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Income elasticity of the main taxes in Mexico and fiscal loss during the COVID-19 pandemic

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Abstract

We estimate the income elasticity of Mexico's value-added, income and total taxes. Our findings reveal that the elasticity of these taxes is greater than one, indicating a responsive tax system to economic fluctuations. These results confirm the countercyclycal role of the tax system and underscore the growing importance of non-oil tax revenue in maintaining fiscal stability. A counterfactual analysis to assess the revenue losses attributable to the COVID-19 pandemic, offers insights on the resilience of Mexico's tax system to economic shocks.

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1. Introduction

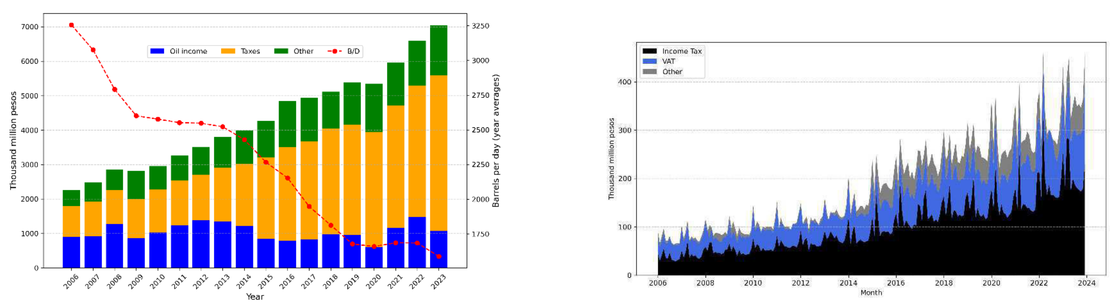
The income elasticity of tax revenue is a key indicator of efficient fiscal policy. It quantifies the response of tax revenues to shocks in national income (GDP). An elasticity greater than one implies that tax revenues decline more sharply than GDP during recessions but increase more significantly during economic expansions, providing the economy with an "automatic" stabilizer. This paper examines the responsiveness of income (IT) and value-added (VAT) tax revenues to economic activity in Mexico.[1]

Understanding the determinants underlying tax revenue has become even more relevant for Mexico. The Federal Government has reconfigured its funding sources in light of a steadily declining oil production and oil revenue. As illustrated in Figure 1 panel (a), oil revenue declined both in absolute terms and relative to total revenue and was particularly low in 2020. The red line in the figure highlights the sharp decline in oil production in Mexico since 2006, underscoring the diminishing role of oil as a revenue source. The Figure also shows that taxes have become the primary source of public revenue since 2013. Tax collection increases with price level, which explains the trend in Figure 1 panel (b). However, it is apparent that VAT revenue has experienced the fastest rate of growth in the past eight years. This suggests that the elasticity of income for each tax may be different.

Figure 1: Panel (a): Federal Government Revenue and oil production in barrels per day. Panel (b): Federal taxes, VAT, and IT. Source: SHCP.

(a) Federal Government Revenue amd oil production.

(b) Federal taxes, VAT, and IT.



By employing a cointegrated ARDL model, we provide estimates of long-term tax elasticities and extend the analysis to include a counterfactual assessment of revenue losses during the COVID-19 pandemic. These estimates offer a benchmark to assess the effectiveness of government measures implemented during the pandemic.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature on tax elasticity and provides an overview of the tax system in Mexico and its recent developments. Section 3 describes the methodology employed in the analysis and presents the main results. The counterfactual estimation of the revenue loss during the pandemic is presented in Section 4 while Section 5 concludes.

2. Literature Review

To the best of our knowledge, there are relatively few studies on the revenue elasticity of taxes, particularly in emerging economies. However, several relevant references do exist. Mansfield (1972) examines Paraguay's tax system from 1962 to 1970, finding an elasticity of 1.14 and a buoyancy of 1.69, indicating that discretionary changes contributed significantly to revenue growth. Similarly, Bilquees (2004) studies Pakistan's tax system from 1974-75 to 2002-03, revealing an overall elasticity of less than unity, although the sales tax notably improved revenue collection. Yousuf and Huq (2013) analyze Bangladesh's tax system and find that total tax revenue, income tax, and VAT are elastic, while customs duties are inelastic. Machado and Zuloeta (2012) estimate elasticities in eight Latin American countries, showing that long-term elasticities generally exceed one, while short-term elasticities are often not statistically significant. More recently, Casalecchi and Bacciottii (2021) differentiate between short- and long-term elasticities, revealing that long-term elasticities are less than unity, whereas short-term elasticities exceed unity.

[1] *Impuesto Sobre la Renta* and *Impuesto al Valor Agregado*, in Spanish, respectively.

For Mexico, Capistrán (2000) finds a long-term income elasticity of 1.46 for IT, with a significantly higher short-term elasticity. Building on this, Cárdenas et al. (2008) estimate elasticities for VAT, IT, and total tax revenue, all of which are greater than one. Fonseca and Ventosa-Santaulària (2011) further confirm the high elasticity of Mexico's main federal taxes using a cointegration model, reporting long-term elasticities of 2.16 for IT and 2.03 for VAT.

Table I provides a comparative analysis of income elasticity estimates for VAT, IT, and total taxes across various studies and countries, highlighting the consistent tax responsiveness to income changes. Notably, in Mexico, these elasticities are significantly higher than those reported for other countries.

Table I: Elasticities from other studies for Mexico, advanced economies, and emerging economies

VAT	IT	TOTAL	Country	VAT	IT	TOTAL	Country	VAT	IT	TOTAL
Mexico			Advanced Economies				Emerging Economies			
-	1.46[a]	-	Germany[f]	1.11	1.45	1.17	Argentina[k]	-	1.00	-
1.12[b]	1.15[b]	1.2[b]	Japan[f]	0.90	1.57	-	Bangladesh[i]	1.18	-	1.14
1.88[c]	1.36[c]	-	Netherlands[g]	-	2.30	-	Brazil[k]	-	1.03	-
2.03[d]	2.16[d]	-	UK[h]	-	1.40	-	Chile[k]	-	0.96	-
-	1.47[e]	1.72[e]	US[f]	-	1.08	1.04	Colombia[k]	-	1.10	-
			US[h]	-	0.80	-	Costa Rica[k]	-	1.11	-
							El Salvador[k]	-	1.36	-
							Pakistan[j]	-	1.21	0.88
							Peru[k]	-	1.11	-

Note: a. Capistrán (2000); b. Cárdenas et al. (2008); c. CEFP (2008); d. Fonseca and Ventosa-Santaulària (2011); e. Ilzetzki (2011); f. Giorno et al. (1995); g. Wolswijk (2007); h. Choudhry (1979); i. Yousuf and Huq (2013); j. Bilquees (2004); k. Vladkova-Hollar and Zettelmeyer (2008).

The income elasticity of tax revenue can be either countercyclical or procyclical. Elasticities above 1 indicate a healthy countercyclical relationship between income and tax revenues.

An income elasticity greater than 1 implies a robust and automatic buffer when the economy falls into a recession. During downturns, a more than proportional decline in tax revenues can provide relief to households and businesses, easing the impact of recessions and supporting recovery. This dynamic enhances the resilience of the fiscal system and contributes to overall macroeconomic stability.[2] It serves as an inherent countercyclical mechanism within the fiscal system. When income increases, tax revenues increase more than proportionally, helping to mitigate economic overheating by automatically moderating excess demand.

Accurately estimating the elasticity of key taxes also enables policymakers to assess the effectiveness of current tax policies and to make adjustments to optimize revenue collection. For instance, during economic downturns, understanding tax revenue elasticity can help guide the government in designing targeted measures to address revenue shortfalls and maintain fiscal balance.

3. Empirical strategy

We estimate an Autoregressive Distributed Lag model with an error correction mechanism (ARDL ECM) to measure the tax elasticities.[3] The model is then used to calculate a counterfactual of tax revenues during the pandemic period, simulating what revenues would have been had the pandemic not occurred. The specification is as follows:

$$\tau_t = \beta_0 + \sum_{i=1}^{k} \beta_i \tau_{t-i} + \sum_{i=1}^{k} \gamma_i P_{t-i} + \sum_{i=1}^{k} \delta_i y_{t-i} + \theta ECM_{t-1} + x_t' \Phi + \epsilon_t, \tag{1}$$

[2] In the context of the Mexican tax system, understanding income elasticity is particularly important due to its direct impact on federalized expenditures. These consist of resources that the Federal Government transfers to states and municipalities through law-enacted federal contributions, which supplement local expenditures in areas such as education, health, social infrastructure, public security, pension systems, public debt, and other critical sectors.

[3] A VEC model was also estimated as a robustness check. See Appendix Appendix B.

where τ, P, and y represent tax revenue (either VAT or IT), the unemployment rate, and income, respectively (all the variables are in logs). The term $x_t'\Phi$ includes exogenous variables (x_t) and their associated parameters (Φ): WTI crude oil prices, COVID-19 deaths (used as a proxy for the pandemic), and a dummy variable that accounts for the 2008 crisis.[4] The term ECM is the error correction mechanism. k represents the number of lags in the equations, which are determined by selecting the lag that appropriately controls for autocorrelation in the model.[5]

Table II presents the long-run elasticity estimates for VAT, IT, and total tax revenue, capturing the responsiveness of these tax revenues to changes in nominal GDP.

Table II: ARDL long-run estimates of elasticities for the three tax categories

	Regressions		
Variables	VAT	IT	Total Revenue
Nominal GDP	1.229	1.770	1.683
	(0.034)	(0.092)	(0.067)
Unemployment	-0.020	-0.026	0.001
	(0.009)	(0.022)	(0.018)
Constant	3.99	1.911	2.783
	(0.748)	(0.387)	(0.522)
Non-dynamic regressors			
D2008	Included	Included	Included
COVID deaths	Included	Included	Included
WTI	Not Included	Included	Included
Lags			
	(6)	(3)	(6)

On the one hand, the value-added tax income elasticity is 1.22, that is, a 1% increase in nominal GDP leads to a 1.22% increase in VAT collection. The elasticity of VAT with respect to unemployment is quite small, -0.02, and not statistically significant, suggesting that higher unemployment barely impacts VAT collection. On the other hand, the income tax elasticity is 1.77, higher than that of VAT; this is intuitive, as income tax revenue should be more sensitive to changes in economic activity. Finally, the total tax revenue income elasticity is 1.68. In both cases, unemployment does not seem to have a statistically significant impact on tax collection.

Figures 2, 3, and 4 show the VAT, IT, and total tax revenue responses to a 1% shock in nominal GDP. Note that there are two Impulse Response Functions (IRFs) in each figure: the blue line corresponds to the ARDL-ECM model, while the red is obtained from the robustness-check VEC model. Both IRFs exhibit similar behavior, thus providing robustness evidence. In the case of the VEC, we did not find evidence of normality, which is why we opted for the ARDL-ECM as the baseline model. In all cases, the tax response seems to stabilize at a non-zero value after roughly 8 to 12 months.

[4] Tax revenues (IT, VAT, and total tax revenue) were retrieved from the Ministry of Finance (SHCP). Taxes are expressed in current Mexican Pesos; income level was measured using the General Economic Activity Index (IGAE, in Spanish). Source: National Institute of Statistics and Geography (INEGI). This variable was adjusted to mimic nominal GDP; WTI, obtained from the Federal Reserve Bank of St. Louis (FRED); COVID deaths, obtained from the Mexican Research Council, Conachyt.

[5] All variables are tested for stationarity and are found to be integrated of order 1, $I(1)$, and subsequently for cointegration. We employ two commonly used unit root tests: the Phillips-Perron (PP) test and the Augmented Dickey-Fuller (ADF) test. We then proceed with cointegration analysis via the Johansen (1991) test. The results can be found in Appendix Appendix C.

Figure 2: IRFs for Total Tax Revenue

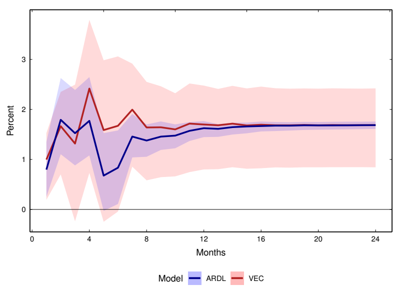


Figure 3: IRFs for VAT

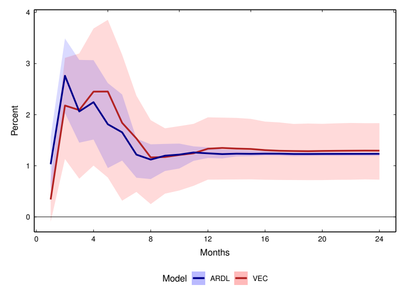
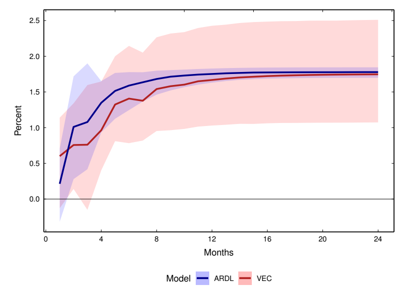


Figure 4: IRFs for IT



4. Revenue Loss during the Pandemic

We use the estimated ARDL models to construct a counterfactual scenario for VAT, IT, and total tax revenues, assuming that the COVID-19 crisis did not occur. The ARDL is a single-equation model that requires input values for other variables –GDP growth, unemployment rate, and WTI oil price– over the period affected by the crisis. For the unemployment rate (which we treat as labor force participation), given its nearly constant growth, we forecast it using a linear trend (see Figure 5). The WTI oil price was modeled using an AR(1) process. Regarding GDP growth, we employ two approaches:

1. An $AR(1)$ model, and
2. The 1.4% annual growth rate forecast by the Bank of Mexico for 2020 at the end of 2019.

Table III summarizes the estimated tax revenue losses due to the COVID-19 pandemic across three main tax categories: total taxes, VAT, and IT. Using ARDL models with ARIMA forecasts and Bank of Mexico's growth projections, we estimate substantial revenue shortfalls.

Table III: Revenue Loss from Taxes

Tax Type	**Model**	**Revenue**		**Loss**	**Loss as % of observed 2020 GDP**
		With COVID	**Without COVID**		
Total Taxes	VEC	$2,771,334.963	$3,078,358.341	$307,023.3776	1.18
	ARDL ARIMA	$2,739,967.68	$2,956,875.99	$216,908.30821	0.83
	ARDL Banxico	$2,739,967.68	$3,049,746.38	$309,778.69988	1.00
VAT	VEC	$858,943.12	$933,470.95	$74,527.82	0.28
	ARDL ARIMA	$768,400.65	$824,775.81	$56,375.15	0.22
	ARDL Banxico	$753,964.04	$842,055.65	$88,091.61	0.33
IT	VEC	$1,437,927.636	$1,610,915.825	$172,988.1885	0.66
	ARDL ARIMA	$1,390,633.84	$1,594,101.85	$203,468.007	0.78
	ARDL Banxico	$1,390,633.84	$1,617,720.63	$227,086.79	0.87

For total taxes, the pandemic led to an estimated revenue loss between 0.83% and 1.00% of GDP, depending on the growth forecast used. The impact on VAT revenue is similarly significant, with losses ranging from 0.22% to 0.33% of GDP. Income tax (IT) revenue saw the largest drop, with losses between 0.78% and 0.87% of GDP.

Figure 5: ARDL Counterfactuals

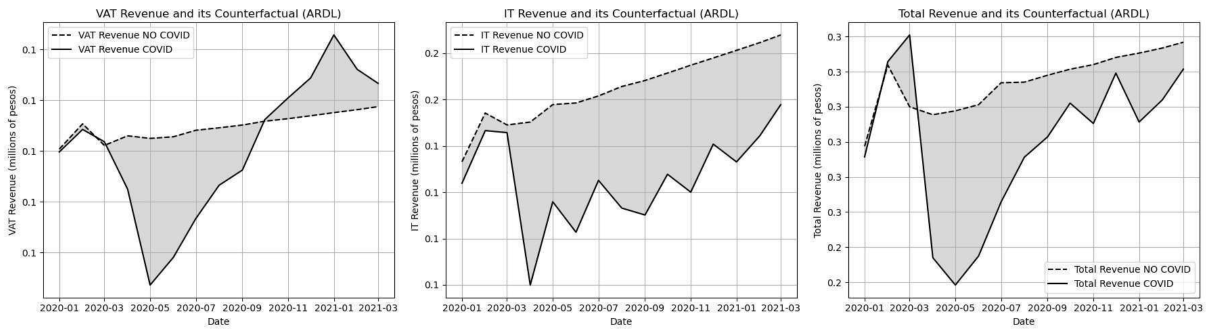


Figure 5 illustrates the counterfactual tax revenues, showing a stark divergence between actual and hypothetical revenues across all tax categories, emphasizing the pandemic's fiscal impact.

5. Concluding remarks

In this paper, we set out to estimate the income elasticities of Mexico's main taxes and to quantify the revenue loss caused by the COVID-19 pandemic. The results reveal that the income elasticities for the value-added, income and total tax revenues exceed one, suggesting that tax revenues grow more than proportionally with GDP.

Greater than one income elasticities highlight an important feature of Mexico's fiscal system: tax collection acts as an automatic stabilizer. When the economy grows, tax revenues increase more than proportionally, helping to prevent overheating. Conversely, in times of economic contraction, tax revenues decline at a faster rate, providing a natural buffer that supports economic recovery. However, this also means that in times of crisis, government revenues will fall more than proportionally, potentially constraining the fiscal space for additional crisis-response measures. If the government wishes to implement further initiatives to support recovery, it may need to explore alternative sources of funding beyond tax revenue.

References

Bilquees, F. (2004). Elasticity and Buoyancy of the Tax System in Pakistan. *The Pakistan Development Review*, 43(1):73–93.

Capistrán, C. (2000). Elasticidad Ingreso del ISR: Una Aplicación de la Metodología General a Particular en Econometría. *Gaceta de Economía*, 5(10):6–36.

Casalecchi, A. and Bacciottii, R. (2021). The Elasticity of Tax Revenues to GDP. Technical Report Special Study No. 16, Independent Fiscal Institution (IFI).

CEFP (2008). La elasticidad del ISR respecto al Producto Interno Bruto. Technical report, CEFP.

Choudhry, N. N. (1979). Measuring the Elasticity of Tax Revenue: A Divisia Index Approach. *IMF Staff Papers*, 26(1):87–120.

Cárdenas, O., Ventosa-Santaulària, D., and Gómez, M. (2008). Elasticidad ingreso de los impuestos federales en México. *El Trimestre Económico*, 75(298):141–173.

Fonseca, F. J. and Ventosa-Santaulària, D. (2011). Revenue Elasticity of the Main Federal Taxes in Mexico. *Latin American Journal of Economics*, 48(1):89–111.

Giorno, C., Richardson, P., Roseveare, D., and van den Noord, P. (1995). Estimating Potential Output, Output Gaps and Structural Budget Balances. Oecd economics department working papers no. 152, OECD, Paris, France.

Ilzetzki, E. (2011). Fiscal Policy and Debt Dynamics in Developing Countries. Policy research working paper 5666, The World Bank.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica*, pages 1551–1580.

Machado, R. and Zuloeta, J. (2012). The Impact of the Business Cycle on Elasticities of Tax Revenue in Latin America. IDB Working Paper Series IDB-WP-340, Inter-American Development Bank.

Mansfield, C. (1972). Elasticity and Buoyancy of a Tax System: A Method Applied to Paraguay. *IMF Staff Papers*, 19(3):425–446.

Vladkova-Hollar, I. and Zettelmeyer, J. (2008). Fiscal Positions in Latin America: Have They Really Improved? Working Paper 137, IMF Working Paper, Western Hemisphere and Research Departments.

Wolswijk, G. (2007). Short- and Long-Run Tax Elasticities: The Case of the Netherlands. ECB Working Paper Series 763, ECB, Frankfurt am Main, Germany.

Yousuf, M. K. and Huq, S. (2013). Elasticity and Buoyancy of Major Tax Categories: Evidence from Bangladesh and Its Policy Implications. Ministry of Finance, Bangladesh Secretariat.

Appendix A. Data

The similarity in trends can be viewed in Figures A.6, A.7 and A.8.

Figure A.6: GDP and TTR

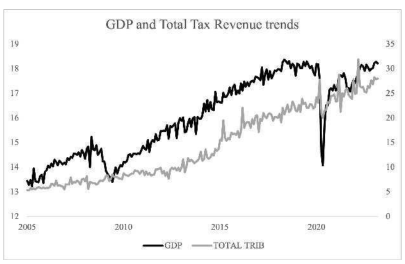


Figure A.7: GDP and VAT

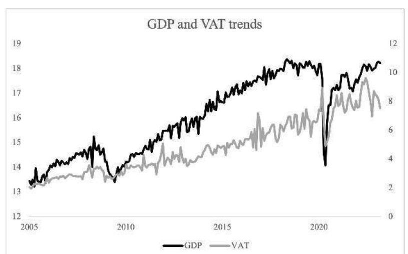
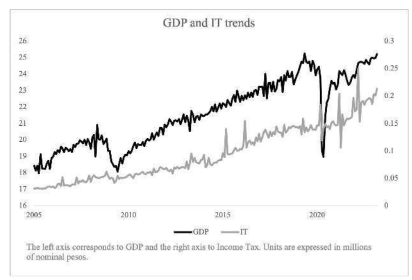


Figure A.8: GDP and IT



Appendix B. VECM model

The VEC model equation is specified as follows:

$$\Delta y_t = \mu_t + \alpha\beta' y_{t-k} + \sum_{i=1}^{t-k} \Delta y_{t-i} + \epsilon_t$$

Where α represents short-term corrections, and β are the coefficients for long-term relationships. Additionally,

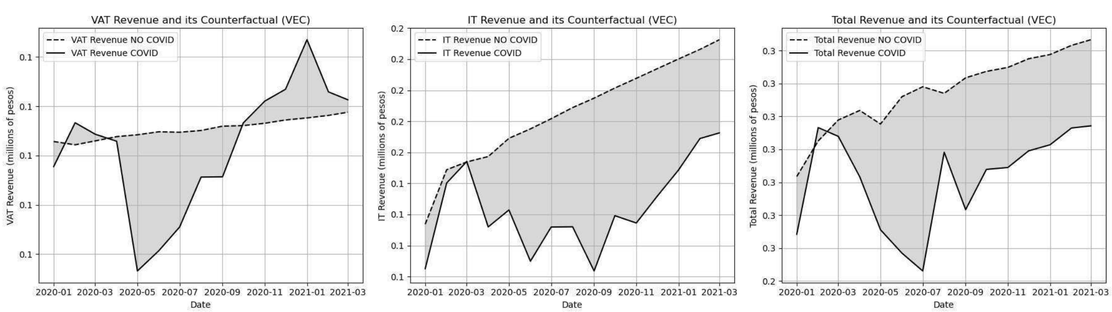
$$y_t^{'} = (nominalGDP, Unemploymentrate, Tax)$$

Table B.4 presents the results for the coefficients and the specification tests of the model. As can be noticed, there is evidence against normality. This is the reason this model was used merely as a comparison for the main ARDL model in the paper.

Table B.4: VEC Model Results and Specification Tests for the Three Tax Categories

		VAT	**IT**	**Total Revenue**
	Model Results			
Endogenous	Nominal GDP	-1.293	-1.750	-1.683
		(0.034)	(0.052)	(0.035)
	Unemployment rate	0	0	0
	Tax	1	1	1
Exogenous	WTI	x	x	0.358
				(0.030)
	COVID deaths	Included	Included	Included
	D2008	Included	Included	Included
ECM	α_1	0	0	0.110
				(0.019)
	α_2	0	0	-0.343
				(0.178)
	α_3	-0.697	-0.469	-0.308
		(0.129)	(0.087)	(0.063)
Lags		6	3	6
	Specification Tests			
Autocorrelation	Equation 1	0.998	0.184	0.965
	Equation 2	0.788	0.798	0.912
	Equation 3	0.989	0.989	0.791
Heteroskedasticity	Equation 1	0.833	0.804	0.541
	Equation 2	0.279	0.111	0.126
	Equation 3	0.628	0.779	0.530
Restrictions		0.545	0.160	0.664
Normality		0.000	0.000	0.000

Figure B.9: VEC Counterfactuals



Appendix C. Statistical test for the models

Table C.5: Unit root tests

Variable	Phillips-Perron		Augmented Dickey-Fuller	
	In levels	First Difference	In levels	First Difference
Nominal GDP	0.442	-14.727	-1.089	-10.018
	(0.861)	(0.000)	(0.72)	($\approx$ 0)
Unemployment rate	1.0824	-14.829	-1.379	-9.729
	(0.954)	(0.000)	(0.59)	($\approx$ 0)
IT	2.301	-28.661	0.845	-11.439
	(0.999)	(0.000)	(0.99)	($\approx$ 0)
VAT	0.652	-19.243	-0.784	-10.933
	(0.902)	(0.000)	(0.82)	($\approx$ 0)
Total Revenue	2.550	-25.898	0.565	-11.469
	(1.000)	(0.000)	(0.98)	($\approx$ 0)

Note: The table shows the test statistic and the corresponding p-value in parentheses.

Table C.6: Johansen test results

Cointegration Test	Test hypothesis	VAT	IT	Total
Trace	$\mathcal{H}_0$	36.572 [0.0064]	41.029 [0.0014]	83.180 [0.0000]
	$\mathcal{H}_1$	4.8541 [0.8215]	8.1211 [0.4598]	7.2165 [0.5591]
Lmax	$\mathcal{H}_0$	31.718 [0.0007]	66.079 [0.0000]	82.498 [0.0000]
	$\mathcal{H}_1$	3.7115 [0.8803]	5.4943 [0.6820]	3.9868 [0.8541]