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Márcio Issao Nakane*
Marcelo Resende**

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* Departamento de Economia-FEA/USP
** Instituto de Economia-UFRJ

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SUMÁRIO

Sumário

O artigo investiga empiricamente a validade da lei de Wagner para a economia brasileira, tomando como referência o período 1948-93. Considera-se explicitamente a não estacionariedade das séries envolvidas por meio de uma análise de cointegração. O estudo considera categorias desagregadas de dispêndios governamentais, especificamente consumo, investimento e pagamentos de transferências. Somente no caso dos pagamentos de transferências encontra-se evidência favorável à lei de Wagner.

Abstract

The paper empirically investigates the validity of Wagner's law for the Brazilian economy, taking as reference the period 1948-93. One explicitly consider the non-stationarity of the series involved by means of a cointegration analysis. The study considers disaggregated categories of government expenditures, specifically consumption, investment and transfer payments. Only in the case of transfer payments one can find favorable evidence for Wagner's law.

1. INTRODUCTION

The role of the public sector in facilitating economic development is still a controversial issue, especially with respect to particular activities in which it is believed that public ownership would induce inefficient resource allocation. [1] In any case, the importance of infrestructure government expenditures and an increasing need of public goods provision as urbanization accelerates, have long been recognized within the so called 'Wagner's law' [see Bird (1970) and Gemmel (1993) for surveys]. A general statement of the 'law' embodies the notion that as industrialization proceeds, the relative importance of government expenditures would grow. It is worth mentioning that revenue constraints to government expansion, as emphasized by Peacock and Wiseman (1961), had been aknowledged by Wagner himself while formulating his 'law'.

The present paper intends to provide a test of Wagner's law for the Brazilian economy making use of different levels of aggregation for government expenditures within a Time Series framework. The paper is organized as follows. The second section overviews in a schematic way the routes for testing Wagner's law. The third section briefly discusses the relevant Time Series concepts to be used in the paper. The fourth section outlines the data to be used and presents the empirical results. Finally, the fifth section summarizes the paper and provides some conclusions.

2. Testing Wagner's Law

An influential version of Wagner's law [eg. Mann (1980), Nagarajan and Spears (1990) and Murthy (1993)] can be summarized in terms of the following equation:

$$\ln (G/GDP) = \ln_0 + \beta_1 \ln (GDP/POP) + \varepsilon \quad (1)$$

where G=government expenditure, GDP=real gross domestic product, POP=population, ε=random disturbance term. Wagner's law would be vindicated if $\beta_1 > 0$. Essentially, the literature is limited to bivariate regressions, although some studies point out that additional explanatory variables should be considered.[2]

In broad terms, one can highlight three stages in the evolution of the research on the topic:

a) Early cross-section studies comprising different countries;

b) Movement towards time series studies and concern with the selection of stable sample periods;

c) Explicit consideration of problems arising from the time series nature of the data related with the presence of stochastic trends.

The early emphasis on cross-section data was clearly unsatisfactory, as the the law refers to an increasing importance of the government as industrialization develops and therefore relates more to a particular economy rather than to a set of different economies at distinct stages of development.

The next natural step was the consideration of economies over time, what has been done either by time series studies for particular countries or in terms of panel of countries. In the case of economies frequently involved in wars, there would tend to arise distortions in the government

expenditure path. Such problem has been addressed either by restricting the sample to peace periods or by introducing dummy variables. [3]

Finally, the literature started to stress the necessity of testing for stochastic trends in the data. In fact, Granger and Newbold (1974) pointed out the possibility of spurious regressions when data has trends, and as Engle and Granger (1987) would clarify, the existence of a long run equilibrium between variables with stochastic trends requires that they 'cointegrate' in a sense to be explained in the next section. The testing of Wagner's law in terms of obtaining a significant positive coefficient b_1, requires a previous test on whether ln (G/GDP) and ln (GDP/POP) cointegrate, otherwise there exists no long run equilibrium between the variables. Murthy (1993) and Henrekson (1993) gave the first step in that direction by testing for cointegration in the Wagner's law context. They considered the economies of Mexico and Sweden respectively, and obtained mixed results, whereas the former confirmed it, the latter rejected it.

One problem with the aforementioned studies is their reliance on the Engle-Granger cointegration test procedure, whose low statistical power is well known [see eg. Kremers et al. (1992)]. A more powerful procedure is the maximum likelihood approach advanced by Johansen (1988). Ashworth (1994) Hayo (1994) and Murthy (1994) considered such technique in the Wagner's law tests for Mexican data. The overall evidence seems not to vindicate Wagner's law.

The aim of the present paper is to contribute to the debate by further considering the relevance of different classes of government expenditures, since it seems reasonable to postulate that Wagner's law arguments may be relevant for some categories of government expenditures but not all of them [see eg. Courakis et al. (1993)]. On the other hand, the empirical literature has traditionally focused either on total government expenditure or on government consumption. [4] In this article, we consider the Brazilian economy for three classes of government expenditures, namely consumption, investment and transfer payments. At this level of aggregation, the conclusions from previous studies are at most tentative, as they neglected possible spurious regressions issues emphasized by the cointegration literature.

3. Cointegration Techniques

As mentioned before, the long run equilibrium between economic variables can be identified with the notion of cointegration. Engle and Granger (1987) have shown that a necessary condition for a pair of variables to be cointegrated is that they are integrated of the same order. A series y_t is said to be integrated of order k [say I(k)] if it has a stationary, invertible ARMA representation after differencing k times.[5]

The existence of a long run equilibrium between the two variables (so that they are cointegrated) requires that, even though each variable is integrated (of the same order), a linear combination of them is integrated of some lower order. More formally, supoose that two series x_t and y_t are both I(k). If exists a constant A such that

$(x_t - Ay_t)$ is I(k-b) for $b > 0$, one say that x_t and y_t are cointegrated of order k,b or

$$(x_{t,}\ y_t) \sim CI(k,b).$$

In order to check whether each series has the same order of integration, we employ the Dickey and Pantula (1987) test. If the presence of multiple unit roots is at issue, the traditional sequential use of the Dickey and Fuller (DF) test would be problematic, as it assumes the absence of unit roots under the alternative hypothesis. In that sense, Dickey and Pantula propose to reverse the tset sequence by starting

with a maintained hypothesis that assumes the largest number of unit roots at first (in our case, two unit roots). The test may be described as follows. First , consider the model in second differences:

$$\Delta^2 y_t = \beta_0 + \beta_1 t + \beta_2 \Delta y_{t-1} + \beta_3 y_{t-1} + u_t \qquad (2)$$

In the event of testing for the presence of two unit roots against a single unit root, the null hypothesis would be such that $\beta_2 = \beta_3 = 0$. However, notice that both under the null and the alternative hypotheses, one has $\beta_3 = 0$, thus one can simply run the regression without y_{t-1} as a regressor and test the significance of β_2 with the DF critical value.

Second, in the case of rejection of the null hypothesis, one would consider the full equation and test for the significance of β_3 in order to test for the presence of a single unit root. In this paper, we will adopt this reversed testing approach and use the relevant critical values of the statistic for small samples provided by MacKinnon (1991).

An underlying assumption is that the error term u_t presents no serial correlation. If this is not the case, one has to proceed in terms of augmenting the regression by including lagged terms of the dependent variable up to a maximum lag determined by the diagnosed absence of errors' serial correlation. This procedure is analagous to the traditional Augmented Dickey-Fuller (ADF) case.

As for the cointegration test, we will make use of the Johansen's procedure, as outlined below. Suppose the following VAR representation for a vector X composed by I(1) variables:

$$X_t = \Pi_1 X_{t-1} + \quad + \Pi_k X_{t-k} + \varepsilon_t \qquad (3)$$

The corresponding long run response matrix is given by:

$$\Pi = I - \Pi_1 - \ldots - \Pi_k \qquad (4)$$

The test accounts for checking the rank of the matrix Π. Three possibilities can arise:

a) Rank (Π) = 0. In this case there is no cointegration and equation (3) can be rewritten as a traditional VAR in first differences;

b) Matrix Π has full rank. This case would contradict our assumption that the variables are I(1) and it would be an indication of over-differencing, and therefore a model in levels would be more appropriate;

c) Matrix Π has reduced rank. In this case, there is cointegration and its rank is equal to the number of cointegrating relationships. Under this assumption, matrix Π can be written as the product of two matrices $\Pi = \alpha \beta'$, where a is the 'loading' matrix and β is the matrix whose components are the cointegrating vectors.

4. Empirical Results

4.1 Data Description

The variables used the study are ln (GC/GDP) ° LGC, ln (GI/GDP) ° LGI, ln(GT/GDP) ° LGT and ln (GDP/POP) ° LGDP, which will denote respectively: the share of government consumption expenditures on gross domestic product, the share of government investment on gross domestic product, the share of government transfer payments on gross domestic product and the real gross domestic product per capita.[6]

4.2 Results

The results concerning the order of integration for each variable are presented in Table 1 below. We report the

Dickey-Fuller (DF) statistics and the Lagrange multiplier test for serial correlation (LM).

Table 1
The Dickey-Pantula Test of Integration

Variable		First Step	Second Step
LGC	DF	-7.204	-0.824
	LM	0.621	0.410
LGI	DF	-6.762	-2.241
	LM	0.261	0.513
LGT	DF	-6.573	-2.453
	LM	0.529	0.055
LGDP	DF	-4.322	-0.881
	LM	0.636	1.053

Critical values for the DF statistics are obtained from MacKinnon (1991). The relevant critical values are -4.697 at 1 % and -4.003 at 5 %.significance level. The LM statistics are distributed as F(2,39) and F(2.38) in the first an second steps, respectively.

The inspection of table 1 leads to the conclusion that all involved variables are I(1), and the test procedures involved did not require the augmented equations, as no evidence of serial correlation was indicated by the LM statistics in the simple model.

Having obtained the same order of integration for the series, we can proceed by testing for cointegration. Since Johansen's test requires a well specified system, our starting point was a unrestricted VAR, which was further simplified following the approach suggested by Hall (1991). Apart from the lag lenght choice, another issue concerns the exact specification of the deterministic terms in the VAR. In this case, the strategy was to start with a unrestricted constant and arestricted trend and test their significance. [7] When the trend was not found significant, a restricted constant was introduced instead. The results displayed below refer to the models involving a restricted trend for government consumption (VAR1) and the restricted constant for government investment (VAR2) and transfer payments (VAR3).

Table 2 presents some diagnostic statistics for the VAR. In this table we display the following: single equation residual standard deviation (σ); single equation statistical tests for: serial correlation (AR), autoregressive heterocedasticity (ARCH), heterocedasticity (H), and normality (N). Moreover, we consider test statistics for: vector serial correlation (vecAR), vector heterocedasticity (vecH), and vector normality (vecN) [for details on these statistics, see Doornick and Hendry (1995)].

Table 2
VAR Diagnostic Statistics

Statistics	VAR1		VAR2		VAR3	
	LGC	LGDP	LGI	LGDP	LGT	LGDP
σ	8.0%	3.4%	14.5%	3.4%	8.7%	3.2%
AR	0.39	1.27	0.20	0.65	0.17	2.77
ARCH	0.10	0.02	1.51	2.11	0.02	0.36
H	0.51	0.98	0.78	5.33**	1.03	0.79
N(2)	1.01	2.73	1.62	0.87	1.63	2.74
ρ	-0.47		0.25		-0.14	
Vec AR	1.41		0.60		1.30	
Vec H	0.65		1.86*		0.79	
Vec N(4)	4.55		1.99		4.81	

N and VecN are distributed as chi-square with the appropriate degrees of freedom indicated in the table. All the remaining statistics have a F distribution with the degrees of freedom given as follows:
VAR1: AR(2,36), ARCH(1,36), H(10,27), VecAR(8,66), VecH(30.74)
VAR2: AR(2,40), ARCH(1,40), H(4.37), VecAR(8,74), VecH(12,92)
VAR3: AR(2,37), ARCH(1,37), H(8,30), VecAR(8,68), VecH(24,81)
(*) indicates significance at 5%, whereas (**) indicates significance at 1%

The results show that except for some evidence of heteroscedasticity for the government investment VAR, all the remaining diagnostics are satisfactory for the usual significance levels. We can pursue further our analysis by

undertaking Johansen's cointegration tests, which are summarized in table 3.

Table 3
Johansen's Tests for Cointegration

System	Null Hypothesis	λ_1	Critical Value	λ_2	Critical Value
VAR1	r £ 1	2.54	12.3	2.54	12.3
	r = 0	14.21	19.0	16.75	25.3
VAR2	r £ 1	4.98	9.2	4.98	9.2
	r = 0	38.5**	15.7	43.48**	20.0
VAR3	r £ 1	6.34	9.2	6.34	9.2
	r = 0	16.21*	15.7	22.55*	20.0

λ_1: likelihood ratio test based on maximal eigenvalue of the stochastic matrix
λ_2: likelihhod ratio test based on trace of the stochastic matrix
Critical values for 5% significance level are obtained from Osterwald-Lenum (1992)
The lag structures are the following: 2 for VAR1 and VAR3 and 1 for VAR2
The deterministic components are as follows: restricted trend for VAR1, and restricted constants for VAR2 and VAR3

The evidence displayed in table 3 indicates that there is no cointegration for government consumption and one cannot reject the hypothesis that there is one cointegration relation for the remaining government expenditures categories. Therefore, there is no support for Wagner's law for government consumptionin the Brazilian economy. This result is in line with the ones obtained by Ashworth (1994) and Hayo (1994) for the Mexican economy. Next, table 4 presents the coefficients of the cointegrating vector for government investment and transfer payments.

Table 4
Normalized Coefficients of Cointegrating Vector

System	Variable	Coefficient
	LGI	-1.00
VAR2	LGDP	-0.16
	Constant	-3.79
	LGT	-1.00
VAR3	LGDP	0.99
	Constant	-2.56

The cointegrating vector was estimated under the restriction that rank(Π) - 1.

According to table 4, there is a negative long run relationship between LGI and LGDP, when one would expect a positive relationship on Wagner law's grounds. However, such result should be interpreted with caution since, as mentioned before, there is a potential misspecification problem in this particular equation.

On the other hand, the equation for government transfer payments support Wagner's law. It should be pointed out that even though it is not a common practice to consider transfer payments separately, the possibility of a positive relationship between transfer payments and economic development is not unreasonable. In fact, as suggested by Gemmel (1993, p.111), Wagner attributed importance to the public provision of welfare services irrespective of how they are provided. In this sense, one can reasonably conceive that the demand for wefare provision associated with transfer payments increase as industrialization proceeds.

5. Conclusion

The present paper intended to provide a more careful testing of Wagner's law for the Brazilian economy along the period 1948-93. The paper follows the recent strand of the literature of considering non-stationarities and cointegration

issues. From this point of view, the present paper contributes to the debate by assessing the importance of considering different categories of government expenditures for infering the validity of Wagner's law. Although this last point is not new, it had not been addressed before in the context of cointegration techniques.

Our empirical results confirm the relevance of pursuing a disaggregated analysis. It has indicated that only for government transfer payments, Wagner's law can be vindicated. In the case of government investment, as mentioned before, we have ontained a negative relationship between the LGI and LGDP. It would be interesting to eventually consider further disaggregated analysis in the study of Wagner's law, a important obstacle will be, of course, data availability.

Notes

1 Despite the justifiable interest on the debate concerning privatization, such discussion is outside the scope of the present paper. The reader is referred to Vickers and Yarrow (1988) for a discussion on privatization.

2 See for example Courakis et al. (1993). Despite the relevance of this point, reliable data availability and small sample size restrictions prevent us from pursuing that route. Interpolation of existing data, as done by Murthy (1993), is clearly problematic.

3 For the first two categories of studies, the reader is referred to the survey provided by Gemmel (1993).

4 For instance, the recent time series studies have used the Penn World Table which considers only the consumption component of government expenditures.

5 For a survey on the concepts of integrated and cointegarted variables see Diebold and Nerlove (1990) and Psaradakis (1989).

6 For further details on sources and variables' construction, see the appendix.

7 The restricted component is constrained to be present only in the cointegrating vector. The trend is assumed to be restricted because otherwise one would have a model where there is a quadratic trend affecting the variables in levels, what does not seem to be appealing.

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APPENDIX

List of variables:

• GC: government consumption expenditures deflated by the government consumption implicit price deflator (1948-69) and by the total consumption (private plus public) implicit price deflator (1970-93). The use of different price deflators is due to data availability.

• GI: gross fixed capital formation defalted by the total corresponding implicit price deflator (which comprises government, firms and families).

• GT: government transfer payments deflated by the same deflators used for GC. In the Brazilian case, interest payments on public debt has become an increasingly important component of government transfers since the late 1970's. From the point of view of Wagner's law, it is not sensible to include such payments when examining the transfers behaviour. For the period 1970-93, the reported data already excludes these payments. For the previous period (1948-69), however, interest payments were included in the reported figures. In the last case, we adjusted the series by considering reasonable lower and upper bounds for the share of interest payments on total transfers. The assumed lower bound was simply zero; in other words, those payments were supposed to be negligible over that period. The upper bound, on the other hand, involved the

consideration of the average share for the period 1970-75 which was used to scale down the series for the period 1948-69. The obtained results were not sensitive to the method chosen to adjust the series. Therefore, in the text we just report results from the second procedure.

• GDP: gross domestic product deflated by GDP implicit price deflator.

• POP: total population.

The source for all the variables is FIBGE, **Anuário Estatístico do Brasil** (several years).

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