and government, followed by a country comparison of their accumulated frequencies. Thus, the first set of results sought to identify the relative frequencies by which the liquid biofuels were categorized in each of the macroenvironmental dimensions over the analyzed period. In this regard, Figure 4 shows that there are similarities and differences among the Governments of Germany, Brazil and United States.

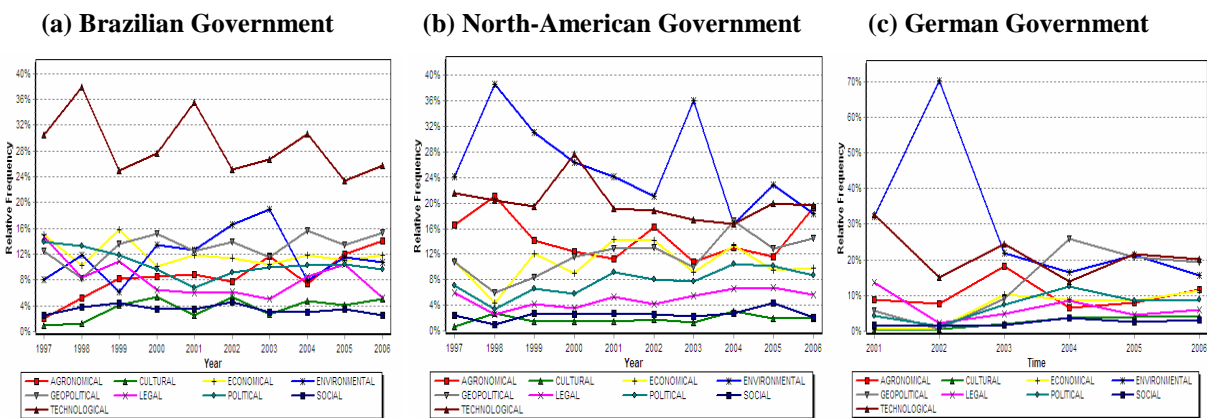


Figure 4 – Relative frequency of the macroenvironmental dimensions under which the liquid biofuels were categorized by the Governments of Germany (a), Brazil (b) and United States (c) in the ten-year period  
 Source: Research data

While the configuration of the liquid biofuels by the Brazilian Government is oriented at the TECHNOLOGICAL dimension over the entire period of analysis, for the Governments of Germany and the United States the main dimensions are the ENVIRONMENTAL and TECHNOLOGICAL ones, which alternate over time in terms of greater relative frequency. The predominance of the TECHNOLOGICAL dimension in Brazil may be associated with Petrobrás, a public company in the petroleum business which is responsible for acquiring and distributing liquid biofuels. Interestingly, the results show that although the United States was the only industrialized country that refused to sign the Kyoto Protocol, at the same time the ENVIRONMENTAL dimension predominates the American Governmental documents. Thus, although publicly the United States Government seems to show little concern with environmental issues, environmental issues are in the core of their official programs and policies on liquid biofuels. In documents of the German Government, the ENVIRONMENTAL dimension dominated only, but strongly, in 2002. Interesting in the analysis of the American government is the prominence of the AGRONOMICAL dimension, especially in the early and last periods, emerging as the third most used dimension in several of the analyzed periods.

Then data show interesting patterns on dimensions and countries. First, the three Governments have in common that the share of the TECHNOLOGICAL and ENVIRONMENTAL dimensions is descending over the analyzed period. This decrease indicates that other macroenvironmental dimensions became more important in the publications on liquid biofuels. In other words, in recent years the concerns of the governments became increasingly focused on other aspects associated with the production and use of liquid biofuels. Second, in this regard, it is interesting to focus on the rising share of the GEOPOLITICAL dimension, especially in recent years. The rise is larger with the Government of Germany, followed by United States and Brazil, even though in Brazil it was already the second main dimension over the last three years of the analyzed series. Third, attention should be also drawn to the low relative participation of the CULTURAL and SOCIAL dimensions verified in the Governments of the three countries. Even in the specific case of Brazil, there are imperceptible meaningful changes in the relative importance of the SOCIAL dimension, even after the inauguration of President Luiz Inácio Lula da Silva in 2003 or after the launch of the National Agroenergy Plan in 2005.



Based on the data of Figure 3, the analysis of the macroenvironmental dimensions under which the liquid biofuels are categorized by the Governments in the different countries was based on the relative frequency with which each dimension occurred in the government documents for each of the analyzed periods. We now turn to the descriptive presentation of the country comparison of relative frequencies with which each dimension occurred, accumulated over the studied periods, which is presented in Figure 5.

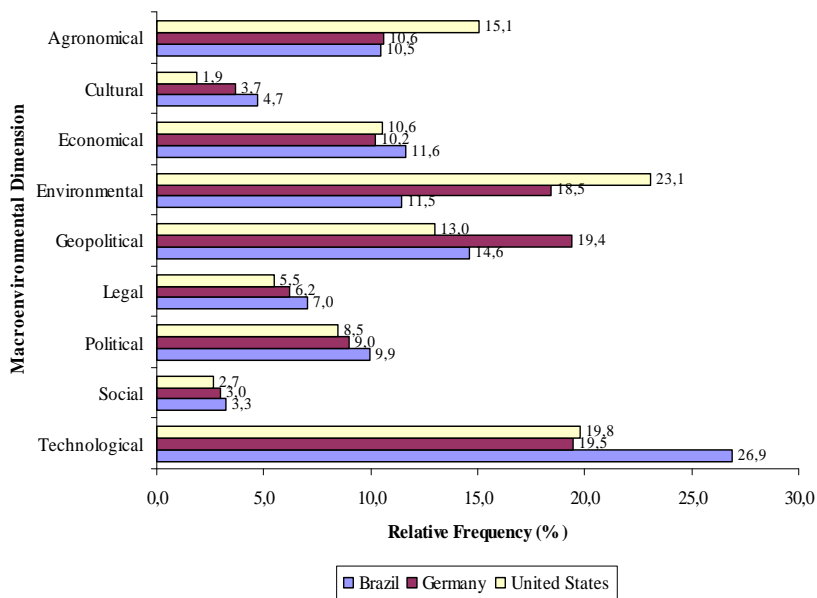


Figure 5 - Relative frequency of the macroenvironmental dimensions under which the liquid biofuels were categorized by the Governments of each country in the ten-year period  
Source: Research data

The accumulated results confirm the presence of some similarities and differences among the three Governments. In the case of Brazil, the main macroenvironmental dimension used by the Government to categorize liquid biofuels is the TECHNOLOGICAL dimension, whose verified frequency was 26.9%. The second macroenvironmental dimension most frequently found in the Brazilian Governmental documents is the GEOPOLITICAL dimension, reflecting the impact of the growing participation of this dimension over the analyzed period. The dimension with the lowest attention in Brazilian Governmental publications on biofuels was SOCIAL, while the other dimensions show relative intermediate frequencies.

The accumulated results show also that the German Government has categorized the liquid biofuels along three main dimensions: TECHNOLOGICAL, GEOPOLITICAL and

ENVIRONMENTAL, with very similar relative frequencies, ranging from 18.5% to 19.5%. These results reflect the importance of the GEOPOLITICAL dimension for the German Government. The dimensions AGRONOMICAL, ECONOMICAL and POLITICAL appear with much lower, intermediate frequencies. In line with Brazil, the documents of the German Government show little expression of the SOCIAL and CULTURAL dimensions.

Finally, the documents of the Government of the United States show a dominant presence of the ENVIRONMENTAL dimension in the macroenvironment configuration for liquid biofuels. Its relative frequency is 23.1% of the total occurrences. Apart from this dimension, aspects related to TECHNOLOGICAL and AGRONOMICAL issues hold the second and third position respectively. In contrast, the least dimensions with the lowest occurrence in the United States Governmental publications is made up by the LEGAL, SOCIAL and CULTURAL dimensions. Nevertheless, in comparison to Germany and Brazil only the American Government emphasized the SOCIAL dimension more than the CULTURAL dimension.

Generally, three conclusions can be drawn from the accumulated data presented so far. First, the Governments of Germany and Brazil feature more similar dimensions in their macroenvironmental configuration for liquid biofuels. Although the relative frequencies differ somewhat, for both Governments the TECHNOLOGICAL and GEOPOLITICAL dimensions are the two main ones. Second, the divergence by the Government of the United States relates primarily to the ENVIRONMENTAL dimension. The third conclusion may be that the SOCIAL and CULTURAL dimensions get hardly any attention in the publications of each of the three Governments.

## ANALYSIS

In the previous set of results the relative frequencies of each individual dimension were used for the comparative analysis of the three different Governments, but this section presents the joint use and similarity of the dimensions in the macroenvironmental configuration for liquid biofuels. Regarding the joint use of dimensions, it entails an analysis of the texts of Governmental documents based on the co-occurrence of the "d-words" of two or more macroenvironmental dimensions. In order to observe such behavior in the document base of each

Government, the Jaccard's Coefficient of Similarity was used (see methodology-section), the results of which are shown on Figure 6.

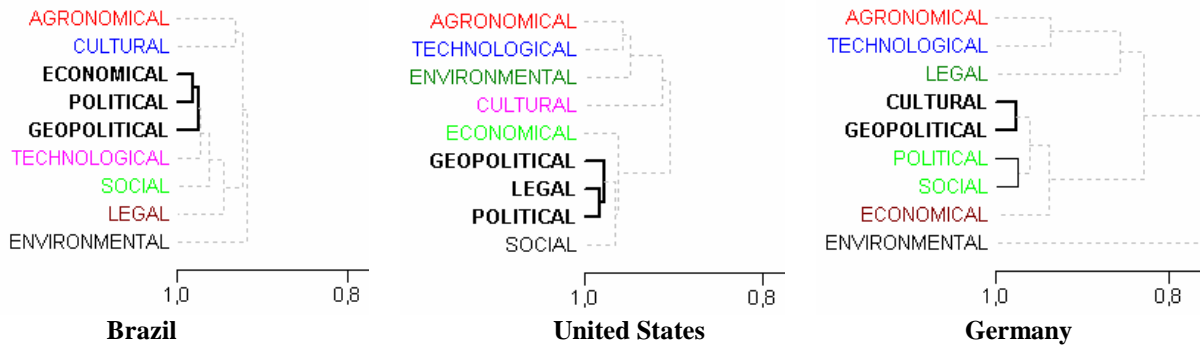


Figure 6 – Dendrogram of Macro-environmental Dimensions in German, Brazilian and North-American Government grouped by Jaccard's Coefficient of Similarity  
Source: research data

Figure 5 shows the differences in the composition of the governmental documents of the three countries in respect of the liquid biofuels. In the case of the Government of Germany, the text composition of the documents is based on four major macroenvironmental dimensions grouped in two subgroups with high Jaccard's Coefficients: the first subgroup comprises of the dimensions CULTURAL and GEOPOLITICAL, and the second subgroup comprises of the dimensions POLITICAL and SOCIAL. These two subgroups form the group of four major dimensions that often occur together in the German Government documents. This means that, even though the SOCIAL and CULTURAL dimensions have relative low frequency in the total volume of documents of the German Government (see: Results), these dimensions are often present and associated to political and geopolitical issues by the German Government.

The text analysis of the Brazilian Government documents brings systematically different results than the German case. On Brazil, Jaccard's Coefficient of Similarity values reveal a discourse based on the following three main nested dimensions: {[ECONOMIC + POLITICAL] + GEOPOLITICAL}. It indicates a strong association between economic and policy issues which subsequently are associated with geopolitical issues. Finally, the results of the American Government are more similar to the Brazilian Government than to the German one. The basic difference is that the documents of the Government of the United States start from an association

base between legislative issues and political aspects [POLITICAL + LEGAL], which is subsequently associated to the GEOPOLITICAL dimension.

Further analysis of the dendrograms of Figure 6 reveals that the values of Jaccard's Coefficient of Similarity had less amplitude in the case of the Governments of Brazil and the United States compared to the Government of Germany. Such results show that the documents of the German Government dealing with liquid biofuels are more specific, that is, related to particular discussions for each of the dimensions. In the cases of Brazil and United States, there is a more holistic approach in the preparation of documents, including different macroenvironmental dimensions in the construction of the governmental discourse in these countries.

Apart from the joint use of dimensions in governmental document, one may measure the similarity in the usage of macroenvironmental dimensions between the Governments of the different countries. The similarity has been measured by means of the Homogeneity Test. The Homogeneity Test tests the affirmation that different populations feature the same proportion of some trait. In this case, the Homogeneity Test tested whether, in the contents of the governmental documents of the three countries, the macroenvironmental dimensions under which the liquid biofuels were categorized feature the same proportion. From the absolute frequencies observed for each of the dimensions in each of the analyzed periods and the total accumulated frequency over the ten-year period, different Homogeneity Tests were conducted. The results of the different homogeneity tests are presented on Tables 1, 2 and 3.

Table 1 shows the values of the Chi-square statistic measures from the accumulated frequencies of each macroenvironmental dimension over the ten-year period. Three different Homogeneity Tests were conducted, comparing the performance between the pairs of Governments. The results show the absence of statistically significant chi-square values, indicating the absence of homogeneity between the different Governments regarding the frequency of use of each macroenvironmental dimension for the categorization of the liquid biofuels.

Similarly, Table 2 shows the results of the Homogeneity Tests between the Governments of the three countries considering the frequencies of each macroenvironmental dimension for each of the analyzed periods. The values obtained for the Chi-square test statistics reveal the non-existence of statistically significant homogeneity during the ten years. Some values indicate a

rising trend of homogeneity in some periods, such as 2001, 2003 and 2005, when the Chi-square statistical values were significantly reduced compared to the remaining periods. Notice that the absence of documents on the German Government for the years 1997-2000 made it impossible to conduct comparative tests for this Government in the respective periods.

Table 1 - Homogeneity Test between the Governments of the three countries – total dimensions

<b>Governments</b>	<b><math>\chi^2</math> Value</b>
Germany x Brazil	4824.3
Germany x United States	5049.4
Brazil x United States	20522.2

gl = 8;  $\alpha = 0.01$ ;  $\chi^2$  Critical = 20.09; \*p > 0.01  
Source: results obtained from the research data

Table 2 - Homogeneity Test between the Governments of the three countries – for each period

<b>Years</b>	<b><math>\chi^2</math> Value</b>		
	<b>Brazil x Germany</b>	<b>Germany x United States</b>	<b>Brazil x United States</b>
1997	n.a.	n.a.	347.2
1998	n.a.	n.a.	1610.1
1999	n.a.	n.a.	3658.4
2000	n.a.	n.a.	3234.1
2001	264.0	251.3	797.3
2002	4110.3	3558.7	1864.7
2003	160.1	505.3	1056.4
2004	2466.4	1194.9	3801.6
2005	1052.8	733.4	1831.6
2006	1536.5	3143.5	4705.5

gl = 8;  $\alpha = 0.01$ ;  $\chi^2$  Critical = 20.09; \*p < 0.01;  
n.a. = the homogeneity calculation is not applicable as the expected frequency for a certain period was less than 1;  
Source: results obtained from the research data

Another set of Homogeneity Tests sought to identify similarity of using each individual macroenvironmental dimension. For such, Homogeneity Tests were conducted by using the frequencies of each dimension per each of the analyzed years. The Chi-square statistical values obtained in the tests are shown on Table 3. The results show the inexistence of statistically significant values for the Chi-square test statistics indicating the absence of similarity between the governments regarding the use of a certain macroenvironmental dimension for the categorization of the liquid biofuels over the ten years under analysis. Only the dimensions that had lower absolute and relative frequencies, such as the CULTURAL and SOCIAL dimensions, showed lower Chi-square values, even so without statistical significance.

Table 3 - Homogeneity Test between the Governments of the three countries – by macroenvironmental dimension

Macroenvironmental Dimensions	$\chi^2$ Value		
	Brazil <sup>b</sup> x Germany <sup>a</sup>	Germany x United States <sup>b</sup>	Brazil x United States <sup>c</sup>
AGRONOMICAL	1229.9	2458.8	5268.8
ENVIRONMENTAL	941.6	5545.3	9212.4
CULTURAL	769.6	1317.1	2499.2
ECONOMIC	2564.8	5548.7	6239.8
GEOPOLITICAL	3216.0	6036.5	8267.4
LEGAL	1799.4	2341.6	4944.9
POLITICAL	1553.7	3394.2	6385.5
SOCIAL	914.7	1783.0	2354.6
TECHNOLOGICAL	4226.0	5784.0	12634.4

<sup>a</sup> between the years 2001 and 2006. In periods before 2001 the frequencies are under the necessary requirements for the homogeneity calculation;

<sup>b</sup> gl = 5;  $\alpha = 0.01$ ;  $\chi^2$  Critical = 15.08; \*p < 0.01

<sup>c</sup> gl = 9;  $\alpha = 0.01$ ;  $\chi^2$  Critical = 20.09; \*p < 0.01

Source: results obtained from the research data

The conclusions is justified that the different Homogeneity Tests to compare the presence of similarity between the Governments resulted in statistically insignificant values, showing the absence of similarity between the Governments of Germany, Brazil and United States regarding the frequency of use of the macroenvironmental dimensions for the categorization of liquid biofuels.

However, additional tests using the average of absolute differences between the relative frequencies of each dimension, considering the accumulated frequencies in the ten-year period, indicate greater similarity between the Governments of Germany and United States ( $\mu = 29.1$ ). The second lower average was observed between the Governments of Germany and Brazil ( $\mu = 31.1$ ). The greatest divergence verified was between the Government of Brazil and the United States ( $\mu = 48.4$ ).

## CONCLUSIONS

The purpose of this study was to identify the dimensions under which the Governments of Germany, Brazil and United States have configured the macroenvironment for liquid biofuels over time and test for similarities among the Governments of these countries. In order to achieve

the purpose, a documentary research was conducted using a database of official documents of the German, Brazilian and American Governments.

The results show that the Governments of Germany, Brazil and United States have configured the macroenvironment for liquid biofuels under different dimensions. While for the German Government the predominant dimensions are the TECHNOLOGICAL, GEOPOLITICAL and ENVIRONMENTAL, in this order, the Brazilian Government uses the TECHNOLOGICAL dimension more frequently across the entire analyzed period. The American Government, in turn, has interestingly prioritized the ENVIRONMENTAL dimension in their categorization of liquid biofuels, followed by the TECHNOLOGICAL dimension.

The composition of the contents found in the government documents, measured by the Jaccard's Coefficient of Similarity, revealed the existence of different approaches between the three governments. In the contents of the documents of the Brazilian Government the discourse construction was found more based on market aspects and its regulation. Such facts were revealed to be in agreement with the characteristics of the market of liquid biofuels in Brazil, which is developing in growing way from Proalcool in 1975. Recently, the plans of expansion of the production and consumption of liquid biofuels have Petrobrás as the public regulatory agency of the purchase and distribution processes. In the documents of the United States Government seems to be a strong presence of political and geopolitical aspects on the discourse construction. The results confirm that the internal and external politics events happened along the analyzed period have influenced the conduction of the public politics related to the liquid biofuels in the United States. In the case of documents of German Government the results seems show that the discourse construction reinforces the culture of a consumers which is supported by public policies that emphasize social aspects.

The results of the similarity analysis, which was carried out by means of Homogeneity Tests between Governments, showed the inexistence of statistically significant values for the Chi-square test statistics in the different test arrangements. Therefore, the conclusion is reached that the Governments of the analyzed countries diverge in the macroenvironment configuration for liquid biofuels, categorizing them under a same set of macroenvironmental dimensions, but with different frequency levels for each of them. Although, additional analysis revealed the existence of greater similarity between the Governments of Germany and United States and greatest divergence between the Governments of Brazil and the United States.

In short, it can be concluded that, even though the liquid biofuels have been a global topic seemingly dominated by the ENVIRONMENTAL dimension, it emerges from the data that three countries configure different macroenvironments, emphasizing different dimensions.

Finally, what are the implications for the management in agribusiness from the findings? Five points can be mentioned in answer to this question. First, considering the fact that the Governments from different countries stress different macroenvironmental, implies that investment decisions and the expansion in the production and use of liquid biofuels may be more or less affected by (changes in) the prevalent configuration of the macroenvironment of that specific country.

Second, the results are in line with Auster and Choo (1994) as it shows that the TECHNOLOGICAL dimension is one of the main dimensions employed by the Governments for the categorization of liquid biofuels, especially by the Brazilian Government. Other dimensions differ more countrywise. Therefore, companies, who 'scan' their macroenvironment for their strategic plans on liquid biofuel production, should take into consideration the specific dominant dimensions in the contents of governmental documents.

Third, the fact that the categorization of liquid biofuels changes from one dimension to the other over time reinforces the importance of making the environment 'scanning' step a structured and continuous process. Therefore, new information can be continuously extracted from the environment and turned into support for the strategic planning and action of companies.

Fourth, it was possible to confirm the possibility of association between a large quantity of textual information and new Information Technologies so as to extract quantitative data from the liquid biofuel macroenvironment. This means that the organizations acting within different fields as well as those acting directly in biofuels may use such resources to carry out environmental 'scanning', making such data available for the strategic planning of their activities.

Fifth and final, the results obtained in this research also have implications for the specific agribusiness field, where the decision between the production of food and energy becomes a strategic decision of companies active in this sector. The fact that the expansion in the production and consumption of liquid biofuels is happening under different macroenvironmental dimensions determined by the particulars of the country may have implications for the local agribusiness motivated by categorization changes verified in other countries. For example, changes in the economic dimension may have a larger impact in the Brazilian Governmental documents on



biofuels than in other countries. A country-by-country analysis of Governmental policies must be taken up to safeguard private biofuel activities in a country.

Finally, the same approach may be applied to other areas of economic activity and may give similar insights, but that up for future research.

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