ASSESSING TAX INSPECTION PERFORMANCE:
A DATA ENVELOPMENT ANALYSIS ON BRAZILIAN FEDERAL TAX OFFICES

By

DE CARVALHO COUY, Joao Paulo

THESIS

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
for the degree of

MASTER OF PUBLIC POLICY

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Committee in charge:

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Approval as of April, 2015

ABSTRACT

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The search for operational efficiency has caused a series of organizational changes for the Secretariat of the Federal Revenue of Brazil (RFB). A large number of them are taking place on tax inspection projection, whose activities have been shifted to regional groups. As the restructure trend seems to only be beginning, it is necessary to evaluate the performance of the current structure in order to guide the forthcoming changes.

The present thesis makes use of Data Envelopment Analysis to rank local offices according their tax inspection performance. The study identified the potential outputs that were not achieved, the best and worst performing units, as well as the relation between their performance and geographic characteristics.

ACKNOWLEDGEMENTS

First of all, I'd like to thank to KDI School for the technical expertise and excellent academic atmosphere. I would also like to acknowledge those who have directly contributed to my writing: Paulo Ogliari for our technical discussions and Ana Gonzalez for the remaining (and greatest) support. I'm grateful for my mother's constant encouragement. Thank you to Café Suplicy for the paid caffeine and free Wi-Fi that have nurtured the following lines.

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List of Acronyms

ADP	Automated Data Processing
COFIS	Tax Inspection Coordination of the Secretariat of the Federal Revenue of Brazil
COGEP	Human Resources Coordination of the Secretariat of the Federal Revenue of Brazil
CRS	Constant Return to Scale
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
GDP	Gross Domestic Product
IBGE	Brazilian Institute of Geography and Statistics
ICT	Information and Communication Technology
IRS	Internal Revenue Service
OECD	Organization for Economic Co-operation and Development
RFB	Secretariat of the Federal Revenue of Brazil
VRS	Variable Return to Scale

1. Introduction

Since its creation in 1965, the Secretariat of the Federal Revenue of Brazil (RFB) – the federal department responsible for the administration of federal taxes, customs operation and social security contributions – organizes its field operations geographically. Local units physically spread throughout the country are responsible for executing almost all of the RFB's mandates.

Even though this structure has historically allowed the institution to have greater knowledge of local differences, there have been studies suggesting that it can cause operational inefficiencies within RFB's human resources management[1] and working specialization.

The development of information and communications technologies (ICT) in the past decades has allowed for significant innovation in the way organizations structure their activities. According to OECD (2013), a world-wide trend has been observed that involves this change in the structure of tax administrations.

The RFB is no exception, and some initiatives show that the institution is changing the organization used to execute its mandates – especially in the field of tax inspection. With new technologies available, inspection activities can be executed with less geographical dependency. Since 2010, the large-taxpayers' inspection procedures are executed by means of a regional structure, rather than locally. By the end of 2014, there are plans to extend this formula to all inspection procedures as well as to tax return assessment – currently performed by local units.

[1] Abranches (2011)

The RFB's tax inspection function is clearly becoming less geographically-driven.

Nevertheless, the research to evaluate the past and forthcoming changes within the Secretariat is little to none. What local units are executing their tax inspections function most efficiently? Where are they located? Does geographical organization influence tax inspection performance?

The knowledge of these aspects is important not only for management evaluation, but also to base future changes to the organization of RFB. In order to answer those questions, the present work uses Data Envelopment Analysis (DEA) to assess the tax inspecting performance of RFB's local offices in the 2009-2013 period.

1.1. Research Questions

The questions guiding the present research are the following:

- What are the RFB's best performing units in terms of tax inspection results?
- Is tax inspection performance influenced by the RFB's geographic division of activities?

1.2. Objectives

The main objective of this research is to evaluate the RFB's operational offices in terms of its tax inspection function. Therefore, the study intents to classify the network of local units by their performance in this function, identifying which of them use resources most efficiently to deliver their respective outputs.

The research also aims to analyze the geographical features of best and worst units in order to determine whether or not performance is influenced by the RFB's geographic organization.

1.3. Scope and Assumptions

The Secretariat is a very complex organization. Its network of local offices has to execute a wide range of activities to fulfill the RFB's institutional and legal mandates. Taxpayer services center, customs administration, tax collection, dispute resolution, to cite a few.

In order to complete a performance study of such a complex organization, it is necessary to limit the scope to be examined. The following limitations and assumptions were used in the research.

1- The customs function is heavily dependent on geographical position. It is mainly executed on the country's border. Many customs activities can be "internalized", but its main objectives and activities are still geographically driven. Therefore, RFB's customs units will not be considered in this work.

2- The RFB also has specialized units for tax collection, tax inspection, for Large Taxpayers and for Financial Institutions. Those units are not in the scope of the included research, as their characteristics are not comparable to those of a regular local unit.

3- In accordance with federal law, the RFB has one type of career and two job titles: tax auditors and tax analysts. To the former, legal power is given to execute core activities –

inspecting, dispute resolution, assessment, penalties constitution, etc., The latter has auxiliary functions – mainly administrative tasks, such as procurement, technology support, etc. The terms *staff* and *workers* will be used to refer to both of the job titles. The term *tax officials* will be used as a synonym for *tax auditors*.

1.4. Relevance

Any business enterprise whose organizational structure does not allow resource optimization and is not aligned with the institution's strategic plan is likely to fail to accomplish its mission. In the case of a country's revenue administration, the organizational factor can be considered an even more delicate issue, considering that "business" outputs, revenue collection, are the main financial source for a nations' public services and social welfare system.

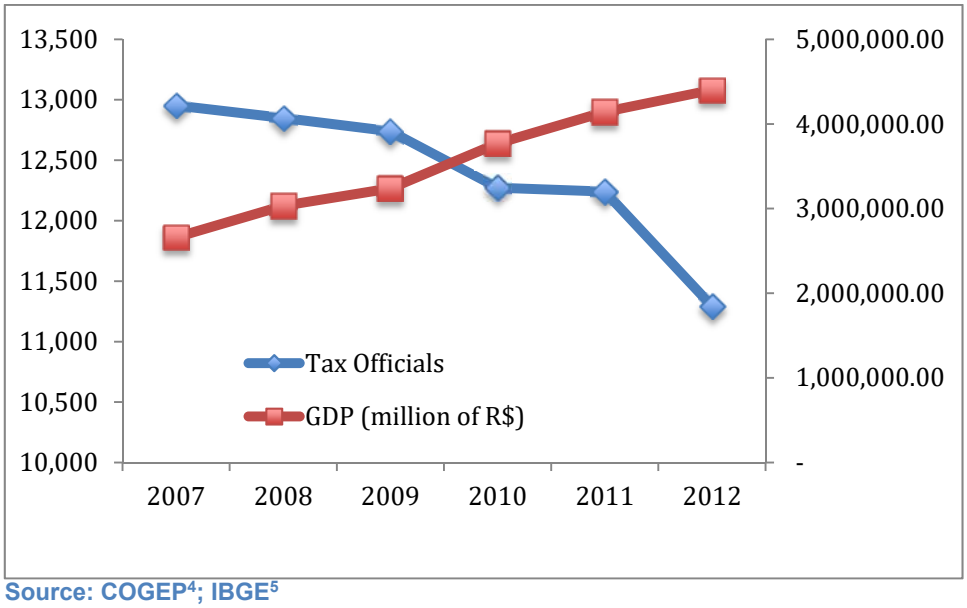
Events such as the 2008-2009[2] world economic crisis indicate that the Brazilian Federal Tax Administration [3] will need extraordinary technical expertise and operational flexibility to maintain the growth of collected revenue. The global economy increases the quantity and complexity of tax related operations and, consequently, possibilities for tax evasion. At the same time, concerns about national fiscal imbalance impose severe limitations to RFB's resources. Graph 1 shows the evolution of RFB's tax

[2] In 2009, the federal tax revenue's growth fell for the first time in 6 years.
[3] It is important to note that the terms t*ax administration* and *revenue administration* are commonly use to describe both the state's power to levy and collect tax and the public organization – the agency, department, etc. – responsible for the necessary activities to collect taxes. To avoid confusion, in the present work it will be using capital letters when referring to the latter.

auditors vis-à-vis the country's gross domestic product, and explains the scenario.

In order to cope with higher demands and fewer resources, higher levels of working efficiency within the Secretariat are indispensable.

Graph 1 - Tax Auditors vs. GDP Evolution



Source: COGEP[4]; IBGE[5]

In the search for higher efficiency, a series of organizational changes has been implemented. Since 2010, tax inspection activities are no longer an exclusive mandate of local units. Regional groups became responsible for large-taxpayers inspections as an attempt to gain economies of scale and specialized environments. Likewise, there are signs that tax return assessment and other inspection activities will be also performed by regional groups.

In order to promote these changes in the best possible fashion, it is essential to identify the current best practices in tax inspection as well as understand the influences of the current organizational model on performance.

[4] RFB's Human Resources Coordination
[5] Brazilian Institute of Geography and Statistics. http://seriesestatisticas.ibge.gov.br/ Accessed in December 2014.

1.5. Thesis Outline

To better contextualize the issues involved in the research and to deliver the work findings, the present study is organized as follows:

Initially, Chapter 2 will discuss the main theoretical aspects involved in the study. It will start with the theory of the organization focusing in the case of Tax Administrations. Then the RFB's key features and current organization will be explored. Finally, the method applied in the research will be discussed.

Chapter 3 will cover the theoretical framework for this research – the DEA and its aspects, as well as the variables chosen.

The results will be evaluated in chapter 4, which will be followed by a final discussion of findings, presented in chapter 5.

2. Literature Review

This chapter presents a discussion of the theoretical research aspects. Initially, the theory of organizations will be introduced, contextualized for Tax Administrations. It will be shown how these institutes are academic revised in terms of structural organization. An examination of RFB's current organization arrangement follows. Finally, the theory of Data Envelopment Analysis is presented as a basis for the next chapter's development.

2.1. Theory of Organization in Tax Administration

Virtually all nations rely on revenue collection to obtain the necessary financial resources to implement public policies and services. Society demands education, security and healthcare – among many other forms of public infrastructure – that are ultimately supported by the collection of taxes.

According Alink and Kommer's (2000) definition, Tax Administrations are organizations whose core business activity is *"the levy and collection of taxes"*. In other words, it is the public organization responsible for executing the activities required to guarantee tax law enforcement and offer necessary services so taxpayers can fulfill their own obligations.

Given the importance of those functions, governments around the globe pay close attention to their Tax Administrations in an effort to achieve the most effective revenue collection possible.

An essential part of the pursuit of revenue maximization is defining the right organizational arrangements for the institution responsible for this activity. According to the OECD (2013), the organizational structure of national Tax

Administrations has recently been "*the subject of major reform*" to increase "*operational efficiency and effectiveness"*.

In this subchapter, the main features of those organizational models will be reviewed.

2.1.1. Tax-type Organizational Structure

The OECD (2013) states that the early choice of 53 researched nations was to structure their Revenue Administration based on the "tax-type" organization. This kind of model would display a number of departments executing all tax-related functions, each of them doing it for a different tax category. The units "*were […] self-sufficient and independent of each other*". (ibid.)

The work of Alink and Kommer (2000) calls this structure the "*tax law approach*", and holds that the working division is generally made between state taxes, customs duties and social security contributions.

Even though the tax type structure can bring some level efficiency by facilitating specialization and making it "*easier to integrate tax collection with auditing"*[6] functions, it is a costlier solution both for the government – as it duplicates operational function – and taxpayers – who have to deal with more than one department to solve a same issue.

According to Crandall and Kidd (2010), international experience proved that structuring departments for different taxes "*perpetuates inefficiencies and duplication of staff, facilities, resources and effort, and is not conducive to*

[6] Alink and Kommer (2000), 53.

taxpayer compliance." These problems led to a development of new structuring solutions, discussed in the following.

2.1.2. Functionally-oriented Structure

Given the inefficiencies detected in the tax-type structure, Tax Administrations have been searching for new solutions to operate. According to the research made by OECD (2013), they are more commonly opting for the "functional" approach. Under this type of organization, the Revenue Organization is grouped by functional groups, such as "*audit, collection, appeals, etc.,*"[7] normally executing these activities for all kinds of taxes.

Kidd (2010) defines function-based organization as "*one structured on the basis of the type of work performed, rather than the type of business or product or the type of customer,*" and states that a Tax Administration under this model achieves "*real gains […] through an increased depth of knowledge in core areas of business expertise."* The development of expertise naturally leads to gains of scale as mastered processes and activities are executed more efficiently.

2.1.3. Taxpayer-type Structure

The search for further operational specialization has developed an organizational model in which the division of work is made based on the taxpayer characteristics. According to Alink and Kommer (2000), categorization can be made according to the nature of the taxpayers – individuals or companies –, their size – small, medium or large –, or the activity they perform – financial companies, government institutions, etc. The

[7] OECD (2013), 59.

rationale behind this form of organizational structure is that specialization will occur by mastering the specific compliance and service demands that each taxpayer segment requires, and gain efficiency through the "*tailored treatment approach."*[8]

Although client-type restructuring should not yet be seen as a general tendency, a hybrid model of it has been largely applied throughout the world. Recent research in the field indicates that only the United States of America and Australia have completely adopted this model, but it also affirms that "*the vast majority of revenue bodies surveyed have established special dedicated units*" to deal with large taxpayers.[9]

2.1.4. Geographical Model and Field Operations Structure

It can be said that geography is always a factor involved in the determination of the Tax Administration organizational model. This might explain why the OECD does not mention this approach as type of model on its own. Nonetheless, Alink and Kommer (2000) reminds us that the geographical model is "*the most common form and makes an ideal combination with other approaches.*" Under this model, the work division is made according to the physical location of taxpayers: a number of regional/local offices offers services and guarantees enforcement within a delimited area.

As mentioned, all other organizational models use the geographical approach, especially in the design of the network of operational offices. It can be seen as a form of division of labor, and the rationale behind it support that

[8] OECD (2013), 60.
[9] Ibid., 84.

the delivery of better services can be made closer to the taxpayers. This includes not only services, but also eased enforcement due to the fact that the institutions have the opportunity to better understand regional and local economic activities.

For those reasons, Tax Administrations tend to adopt geography as the critical factor to structure their networks of field offices. The historical necessity to be in close proximity to individuals and companies makes "*all revenue bodies* [to] *operate with office networks which are geographical and hierarchical*." The resulting structure normally consists of *"large numbers of regional and/or local offices to carry out the full range of functions required for effective administration of tax laws."*[10]

This uniformity across countries may explain why not much theoretical discussion has been made about the organization of operational offices. The debate is also affected by the variety of aspects to be taken into account when structuring the network of operational offices – the country's size, its tax law and mandates, etc. The differences might not allow a feasible general discussion of the issue.

Nonetheless, the debate is likely to increase.

As ICT modifies the way tax activities are executed, initiatives to adjust the operational offices to this new technological reality are observed. A recent study[11] shows that countries are seeing the redesign of "*the administration (and related process redesign and automation) as a high priority area for (…) delivering savings/efficiency gains."*

[10] OECD (2013), 58.
[11] OECD (2012), 02.

The next section discusses the origins for this structural redesign trend, which is founded on the operational evolution of tax activities.

2.1.5. Operational Evolution and Organizational Structure

Camp (2009) is one of the most comprehensive summaries of the evolution of technology and operations on Tax Administrations' activities. The article analyzes the progressive use of Automated Data Processing (ADP) in the Internal Revenue Service (IRS) – the federal revenue administration in the United States of America –, and its findings can be easily expanded to any national Tax Administration.

Computational tools transformed the processing capability of tax administrations, and produced a notable increase in the quantity of taxpayers audited and served by these institutions. The automation of activities has significantly reduced human intervention in various tax-related activities because it allows efficient concentration of processes. This consolidation consequently lowers the need for physical proximity between tax officials and the taxpayers. For that reason, Tax Administrations around the world are showing "*strategies […] to redesign their organization towards a more centralised approach.*"[12]

This trend of transformations is at the core of the present research: organizational changes to adapt to the new operational possibilities in the tax-related activities and achieve higher working efficiency. The following section brings this discussion to the Brazilian Federal Tax Administration reality.

[12] OECD (2012), 15.

2.2. The RFB's Current Organizational Structure

Before exploring the structural aspects of the Secretariat of the Federal Revenue of Brazil, it is important to contextualize the tax system that it is part of.

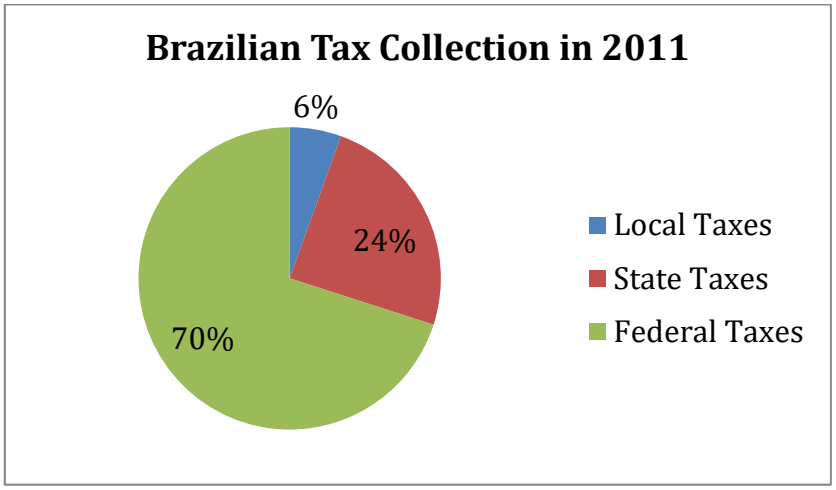
2.2.1. The Brazilian Tax System

Brazil is a federative country that displays a considerable level of decentralization among its three federative entities: federal, state and local (municipal) governments. The nation is composed of 27 states (including the Federal District where the country's capital is located) and more than 5,500 municipalities. One of the decentralized authorities granted to these governments by the country's constitution is tax jurisdiction. Subsequently, the tax system in Brazil is formed by Tax Administrations from all of these federative entities.

However, in terms of revenue collection, the Federal Tax Administration is by far the most representative. In the year 2011, the revenue collection in the country totaled 35,31% of its GDP.[13] The smallest share, 1.95% of GDP, was collected by municipalities, followed by the 26 states and Federal District that together gathered 8.63% of GDP in taxes. The highest collection parcel is from the federal government, whose revenue was equivalent to 24,73% of GDP that year.

[13] RFB (2012)

Graph 2 - Distribution of Brazilian Tax Collection in 2011



Source: RFB (2012)

Graph 2 above indicates the national significance of the Secretariat of the Federal Revenue of Brazil: the agency is responsible for 70% of all revenue collected in Brazil.

2.2.2. The RFB: a brief background

As shown in the previous section, the RFB is the most important tax authority in Brazil. It is a single directorate subordinate to the Ministry of Finance, and has exclusive authority to "*levy and administer taxes on personal income, corporate income, payroll, wealth, foreign trade, banking, finance and insurance, rural property, hydroelectricity and mineral resources.*"[14]

The Secretariat's current organizational structure was developed in 1968. In that year, the RFB was created to replace the General Directorate of National Finance (DGFN) – an institution that used to be organized with different departments according to tax type: income tax, customs duties and other internal tax.

[14] OECD (2011), Appendix A

With the RFB's creation, the federal Tax Administration migrated from the tax-type structure, merging the tax and customs administration. Later, in 2007, the Secretariat also incorporated the mandate to levy and administer social security contributions.

2.2.3. RFB Organizational Analysis

The Secretariat currently has a functional structure composed of a strong headquarters located in Brasília – the country's capital – and a network of operational offices. The former are responsible for the planning and supervision of tax policies. The operational tax activities (collection, auditing, customs control, taxpayer services, etc.) are executed by the latter – a number of decentralized units geographically organized to deliver those functions.

2.2.4. Operational Offices

The RFB's network of operational offices is organized into 10 regional management divisions – called "fiscal regions" – as shown in Figure 1 below.

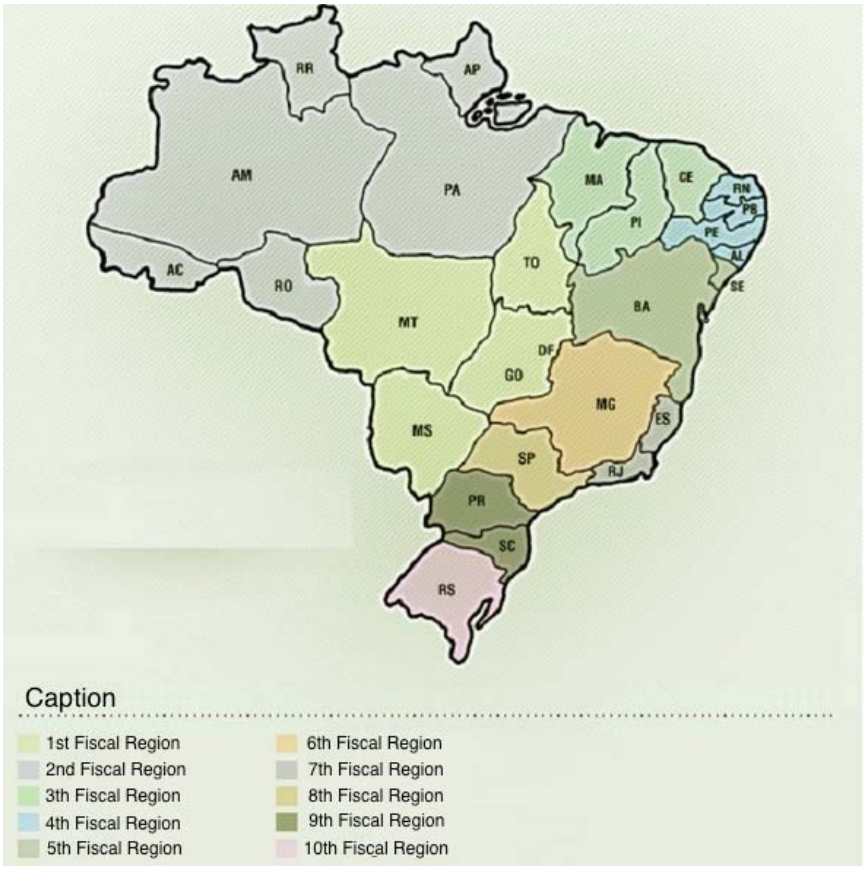


Figure 1 - Fiscal Regions

Each of the fiscal regions manages operational offices through a hierarchy within its region's territory. In the last 50 years, the initial strict geographical approach for the operational office organization has evolved along with the introduction of function-based and, more recently, client-type units.

The following chart shows the quantities of decentralized units for each fiscal region. As mentioned in the Scope and Assumptions section, the present research will focus only on the regular local offices. This type of unit is set to apply locally to all tax related functions – from taxpayer services to tax inspection activities.

Chart 1 - Type of decentralized units

Type of Unit	Fiscal Region										
	1st	2nd	3th	4th	5th	6th	7th	8th	9th	10th	Total
Customs Office	1	4	4	2	2		4	4	3	2	26
Customs Inspection Office	6	15		6	3	1	1	2	9	12	55
Taxpayers Services Center	33	22	35	31	33	41	21	64	42	38	360
Dispute Resolution Offices	2	1	1	1	1	2	1	3	2	1	15
Special Office for Tax Inspection								1			1
Special Office for Financial Institutions								1			1
Special Office for Large Taxpayers							1	1			2
Special Office for High Net Worth Individuals						1					1
Special Office for Collection Administration								1			1
Special Office for Individuals								1			1
Special Office for International Trade								1			1
Regular Local Office	7	9	7	7	6	12	8	21	11	9	97
Total	49	51	47	47	45	57	36	100	67	62	561

Adapted from http://www.receita.fazenda.gov.br/SRF/UnidadesDescentralizadas/estrutura.htm. Accessed in December 2014.

2.2.5. Tax Inspection Function

The RFB's tax inspection function is mainly executed by the local offices. As seen in Chart 1, by 2014 there were 97 of these offices spread throughout the country.

This considerable number of local offices is a consequence of the Secretariat's historical need for proximity to the taxpayers. Without the technological tools available in the present day, tax forms were filled exclusively by hard copy, corporate accounting acts were registered in large heavy books, and assessment took place in the taxpayer's presence. Efficiency was heavily dependent on proximity to citizens and corporate entities for faster and safer exchange of information.

However, ICT development allowed for significant modifications on tax operations. Today, virtually all tax return forms are filled through a piece of computational software and are submitted to the tax administration via internet. Additionally, companies are recording their accounting activity electronically and storing information in database systems. Moreover, digital tools have facilitated taxpayers' self-assessment and self-assistance.

This operational evolution allowed the Secretariat to consolidate investigation and inspection procedures for large taxpayers in 2010. Since then, every RFB fiscal region coordinates a group that is responsible for executing these tasks. There is a general perception that the initiative was successful, and more changes are expected to come.

There have been trials within the Secretariat that indicate all tax inspection activities will be concentrated in the short term. This move will modify the 50-year-old organizational structure for the activity of tax inspection.

This scenario leads to the belief that the present research plays a key role in the organizational transition. The study has an unprecedented goal: to classify the tax inspection performance of local offices through Data Envelopment Analysis. It will give a blueprint of this activity in the present organization and serve as a basis for the establishment of new structures.

The theoretical aspects of DEA are shown in the next section.

2.3. Data Envelopment Analysis

The research used the method Data Envelopment Analysis (DEA) to evaluate tax inspection performance among RFB's operational offices. Here is a brief discussion of the method's theoretical characteristics.

2.3.1. Definition and Background

According to Cooper, Seiford and Zhu (2004), DEA is a "*data oriented approach for evaluating the performance of a set of peer entities called Decision Making Units (DMUs) which convert multiple inputs into multiple outputs*." The same work states that the concept of DMU is flexible and applications of DEA "*have used DMUs of various forms to evaluate the performance of entities, such as hospitals, US Air Force wings, universities, cities, courts, business firms, and others, including the performance of countries, regions, etc.*"[15]

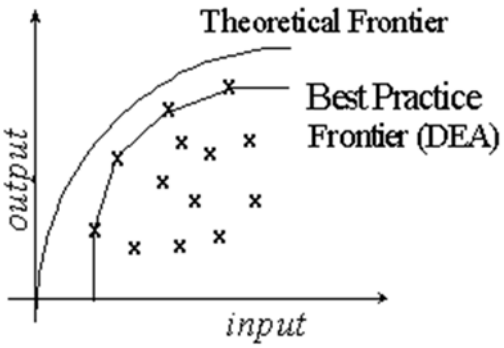
The method was first presented in 1978 and its authors highlighted their intention to create possibilities to evaluate "*not-for-profit entities rather than the more customary 'firms' and 'industries'.*" [16] Given that market measures – such as price and cost of production – are normally not applicable to not-for-profit organizations, the method uses data variables to empirically estimate production relations. In the authors' words, it is a *"mathematical programming model applied to observational data* [that] *provides a new way of obtaining empirical estimates of relations - such as the production functions and/or efficient production possibility surfaces.*"[17]

DEA can thus be defined as a non-parametric methodology that uses a set of data (inputs and outputs) to compare relative efficiency or performance. The method works with the concept of frontiers of efficiency instead of central tendencies normally seen in statistical regression. [18] The efficient DMUs

[15] Cooper, Seiford and Zhu (2004), 02.
[16] Charnes, Cooper and Rhodes (1978), 429.
[17] Cooper, Seiford and Zhu (2004), 02.
[18] Cooper, Seiford and Zhu (2004)

delineate the surface enveloping non-efficient units and serve as referent to the latter.

Figure 2 - DEA frontier



Souce: CMTE (2013)

2.3.2. Applications and Limitations

According to Golany and Roll (1989) the method's application requires comparable units (executes the same tasks and has similar objectives), that these units be under the same "market conditions", and that inputs/outputs be the same except for their magnitudes.

The resulting DEA study will display, among others: an efficient frontier formed by the best practice units; a measurement of inefficiency that consists of "*the distance from each unit to the frontier*"; and targets for the inefficient units.[19]

Although a flexible and robust method, some DEA characteristics can limit its use: data noise "*such as measurement error can cause significant problems";* the method works with relative efficiency rather than absolute efficiency; being a nonparametric technique, it is difficult to use in the case of

[19] CMTE (2013)

hypothesis tests; and the use of DEA can demand huge computational effort due to its linear programing nature.[20]

2.3.3. Model Orientation and Basic Types

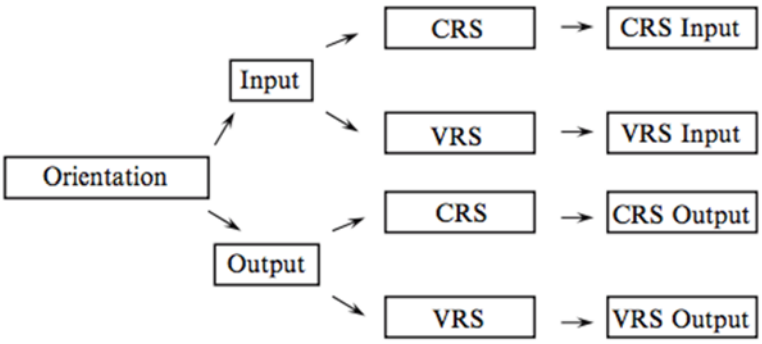
DEA can be applied to be either *input* or *output* oriented. If the analysis is to emphasize reduction of inputs, the former is used, while the latter is normally used when the evaluation is guided by output augmentation of a given set of inputs.

The DEA models can also be classified according to the scale involved in the problem to be assessed. The two basic formulations are the constant return of scale (CRS) – the choice for cases where it can be assumed that output increases (decreases) proportionally to an input increase (decrease); and the variable returns-to-scale (VRS) model, used when a change on inputs causes not proportionate variation on outputs.

Ozcan (2008) summarized the basic DEA model as in the Figure 3.

[20] Trick (1998)

Figure 3 - DEA basic model classification



Source: Ozcan (2008)

2.3.4. DEA to Evaluate Tax Office Performance

DEA is believed to be very appropriate to this study's objectives. The model will identify the RFB's best performing local offices, consider them *efficient* and assign them a score of one. These efficient offices will then serve as a comparison reference to all other units – offices will be considered inefficient if they "*require relatively more weighted inputs to produce weighted outputs or, alternatively, produce less weighted output per weighted inputs than"* efficient offices.[21] The inefficient offices receive a score greater than zero but less than one.

The performance evaluation of tax offices using DEA has been consistently carried out in the literature. Førsund, Kittelsen and Lindseth (2005) did it for Norwegian tax offices, while Barros (2005) and Katharaki and Tsakas (2010) did it for Portuguese and Greek tax offices, respectively.

The work of Moesen and Persoon (2002) – which evaluated 289 Belgian tax offices – is the work most closely related to the present study, as both similarly define inputs and outputs. The following chapter discusses the methodology steps in detail.

[21] Ozcan (2008), 25.

3. Methodology

The research aims to evaluate performance of the RFB's operational offices with respect to its tax inspection function. In order to do so, Data Envelopment Analysis will be used, a methodology first proposed by Charnes, Cooper and Rhodes (1978).

Since its first application, the model has been largely used to evaluate relative organizational performance. It was first intended to apply in the public sector in which economic variables (such as profit) may not be present – which is exactly the case in this research.

According to Golany and Roll (1989), a DEA study may follow three steps: (a) definition and selection of DMUs; (b) determine adequate input and output factors; and (c) application of DEA model and subsequent results analysis. The study was done over a 5-year period - from 2009 to 2013.

3.1. Universe Delimitation

By the end of 2013, the RFB field operations were made by 561 decentralized offices (see Chart 1). Of these, there were a total of 360 taxpayer service units that didn't have tax inspection activities. Also, 81 offices dealt exclusively with customs activity. Even though inspection activities exist in customs units, their nature is not comparable to a regular decentralized unit, and these customs offices were not considered in the study.

Of the remaining 120 offices, there were 27 units organized by specializations – collections office, large taxpayers offices, dispute resolution units, etc. These were also excluded from the investigation because their

internal departmentalization is very different from a regular decentralized office and the method requires comparable DMUs.

The total sum of offices considered in the research is shown in Chart 2 below and the complete list of these DMUs can be seen in APPENDIX A – List of DMUs. For confidentiality reasons, the offices will be represented in this work by a code.[22]

Chart 2 - Number of Offices (DMUs) Considered in the Study

	2009	2010	2011	2012	2013
Number of offices	94	94	95	97	97

3.2. Variables

One of the main goals of the tax inspection function is "fiscal presence" – to display fiscal authority in order to promote taxpayer compliance. And within the RFB, this goal is performed roughly through two activities.

The most important tax inspection activity is *inspection procedures*. It is a classic task in which a tax auditor has to investigate whether or not a taxpayer's economic operations were taxed according to the law. This activity is generally completed out-of-office, and the selection of a taxpayer for inspection is made through internal intelligence techniques.

The second most representative inspection activity is the *assessment of individuals' tax return forms*. This activity is normally performed in-office by tax auditors and consists of a manual revision of return forms with trace irregularities. Forms to be revised are automatically selected by a computational system.

[22] The code is composed by the Portuguese anachronism for local office "*DRF*" followed by a first number to represent its fiscal region (1 to first region until 0 for the tenth) and sequential numbers to enumerate the office. For example, the DRF89 is the unit number 9 of the 8th fiscal region.

There are a few other activities executed within the tax inspection function, but they were not considered significant enough to evaluate performance.

3.2.1. Outputs

The natural outputs for the study would be the total number of return forms manually assessed, and inspection procedures executed per year in each office.

However, the inspection procedures have a strategic purpose: with a limited number of officials to investigate a massive number of tax infractions, ideally every procedure will successfully identify an infraction. When it fails to do so, the limited inspection power available is hindered. Consequently, the performance evaluation should not count a failed procedure as output.

Therefore, the chosen **outputs** for the model are:

a) The total number of return forms manually assessed;

b) The total number of successful inspecting procedures executed.

3.2.2. Inputs

The technology to execute these two activities is basically the same throughout the analyzed offices. It is therefore realistic to affirm that the number of workers is the only substantial constraint varying among the DMUs.

As explained in Section 1.3, there are two job positions within the RFB profession. Tax auditors are the only position with the legal mandate to execute both activities – return forms assessment and inspection procedures. Thus, the number of tax auditors working in the office must be one of the model's inputs.

Even though none of the outputs are directly executed by tax analysts, these workers are indispensable for a well-functioning local office. They play a key role in the execution of other activities locally executed. Therefore, it is expected that the number of tax analysts will influence inspection performance, and it will represent the second input for the model.

In summary, the inputs are:

a) The total number of working tax auditors per office;

b) The total number of working tax analysts per office.

3.3. Data

The data used in the research – inputs and outputs – were all extracted from RFB's intern systems and controls.

Inputs – number of auditors and analysts – were obtained from the RFB's Human Resources Coordination – COGEP. The position was only taken into account for December of each year, as changes during the year are not representative.

Output figures were extracted from the system controlled by the RFB's Tax Inspection Coordination – COFIS. For the first output – number of procedures yearly executed – the final number was found by adding the total number of procedures per tax type. This means that if one procedure inspected, for example, two different types of taxes, this procedure was counted as two outputs. The counting approach was used to consider the inspection's difficulty in the total output.

The total number of personal return forms analyzed – second output – was obtained by considering only the forms assessed by a tax auditor.

3.4. DEA Model

Given the study's objectives, a DEA model with the following characteristics was chosen:

1. Constant Return to Scale. It was assumed that outputs change proportionally to input increases/reductions. According to Moesen and Persoon (2002), this assumption results in a stricter efficient frontier – what is judged to be more appropriate for the present study.

2. Output-oriented. Because the goal is to evaluate which units performed better with their available resources. As explained by Katharaki and Tsakas (2010), the output-oriented was always the choice on DEA studies for tax office performance evaluation.

3. Mathematical formulation. The DEA constant return to scale model was first introduced by Charnes, Cooper and Rhodes (1978). The mathematical representation for its output-oriented model, assuming constant return to scale, is explained by Camanho (1999) as the following.

Equation 1 - DEA constant return to scale output-oriented 'weights' model

$$\text{Min } h_{j_0} = \sum_{i=1}^{m} v_i x_{ij_0} \qquad \text{s.t.} \sum_{r=1}^{s} u_r y_{rj_0} = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \leq 0$$

$$u_r \geq \varepsilon, \quad v_i \geq \varepsilon$$

j = 1,…,n
r = 1,…,s
i = i,…,m

Source: Camanho (1999)

With *x* and *y* being the set of inputs and outputs, respectively, the formulation above is known as weights formulation of the DEA model, with u_r as the weight attached to the former and v_i to the latter. The weights depend "*on the scaling of each input and output"* and the model uses 'virtual' inputs

and outputs[23]. "*The mathematical infinitesimal (ε) is used to ensure that all inputs and outputs included in the model are taken into account.*"[24]

The model above can be written in an envelopment formulation as follows:

Equation 2 - DEA output-oriented 'envelopment' model

$$\left(\sum_{j=1}^{n}\lambda_j^* x_{ij}, \sum_{j=1}^{n}\lambda_j^* y_{rj}\right)$$

$$MAX\ h_{j_0} = \delta_0 + \varepsilon\left(\sum_{i=1}^{m} S_i + \sum_{r=1}^{s} S_r\right)$$

$$s.t. \sum_{j=1}^{n}\lambda_j\, x_{ij} + s_i = x_{ij_0}\,, \qquad \mathrm{i} = 1,\ldots,\mathrm{m}$$

$$\delta_0 y_{rj_0} - \sum_{j=1}^{n}\lambda_j y_{rj} + s_r = 0, \qquad \mathrm{r} = 1,\ldots,\mathrm{s}$$

$$\lambda_j, s_i, s_r \geq 0, \qquad \forall \mathrm{j,i,r}$$

Source: (Camanho 1999)

In this formulation, s_i and s_r are the so-called slacks – variables that "*indicate the extent to which individual inputs or outputs could be improved over and above the amount indicated by the efficiency score.*"[25]

A DMU is efficient if it results in $1/\delta_0^* = 1$, and has no positive slack values.

The model also offers a possibility to analyze inefficient DMUs by assessing a set of targets that would make them efficient. These targets are assessed as the following:

[23] Represented by Camanho (1999) as $v_i^* x_{ij0}$ and $u_r^* y_{rj0,}$ respectively.
[24] Camanho (1999), 31.
[25] Ibid., 33.

Equation 3 - Targets for output-oriented model

$$x_{ij_0}^{OT} = x_{ij_0} - s_i^* = \sum_{j=1}^{n} \lambda_j^* x_{ij};$$

$$y_{rj_0}^{OT} = \delta_0^* y_{rj_0} + s_r^* = \sum_{j=1}^{n} \lambda_j^* y_{rj}$$

Source: (Camanho 1999)

To apply the chosen method, *Open Source DEA* software[26] was used.

The findings are shown on the next chapter.

[26] Available at http://www.opensourcedea.org/

4. Findings

The study results are presented in the following steps: 1) an overall examination of performance scores, 2) an analysis of best and worst performers in one year, 3) a comparison between actual and potential outputs and 4) a discussion on geographical influence on performance.

4.1. Performance Scores Distribution and Frequency

According to the DEA model, an efficient tax office will have a score equal to 1. The smaller the score, the more inefficient a unit is compared to an efficient DMU.

The analysis of score distribution and frequency shows a considerable number of inefficient units. As can be seen in Chart 3, there are units with scores as low as 0.1 in the years 2012 and 2013.

Chart 3 - Score distribution

	2009	2010	2011	2012	2013
≤ 0.1	0	0	0	1	1
0.1< x ≤ 0.2	1	1	1	1	1
0.2 < x ≤ 0.3	1	8	2	1	1
0.3 < x ≤ 0.4	3	22	7	6	6
0.4 < x ≤ 0.5	17	19	13	21	11
0.5 < x ≤ 0.6	23	21	25	20	24
0.6 < x ≤ 0.7	16	9	19	21	18
0.7 < x ≤ 0.8	12	5	11	11	17
0.8 < x ≤ 0.9	5	5	6	5	8
0.9 < x ≤ 1	16	4	11	10	10
Total	94	94	95	97	97

Source: ***OpenSource DEA; MS Excel 2010***

Chart 4 shows that the percentage of units with scores below 0.4 increased from 5% in 2009 to 9% in 2013 – peaking at 33% in 2010. In other words, a third of the RFB's units performed 40% below their potential when compared to efficient units in 2010.

As for the top performing units (scores between 0.9 and 1), their frequency decreased from 17% in 2009 to 10% in 2012 and 2013, which

indicates a worsening trend. Moreover, in 2010 only 4% of the 94 DMUs analyzed performed as high as 0.9.

Chart 4 - Score frequency

Scores	2009	2010	2011	2012	2013
≤ 0.4	5%	33%	11%	9%	9%
0.4 < x ≤ 0.7	60%	52%	60%	64%	55%
0.7 < x ≤ 0.9	18%	11%	18%	16%	26%
0.9 < x ≤ 1	17%	4%	12%	10%	10%

Source: OpenSource DEA; MS Excel 2010

Finally, the examination of Chart 4 indicates that throughout the 5 years of study, the majority of RFB's local units were performing at intermediate levels – with scores between 0.4 and 0.7.

4.2. DEA Analysis

As mentioned in the previous subsection, there are few local units working at an efficient level (scores equal to 1). In 2009, there were only 6 efficient units out of a total of 94. These DMUs are shown in Chart 5 below.

Chart 5 - Efficient DMUs - 2009

	Inputs		Outputs		
DMU	**Auditors**	**Analyst**	**Forms revised**	**Inspection Procedures**	**Score**
DRF61	362	103	16647	1477	1
DRF51	203	63	9366	1646	1
DRF24	99	62	8822	938	1
DRF819	70	51	8247	400	1
DRF610	18	6	488	197	1
DRF35	10	12	489	140	1

Source: COGEP; Acao Fiscal; OpenSource DEA; MS Excel 2010

These units are the model's best performers, and serve as a reference for other units. On the other hand, Chart 6 shows the results of units with scores lower than 0.4. It illustrates the key aspects of a DEA assessment.

The model indicates, for example, that when compared with efficient DMUs, unit *DRF17* produced only a third (score 0.33) of possible outputs for its given set of inputs in 2009. The unit executed 416 form assessments and 94 inspection procedures, but if it was to perform as an efficient unit, the

outputs should have been the 1268 and 286, respectively. These values are the output *targets* found by the DEA model for each inefficient office.

Chart 6 - Worst Performing Units - 2009

	DMU					
	DRF08	**DRF96**	**DRF17**	**DRF09**	**DRF65**	**Total**
1. Performance Score	0.11	0.29	0.33	0.36	0.40	
2. Forms assessed	230	683	416	1081	1790	
2.1 Target	2089	2323	1268	3003	4486	
Difference from target	*1859*	*1640*	*852*	*1922*	*2696*	*8969*
3. Inspection procedures	74	321	94	102	308	
3.1 Target	672	1092	286	283	772	
Difference from target	*598*	*771*	*192*	*181*	*464*	*2206*
4. Analyst	73	152	24	28	59	
Input Slack	*15*	*58*	*0*	*7*	*0*	*80*

Source: COGEP; Acao Fiscal; OpenSource DEA; MS Excel 2010

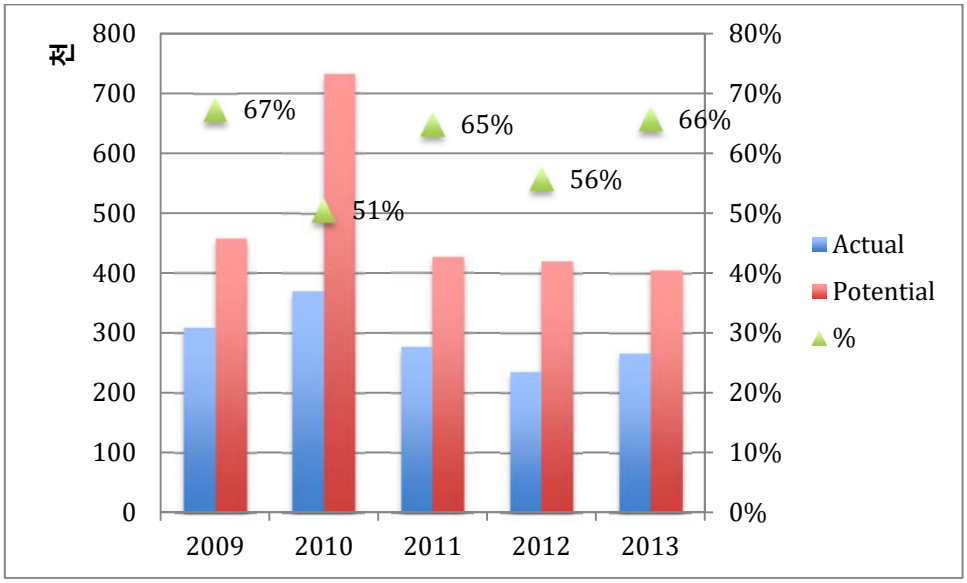
Similarly, the *DRF96* could increase its output by 1640 forms assessed and 771 inspection procedures. The difference in this case is the *input slack*: even after the proportional increase of outputs by performance score, this unit would still be inefficient. Due to the fact that it cannot achieve further increases in output, the *DRF96* would need to reduce its number of Tax Analysts to become efficient. In conclusion, to become efficient the unit needs not only for their outputs to increase, but also to reduce the number of tax analysts by 58.

The analysis made for the year 2009 can similarly be extended to 2010-2013 period.

4.3. Potential vs. Actual Outputs

The output targets represent the potential production an inefficient office can deliver if it works as an efficient unit. Graph 3 gives a comparison between observed and potential number of returns forms revised from 2009 to 2013.

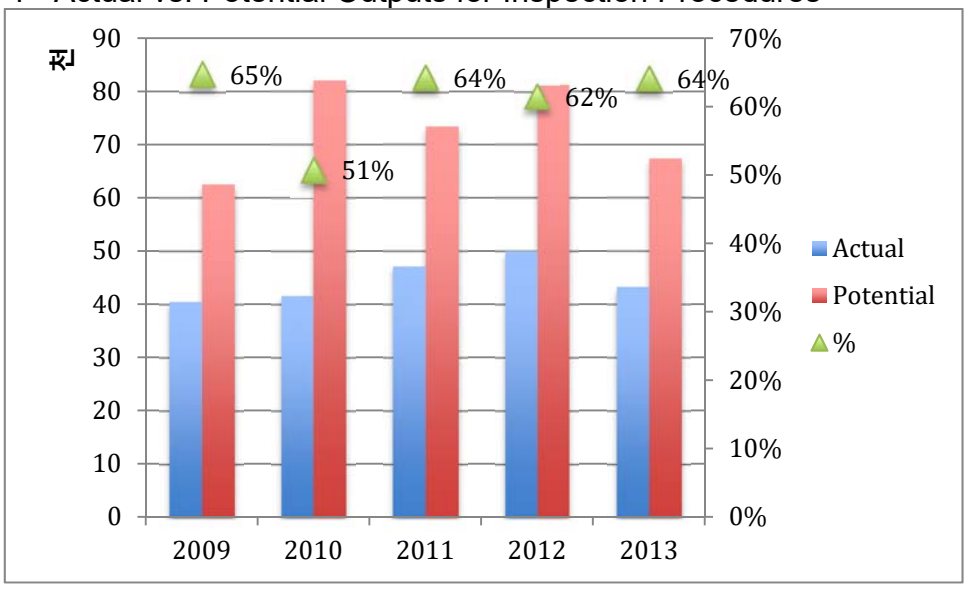
Graph 3 - Actual vs. Potential outputs for return forms assessment



The potential capacity to assess personal tax returns within the RFB leveled off at around 400,000 between 2011 and 2013. However, the number of assessed forms never reached 300,000 in this period. The Graph's secondary axis indicates the percentage of the potential output was actually executed in each year – this figure never reached the 70% level throughout the 5 years analyzed.

Similarly, the total number of inspection procedures executed stayed at around 65% of potential output for the whole period – reaching a minimum percentage of 51% in 2010.

Graph 4 - Actual vs. Potential Outputs for Inspection Procedures



Source: OpenSource DEA; MS Excel 2010

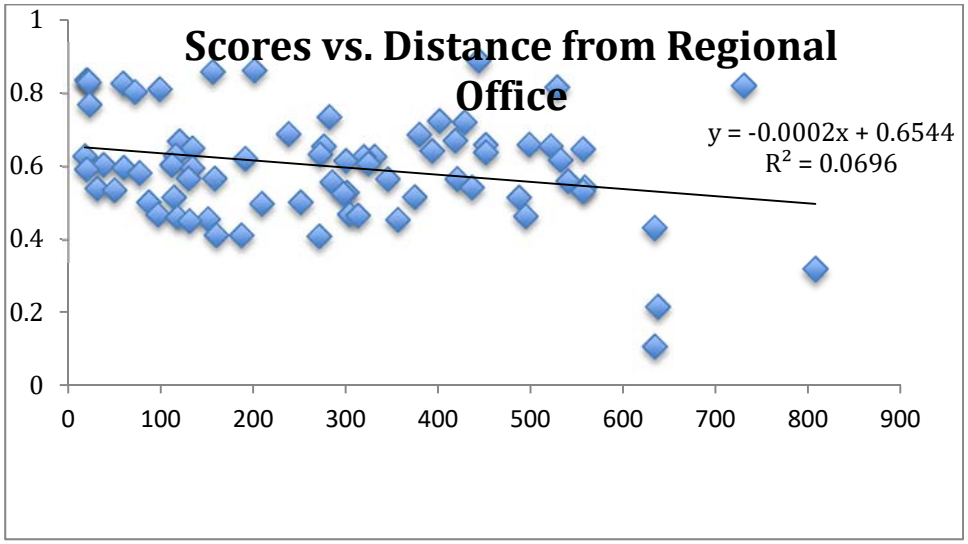
4.4. Performance vs. Geography

A secondary objective of the present study is to evaluate whether or not RFB's geographic-driven organization influences tax inspection performance. In order to do so, this subchapter analyzes the geographical characteristics of both top 10 and bottom 10 performers according to the model.

The first step was to evaluate any possible correlation between the local office's overall performance and its distance from the corresponding regional unit. The rationale behind this test comes from the perception that the farther a local unit is from its Regional Office, the lower the capacity of the DMU to retain staff, and consequently, its working specialization.

Having sorted the list of DMUs by the weighted mean of their performance scores, the regression in Graph 5 shows that there is no correlation between a DMU performance and distance from the respective regional office.

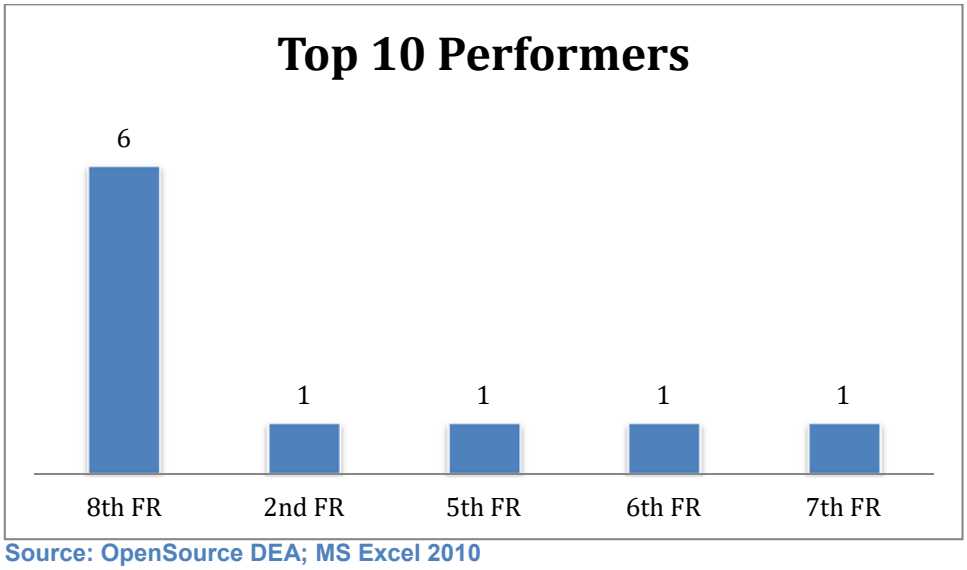
Graph 5 - Performance Scores vs. Distance from Regional Office



Source: OpenSource DEA; MS Excel 2010

Nevertheless, it is possible to note some key geographic features in the top 10 and bottom 10 performers. Graph 6 displays the fiscal region in which the top performers are located. According to the model, 60% of top performers are located in the 8th fiscal region – which corresponds to the state of Sao Paulo.

Graph 6 - Fiscal Region, Top 10 Performers



Source: OpenSource DEA; MS Excel 2010

The 8th fiscal region is the RFB's densest in terms of local offices and staff. Taking the year 2011 as an example, the region's local office density was one per 11,820 square kilometers. As for staff density, the figure was one

worker (either tax auditor or analyst) per 104 square kilometers. Chart 7 shows the density for 2011.

Chart 7 - Staff and DMU Density per Fiscal Region in 2011

FISCAL REGION	AREA (km^2)	LOCAL UNITS	STAFF	UNITS DENSITY (km^2/Unit)	STAFF DENSITY (km^2/Staff)
8th FR	248,222	21	2396	11,820	104
7th FR	89,875	6	829	14,979	108
9th FR	295,044	11	1533	26,822	192
10th FR	281,730	9	1213	31,303	232
4th FR	235,207	6	704	39,201	334
6th FR	586,522	12	1322	48,877	444
3th FR	732,435	8	657	91,554	1,115
5th FR	586,648	6	654	97,775	897
1st FR	1,884,124	7	921	269,161	2,046
2nd FR	3,575,956	9	640	397,328	5,587

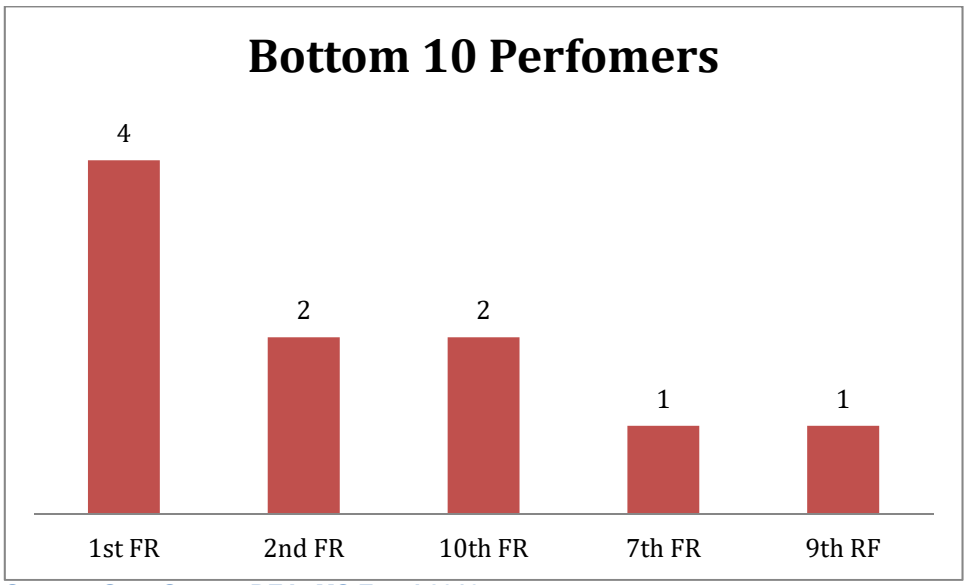
Source: COGEP; IBGE[27]

Conversely, the 1st and 2nd fiscal regions are the Secretariat's least dense. In these fiscal regions, there was one local office for every 269,161 and 397,328 square kilometers, respectively. In terms of staff, the referred to regions also show small density with one worker for every 2,046 square kilometers in the 1st fiscal region and one per 5,587 in the 2nd.

It appears to be no coincidence that the 1st and 2nd FRs together account for 60% of the study's bottom 10 performers (as shown in Graph 7). Although it is not possible to directly correlate density of local units and staff to tax inspection efficiency, the characteristics of best and worst performers suggest that the analyzed density may influence in the way a DMU will perform that tax function.

[27] http://www.ibge.gov.br/home/geociencias/areaterritorial/principal.shtm. Accessed in July/2013.

Graph 7 - Fiscal Region, Bottom 10 Performers



Source: OpenSource DEA; MS Excel 2010

5. Conclusions and Final Remarks

Public organizations are under constant pressure to reach higher levels of working efficiency. With decreasing human resources and growing service demand, these institutions have no option but to find new ways of executing their activities more efficiently.

In the case of RFB, a great part of this effort is reflected in modifications of its organizational structure. The Secretariat innovated by creating offices according to functions and taxpayer types. Also, activities previously completed by the network of operational offices were shifted to regional groups, and more initiatives are expected to come.

The present research has aimed to serve as a basis for these future transformations. The main purpose of the study was to evaluate local offices according to their tax inspection performances for the 2009-2013 period.

By ranking the local tax offices, the Secretariat can: a) identify which units are working at higher levels of efficiency; b) pinpoint the location of these high-performing units and study their management features; and c) in case of organizational changes, evaluate how to expand the identified best management practices for the new institutional arrangement.

The results show that around 10% of analyzed offices are currently performing 40% below their potential in terms of tax inspection. The Secretariat has an immediate opportunity to act on the management of these units in order to improve tax inspection outputs.

Concerning the total output, the study indicates the studied local offices are performing at around 65% of potential output. In other words, there would be room to increase tax inspection by 35% if inefficient units worked as

efficiently as their peers. Even though it is not realistic to imagine an institution with all its units operating at maximum efficiency levels, this figure indicates that feasible management modifications would lead to considerable improvement in results.

The second objective of the study was to investigate whether or not performance was somehow related to the RFB's geographic organization. A correlation test between a unit's performance and its distance from the respective regional office showed no significant correlation between these variables.

Even though the remoteness of a local office doesn't seem to influence working efficiency, some regional features appear to do so. When looking at the characteristics of the fiscal region where the local offices are located, it became clear that the majority of the overall top performing units were located in a region with a high density of local offices. Conversely, the overall worst performers are located in the two lowest dense regions in terms of units.

This finding seems to be important for the Secretariat, as recent changes in the tax inspection field have been shifting this function's management and execution to groups that are regionally centered. If this modification trend is to continue, the RFB will need to evaluate whether office density is a variable to be taken into account.

The application of Data Envelopment Analysis has proved to be a very useful evaluation tool, and it is possible to imagine its further use in the Secretariat. Future researches could, for example, use the method taking into account other tax functions executed by local offices. Also, the DEA input-

oriented methodology could promote fairer distribution of resources, reallocating staff and other resources based on DEA's efficiency results.

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APPENDIX A – List of DMUs

DMU	Years	DMU	Years	DMU	Years
DRF16	All 5 years	DRF63	All 5 years	DRF816	All 5 years
DRF11	All 5 years	DRF54	All 5 years	DRF811	All 5 years
DRF12	All 5 years	DRF55	All 5 years	DRF812	All 5 years
DRF13	All 5 years	DRF56	All 5 years	DRF813	All 5 years
DRF14	All 5 years	DRF61	All 5 years	DRF814	All 5 years
DRF15	All 5 years	DRF62	All 5 years	DRF815	All 5 years
DRF17	All 5 years	DRF64	All 5 years	DRF817	All 5 years
DRF21	All 5 years	DRF65	All 5 years	DRF818	All 5 years
DRF22	All 5 years	DRF66	All 5 years	DRF819	All 5 years
DRF23	All 5 years	DRF67	All 5 years	DRF820	All 5 years
DRF24	All 5 years	DRF68	All 5 years	DRF821	All 5 years
DRF25	All 5 years	DRF69	All 5 years	DRF91	All 5 years
DRF26	All 5 years	DRF610	All 5 years	DRF92	All 5 years
DRF27	All 5 years	DRF611	All 5 years	DRF93	All 5 years
DRF28	All 5 years	DRF612	All 5 years	DRF94	All 5 years
DRF29	All 5 years	DRF71	2012, 2013	DRF95	All 5 years
DRF31	All 5 years	DRF72	All 5 years	DRF96	All 5 years
DRF32	All 5 years	DRF73	All 5 years	DRF97	All 5 years
DRF33	All 5 years	DRF74	All 5 years	DRF98	All 5 years
DRF34	All 5 years	DRF75	All 5 years	DRF99	All 5 years
DRF35	All 5 years	DRF76	All 5 years	DRF910	All 5 years
DRF36	All 5 years	DRF77	2011 to 2013	DRF911	All 5 years
DRF37	All 5 years	DRF78	All 5 years	DRF01	All 5 years
DRF38	All 5 years	DRF81	All 5 years	DRF02	All 5 years
DRF41	All 5 years	DRF82	All 5 years	DRF03	All 5 years
DRF42	All 5 years	DRF83	All 5 years	DRF04	All 5 years
DRF43	All 5 years	DRF84	All 5 years	DRF05	All 5 years
DRF44	All 5 years	DRF85	All 5 years	DRF06	All 5 years
DRF45	All 5 years	DRF86	All 5 years	DRF07	All 5 years
DRF46	All 5 years	DRF87	All 5 years	DRF08	All 5 years
DRF51	All 5 years	DRF88	All 5 years	DRF09	All 5 years
DRF52	All 5 years	DRF89	All 5 years		
DRF53	All 5 years	DRF810	All 5 years		