

Forum: Practical Perspectives

Effects of the electronic invoice program on the increase of state collection

Patrícia Araújo Vieira¹Daiana Paula Pimenta²Alethéia Ferreira da Cruz²Eliane Moreira Sá de Souza³¹ Secretaria da Fazenda do Estado de Goiás, Goiânia / GO — Brazil² Universidade Federal de Goiás / Programa de Mestrado em Administração Pública e Programa de Pós-Graduação em Ciências Contábeis, Goiânia / GO — Brazil³ Universidade Federal de Goiás / Programa de Mestrado Profissional em Administração Pública, Goiânia / GO — Brazil

This article aims to verify if the implementation of the Electronic Invoice program (EI), generated an increase in the collection in the state of Goiás, Brazil. For the research, means test analysis (t-test) was used along with the estimation of regressions difference-in-differences. The results indicated that the average collection in the state of Goiás was statistically higher in the period after the implementation of EI and that the increase in the collection from companies required to issue EI was superior to the collection from those not required to during the period of investigation. Therefore, although the main focus of EI is not the increase in tax collection, it can be observed that the institutionalization of a program of standardization and sharing of fiscal documents included improvements in the inspection processes of the tax administration, increasing the collection of state taxes through the reduction of tax default.

Keywords: public fiscal policy; electronic invoice; state collection.

Efeitos do programa de Nota Fiscal eletrônica sobre o aumento da arrecadação do Estado

O objetivo deste artigo é verificar se a implantação do programa de Nota Fiscal eletrônica (NF-e) gerou como consequência algum incremento na arrecadação do Estado de Goiás. Para tanto, utilizaram-se testes de médias e estimação de regressões *difference-in-differences*. Os resultados indicaram que a média de arrecadação no Estado de Goiás é estatisticamente superior no período posterior à implantação da NF-e e que o aumento da arrecadação das empresas obrigadas a emitir NF-e foi maior do que o daquelas que não são obrigadas. Assim, apesar do foco principal da NF-e não ser o aumento da arrecadação, pode-se observar que a institucionalização de um programa para padronização e compartilhamento dos documentos fiscais incluiu melhorias nos processos de fiscalização da administração tributária, aumentando a arrecadação do Estado por meio da redução da inadimplência.

Palavras-chave: política pública fiscal; Nota Fiscal eletrônica; arrecadação do Estado.

Efectos del programa de la Factura Electrónica sobre el aumento de la recaudación en el estado

El objetivo de este artículo es verificar si la implementación del programa de Factura Electrónica (NF-e, por sus siglas en portugués) generó, como consecuencia, algún aumento en la recaudación en el estado de Goiás. Para la investigación, se utilizaron pruebas de promedios y estimación de regresiones de diferencia en diferencias (*difference-in-differences*). Los resultados indicaron que el promedio de recaudación en el estado de Goiás es estadísticamente superior en el período posterior a la implantación de la NF-e y el aumento de la recaudación de las empresas obligadas a emitir NF-e fue mayor que el de las que no son obligadas. Así, aunque el enfoque principal de la NF-e no es el aumento de la recaudación de impuestos, se puede observar que la institucionalización de un programa de estandarización y compartición de documentos fiscales incluyó mejoras en los procesos de fiscalización de la administración tributaria, aumentando la recaudación de impuestos del Estado a través de la reducción de la morosidad fiscal.

Palabras clave: política pública fiscal; Factura Electrónica; recaudación del estado.

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1. INTRODUCTION

The Electronic Invoice is a federal program prepared by the country's tax administration to institute a unified model for electronic invoices throughout the country, substituting paper invoices in the industrial and wholesale sectors (*Receita Federal do Brasil* [RFB], 2007).

This program's main objective is to modernize Brazilian tax administration by reducing bureaucratic costs and obstacles, facilitating contributor compliance with tax obligations and improving the control of tax administration bodies (*Emenda Constitucional* n. 42, 2003).

Thus, the implementation of the EI program intuitively generates the idea of an evolution in tax assessment and collection processes in the states. However, empirical evidence regarding this aspect is still lacking in the literature. Few studies have examined the program's effectiveness, such as Barbosa (2011), which does not consider external economic variables. Others are focused on the analysis of taxation education programs which use the EI, such as the São Paulo Invoice (Mattos, Rocha, & Toporcov, 2013; Naritomi, 2018).

Thus, the effect of the transformation of a manual process into an electronic process for the emission and receipt of invoices on state tax revenues is a gap that still needs to be explored. This article therefore seeks to fill this gap by verifying whether the EI program has fulfilled one of its roles, namely, increasing tax revenues through greater control of tax assessment.

To accomplish this, we have performed *t* tests in a quasi-experiment by using *difference-in-difference* estimation regressions for a specific state, in this instance Goiás. This choice is justified by this state's participation in the EI pilot project in 2006, which up until now has not been addressed by any study of this subject.

In achieving this objective, this study provides useful insights about the effects of implementing public policies in the taxation area which contribute to the reduction of tax evasion, which is relevant to the government and society as a whole.

This article consists of five sections in addition to this introduction. The second section presents its theoretical references. The following section will explain the study's methodology. This will be followed by the results, and finally a discussion of the results and the conclusion.

2. ELECTRONIC INVOICE

The Constitutional Amendment nº 42 (2003) instituted the following obligations — that the economic tax information of contributors be sent to tax administrators to assist in assessing taxes, registering contributors and as well as taxation data — and that it be shared between the three spheres of action in an integrated manner. The sharing of tax information provided by this policy helps each state's Treasury (Sefaz) in the fight against tax evasion and the reduction of delinquency, by cross-referencing data and electronic auditing which facilitates the identification of contributors who are not in compliance (Sousa, 2010).

In relation to tax evasion in Brazil, according to Grzybovski and Hahn (2006), there has been a lack of clarity on the part of the government and popular communication channels about tax collection and its implications for society in general. Citizens only have everyday news to educate

them about tax issues, which most of the time depicts just the negative aspects of taxes, such as the high level of taxation, the creation of new taxes, the public deficit and the misappropriation of public funds.

In addition, the poor utilization of these resources, which leads to contributors not being able to use government services such as health care, education and transport in an adequate manner and alarming numbers in terms of corruption, discourage common citizens from fulfilling their tax duties and preferring establishments that comply with tax legislation.

Grzybovski and Hahn (2006, p. 846) indicate that “[...] there is still a social consensus that those who are ‘intelligent’ are those who trick the tax administrators and/or fail to fulfill their tax obligations.” This situation makes tax evasion common within society in general and contributes to a lack of conscientiousness on the part of citizens and disinterest in the government (Grzybovski & Hahn, 2006).

Due to this situation, we need to stimulate actions that contribute to tax assessment, increase tax collection, diminish tax evasion and stimulate the conscientiousness of citizens. In this sense, evaluating whether the programs that have this goal are achieving the expected result is quite relevant to public administration. With greater tax revenues, it is possible to implement new public policies, for example, and create more infrastructure and social programs. With a decrease in tax evasion and the informal market, another important factor is the sensation of social justice for companies that pay their taxes properly.

The EI arose, therefore, to comply with Constitutional Amendment nº 42 (2003), which introduced Subsection XXII of Article 37 of the Federal Constitution of 1988 (CF/1988). In addition to making it possible to exchange data and perform the coordinated and integrated taxation activities established by this amendment, the program is also expected to reduce costs, provide greater effectiveness in terms of taxation, and decrease tax evasion, and as a result increase tax revenues (RFB, 2007).

The EI has already been the subject of various studies such as Barbosa (2011), who analyzes the impact of the Tax on Operations Related to the Circulation of Merchandise and the Providing of Interstate and Intercity Transport and Communication Services (ICMS) in the state of Ceará. Another study by Sousa (2010), analyzes the impact of using EIs on the tax collection efforts of Sefaz in the State of Ceará. In both cases, the authors found positive results from the use of electronic invoices in the monitoring and collection of the ICMS.

In the state of São Paulo, Saran (2012) demonstrates the enormous leap in efficiency obtained by the State Treasury. Among the improvements cited are assisting the fight against unfair competition, the simplification of consulting obligations and the cost reductions achieved in terms of data and the consumption of paper. Mattos et al. (2013) and Naritomi (2016) studied the São Paulo Electronic Invoice and concluded that there was a 2% increase in the collection from the tertiary sector and an increase in revenues of 22% over four years for the retail sector. However, the focus of both of these studies was not the EI program, but rather the fiscal incentive program which uses EIs.

Mello, Dias, Fontana and Fernandez (2009a) cover the main concepts of the operational model of EIs adopted by countries such as Chile, Brazil, Ecuador, Colombia and Mexico. Later, Mello, Dias, Fontana and Fernandez (2009b) considered this program to be the most important change in this paradigm, due to the integration of the government’s taxation administration bodies to make an

efficient form of tax assessment viable in real time and make electronic cross-referencing possible in the battle against fraud and tax evasion.

In sum, these studies demonstrate the positive effects of the EI on tax revenues, however there has not been any study about its impact on tax revenues while controlling for macro-economic variables. In order to capture the increase in revenues due to the implementation of the IE, it is necessary to isolate the factors that lead to an increase in tax revenues independent of the program to make sure that there are no distortions in the data. Within this context, we offer this study's central hypothesis:

H1: *After controlling for micro- and macro- environmental factors, the average revenues from the ICMS tax in the state of Goiás have been statistically greater after the implementation of the EI.*

3. METHODOLOGY

This is an applied study with a quantitative approach. The data has been collected based on the Sefaz revenues for Goiás, through the *Business Intelligence* tool.

3.1 Study sample

The study's sample is the Sefaz revenue data for Goiás for specific sectors from 2003 to 2014; the data from 2003 to 2007 represents data before the implementation of the EI and from 2008 to 2014 represents data after it became mandatory.

Instead of using the invoice data, the real revenues raised by the state ICMS were used to maintain the same data source for before and after comparisons.

To obtain this universe of EI data, the companies that were required to emit EIs beginning in 2008 were identified. This requirement was based on the National Classification of Economic Activities (CNAE), which identifies a company's area of activity. Protocols ICMS 10/2007 and ICMS 42/2009 describe the categories which were required to emit EIs in 2007, 2008 and 2009 (Protocolo ICMS n. 10, 2007; Protocolo ICMS n. 42, 2009).

The data collection first considered the primary CNAE, which corresponds to the company's principal activity. To stipulate a smaller universe for analysis, specific CNAEs were chosen considering the initial date of their mandatory use in the sectors with the largest revenues in terms of ICMS. However, in accordance with the analysis performed by the tax collection sector of Sefaz, these sectors — manufacturing industries and fuel distributors, automobile manufacturing, and beverages and pharmaceuticals — were already the most closely inspected, and the increase in revenues due to a decrease in tax evasion is probably minimal. Another factor that influences these results is that these industries have tax exemption programs such as Produzir (a fiscal incentive program used by the government of Goiás, which offers discounts on the ICMS tax), which may interfere with this analysis.

Considering these factors, the industries were excluded and the data collection considered the wholesale sector, which was first required to use EIs in the years 2008, 2009 and 2010, and the CNAEs with the greatest revenues within the wholesale sector. For the control sample, we used specific CNAEs from the retail sector (which do not emit EIs) for the same economic activities as the wholesale sector, with both being listed in Box 1.

BOX 1 **SPECIFIC CNAE CATEGORIES FOR STUDY SAMPLE (WHOLESALE) AND CONTROL (RETAIL)**

CNAE	Description	Initial Date of Mandatory Use
4639701	Wholesale commerce in food products in general	9/1/2009
4644301	Wholesale commerce of pharmaceuticals for human use	12/1/2008
4646001	Wholesale commerce in cosmetics and perfume products	7/1/2010
4711302	Retail commerce and merchandise in general, predominantly food products – supermarkets	-
4712100	Retail commerce and merchandise in general, predominantly food products – mini-markets, grocery stores and warehouses	-
4771701	Retail commerce of pharmaceuticals, without compounding prescriptions	-
4772500	Retail commerce in cosmetics, perfumes and personal hygiene products	-

Source: Adapted from Instituto Brasileiro de Geografia e Estatística (IBGE, 2015a) and ICMS Protocols (Protocolo ICMS n. 10, 2007; Protocolo ICMS n. 42, 2009).

3.2 Study variables

To capture the increase in revenues due to the implementation of the EI in Goiás, we need to isolate the factors that increase revenues independently of the program. To do this, we considered the following control variables: Brazilian GDP, the GDP of Goiás, the cost of a shopping basket of goods in the state capital Goiânia, and three inflation indices, the National Broad Consumer Price Index (IPCA), the National Consumer Price Index (INPC) and the General Market Price Index (IGPM).

In addition to these control variables, we used dummy variables such as the Period, to indicate whether it refers to before the implementation of the EI (a value of zero) or after (a value of one), and the Sector, with a value of zero for retail and one for wholesale.

In Box 2 we list the variables created for this study, whose values were obtained through the IBGE, Instituto Mauro Borges and Dieese websites.

BOX 2 **STUDY VARIABLES**

Variable	Expected Relationship	Description
Original Value	Dependent variable	Original value of tax owed
Total Value	Dependent variable	Total value of paid tax (including fines and interest)
Year	Independent variable	Year in which the value was paid
State Registration	Independent variable	Company's state registration
CNAE Code	Independent variable	Company's economic activity
IPCA	Independent variable	National Broad Consumer Price Index

Continue

Variable	Expected Relationship	Description
INPC	Independent variable	National Consumer Price Index
IGPM	Independent variable	General Market Price Index
Brazil GDP	Independent variable	Brazilian GDP for the year
Goiás GDP	Independent variable	Goiás GDP for the year
Cost of a Shopping Basket of Goods in Goiânia	Independent variable	Average cost of a shopping basket of goods in Goiânia for the year
Period Dummy Var.	Control variable	Before the implementation — value of zero After the implementation — value of one
Sector Dummy Var.	Control variable	Retail — value of zero Wholesale — value of one

Source: Adapted from IBGE (2012, 2015b), Instituto Mauro Borges de Estatísticas e Estudos Socioeconômicos (IMB, 2014) and Departamento Intersindical de Estatística e Estudos Socioeconômicos (Dieese, 2015).

4. EMPIRICAL ANALYSIS

Initially we realized difference tests between population averages (Test *t*), for paired data (the same population: before and after) and also for different companies. Specifically, we verified whether the average revenues during the period before the implementation of the EI were inferior to the average revenues during the period after. The tests were performed for different samples. First, we considered all of the selected sectors, the wholesale and retail markets for pharmaceuticals, cosmetics, and food products, or in other words, companies that are required to emit EIs and companies that are not (Table 1).

TABLE 1 TEST T FOR BOTH SAMPLES

Group	Observations	Average	Standard Error	Standard Deviation	[Confidence Level of 95%]	
0	153011	25,301.41	822.6194	321,780.9	23,689.09	26,913.73
1	3371	842,469.3	81,688.69	4,742,871	682,304.9	1,002,634
Combined	156,382	42,916.44	1,959.021	774,698.1	39,076.79	46,756.08
Difference		-817,167.9	13,329.9		-843,294.4	-791,041.4
Difference = average (0) – average (1)					t = -61.3030	
					degrees of freedom = 156,380	
H ₀ : difference = 0		H _a : difference != 0		H _a : difference > 0		
H _a : difference < 0		Pr(TI > t) = 0.0000		Pr(T > t) = 1.0000		
Pr(T < t) = 0.0000						

Source: Study data.

Note: H₀ = null hypothesis. H_a = alternative hypothesis. T = Calculated T. t = critical value of t.

Later we tested just the companies that were required to emit EIs, that is, just those from the wholesale market. The results can be observed in Table 2.

TABLE 2 TEST T WITH THE SAMPLE OF COMPANIES REQUIRED TO EMIT EIS

Group	Observations	Average	Standard Error	Standard Deviation	[Confidence Level of 95%]	
0	3,112	379,558	36,991.8	2,063,599	307,027.2	452,088.8
1	3,371	842,469.3	81,688.69	4,742,871	682,304.9	1,002,634
Combined	6,483	620,260.5	46,124.52	3,713,812	529,841.2	71,0679.8
Difference		-462,911.3	92,150.65		-643,557	-282,265.6
Difference = average (0) – average (1)				t = -5.0234 degrees of freedom = 6,481		
H ₀ : difference = 0		H _a : difference < 0		H _a : difference != 0		H _a : difference > 0
Pr(T < t) = 0.0000		Pr(T > t) = 0.0000		Pr(T > t) = 1.0000		

Source: Study data.

Note: H₀ = Null hypothesis. H_a = Alternative hypothesis. T = Calculated T. t = Critical value of t.

The results presented in Tables 1 and 2 indicate with a 1% level of significance, that the average revenues from the ICMS in the state of Goiás was statistically superior in the period after the implementation of the EI. It may be perceived that even when we consider companies that are not required to emit EIs, their impact on tax revenues have been positive.

In this way, it is possible that other macro- and microeconomic variables can explain this increase in revenues. Thus, in order to obtain more robust results in terms of the relationships analyzed here and to test the research hypothesis, we will investigate how the implementation of the EI has affected the outputs of the state’s revenues through an analysis of ex-post treatment effects.

4.1 The quasi-experiment and the tax revenue outputs after the implementation of the EI

The challenge of analyzing the effect of the treatment in this study is that the association between the pre-implementation revenues and the post-implementation outputs could be due to the endogenous selection of the firms that make up the treatment group, rather than the real impact of an increase in tax revenues. In order to deal with this selection concern, we have opted to perform a quasi-experiment using a control sample whose companies are not required to emit EIs and a treatment sample of companies that are required to emit EIs.

Thus, we opted to perform *difference-in-difference* estimation regressions using a group of panel data that contains information about the activities of companies required to emit EIs and companies that are not required to emit EIs, considering five years before the implementation (t - 5) and seven years after the implementation (t + 7):

$$Tax\ Revenues_{it} = \alpha + \beta_1 After_{it} + \beta_2 After_{it} \times Treat_i + IPCA_t + INPC_t + IGPM_t + GOI\acute{A}SGPD_t + BRAZILGPD_tU + SHOPPINGBASKET_t + e_{it}$$

in which *Tax Revenues_{it}* is equal to the total value collected from company i at time t; the variable *After_{it}* is equal to 1 for the post-EI implementation period (from t + 1 to t + 7) and, 0 for the pre-EI implementation period. The *Treat_i* variable is equal to 1 for treatment events and 0 for other events. The other variables are independent analysis variables that refer to macro- and microeconomic indicators, used to consider and isolate natural increases in tax revenues that are independent of the implementation of the EI. These variables include the index variables *IPCA_t*, *INPC_t*, *IGPM_t*, the GDP variables *GOIÁS_t*, *BRAZILGPD_t* and the *SHOPPINGBASKET_t*, all with a value that refers to time t considered to be within the tax collection period.

TABLE 3 RESULTS OF THE DIFFERENCE-IN-DIFFERENCES ANALYSIS

Panel A	
	Tax Revenues
After	50,523*** (1.90)
After × Treat	51,096*** (1.92)
Fixed Effects	YES
N. of Total Observations	153,011
N. of Treatment Observations	3,112
N. of Control Observations	149,899
R ²	0.0283

Source: Study data.

Note: * p ≤ 0.10; ** p ≤ 0.05; *** p ≤ 0.01.

Through the results presented in Table 3, we can infer, at a 1% level of significance, that the increase in tax revenues from companies that were required to emit EIs is greater than the increase for companies that were not required to emit EIs during the analysis period. Thus, the hypothesis of this study has been sustained.

Even though the R² result is low, it is not significant in terms of the analysis’s goal, because its purpose is not to specify a specific percentage increase in tax revenues, but rather to not reject the hypothesis that implementing the EI led to a decrease in tax evasion and an increase in tax revenues, when controlling for micro- and macroeconomic factors. We wish to emphasize that controlling for micro- and macroeconomic factors in this analysis is a distinguishing characteristic of this study, because other studies have not done this. This type of verification has been performed only in works

that analyze increased tax revenues and company revenues after the implementation of the São Paulo Invoice emission incentive program (Mattos, Rocha and Toporcov, 2013; Naritomi, 2016), instead of the EI itself, which is the focus of this article. In the following section, we will discuss this study's results.

5. DISCUSSION AND FINAL CONSIDERATIONS

The objective of this article has been to verify whether the implementation of the EI in the state of Goiás has led to an increase in ICMS tax revenues, due to better tax collection. The results of the first analysis (Test t) demonstrate that there has been an increase in tax revenues for the specific sectors which are required to emit EIs after the program's implementation. These results corroborate the findings of studies of this subject made in other Brazilian states (Barbosa, 2011; Mello, Dias, Fontana, & Fernandez, 2009b; Saran, 2012; Sousa, 2010). On the other hand, we have identified an increase in the sectors that are not required to emit EIs as well. To ensure that this result is not due to interference in the selected sectors, we performed a quasi-experiment by using *difference-in-difference* estimation regressions. To accomplish this, we used a treatment sample of companies that are required to use EIs and a control sample of companies that belong to equivalent areas in the retail sector, which are not required to emit EIs.

Our findings indicate that the increase in tax revenues from companies required to emit EIs was greater than the increase of those which were not required to emit EIs during the analysis period, even after controlling for micro- and macroeconomic factors.

In the same manner, even though the main focus of the EI is not increasing tax revenues, it may be observed that the institutionalization of this program to standardize and share taxation documents has led to improvements in tax collection and administration processes, improving the state's tax collection by reducing tax evasion.

Grzybovski and Hahn (2006) conclude in their study that there is a lack of commitment to pay taxes on the part of businessmen, and one of their proposed solutions would be tax education. In general, it is believed that this program has acted in an educational manner, because it has influenced the taxation process in the industrial and wholesale sectors, generating a cycle of greater consciousness about the need for invoices and, with this, less tax evasion which leads to greater tax revenues for the state. Specifically, the program appears to contribute to a change in the paradigm, because even the sectors which are still not required to emit EIs increased their participation in ICMS tax revenues in the state. However, it is not known whether this change is being generated by greater consciousness or increased sense of risk by contributors, which thus makes this a limitation of this study.

In addition, it was not possible to quantify the extent to which tax revenues have increased due to this program and together with analyzing the efficiency of the EI program, these are subjects which should be examined in future studies.

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Patrícia Araújo Vieira



<https://orcid.org/0000-0002-9898-0224>

Technology and Information Manager for the State of Goiás; Master's in Administration from the Federal University of Goiás. E-mail: patricia.av@gmail.com

Daiana Paula Pimenta



<https://orcid.org/0000-0003-1111-4778>

PhD in Administration and Adjunct Professor in the Master's Program in Public Administration and the Graduate Program in Accounting Sciences at the Federal University of Goiás.
E-mail: daiana-pimenta@hotmail.com

Alethéia Ferreira da Cruz



<https://orcid.org/0000-0001-7816-998X>

PhD in Administration and Adjunct Professor in the Professional Master's Program in Public Administration and the Graduate Program in Accounting Sciences at the Federal University of Goiás.
E-mail: aletheiacruz@yahoo.com.br

Eliane Moreira Sá de Souza



<https://orcid.org/0000-0003-1144-5286>

PhD in Administration and Associate Professor in the Professional Master's Program in Public Administration at the Federal University of Goiás. E-mail: eliane.mss@hotmail.com