

# **Does Greater Regional Authority in a Federal System Reduce Internal Trade as a Share of National GDP?**

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## I. Introduction

Internal economic integration, represented by internal trade, is a powerful means for countries to promote economic growth and development. It reduces trade barriers, lowers costs, and increases market access, conditions that allow countries to specialize in their areas of comparative advantage, enhance efficiency, and encourage innovation (Ungerer et al., 2018). However, not all countries have equal internal integration, with an important influencing factor being the country's structure of political authority. For instance, federal governing systems distribute legislative powers between national and regional governments. Each level gets authority over specific areas of governance that include passing laws, collecting taxes, and managing services (Brudeau & Brosseau, 2022). From here, we hypothesize that the more powers the regional government bears, the lower internal trade as a share of GDP would be due to differing regulations such as taxes, licensing rules, and they reduce trade efficiency. One research study partly supports this guess: "Regional governments can harm economic integration by creating trade barriers, but they can also benefit by actively participating in negotiations" (Broschek, 2018).

Consequently, this research paper aims to find out the relationship between the design of federal institutions on countries' internal economic integration: Does greater regional authority in federal systems reduce internal trade as a share of national GDP?

This study is conducted by examining the relationship between regional autonomy and internal trade as a share of GDP across different countries. Understanding this relationship is important for economic health and policy-making. As the research has shown that "high internal trade costs decrease economic growth, reduce competition, and raise prices for consumers (McMahon & Bellefleur, 2025), if greater power decentralization harms internal trade by increasing internal trade costs, policymakers must weigh the benefits of local autonomy against the costs of impairing economic

health. Therefore, the findings of this study have direct implications for how governments design fiscal systems and regulatory frameworks.

Using data from the World Input-Output Database (WOID), the World Bank, and the Regional Authority Index (RAI), this paper constructs a cross-country panel dataset covering 43 countries in the year 2014; the comparison between regional autonomy and internal trade as a share of GDP is conducted using multiple linear regression by controlling for GDP per capita, population, and land area.

The regression results show a consistent and statistically significant negative relationship between regional authority and internal trade. Across all specifications, countries with higher Regional Authority Index (RAI) scores, meaning subnational governments bearing more power, have lower levels of internal trade as a share of GDP. Even after controlling for population, GDP per capita, and land area, the estimated effect of RAI remains negative and highly significant. These findings suggest that the higher the regional autonomy, the lower the internal economic integration. The paper proceeds by presenting the data, outlining the empirical model, and discussing the implications of these results for the relationship between power decentralization and domestic market integration.

## **II. Data Description**

### *A. Data Sources*

The analysis combines information from two primary datasets. The first one is the World Input-Output Database (WIOD), which measures the value of goods and services exchanged between a country's subnational regions across all industries. The second one is the Regional Authority Index (RAI), which quantifies the degree of political decentralization and regional autonomy. Moreover, country-level variables such as GDP per capita, population, and land area are obtained from the World Bank.

## *B. Data Structure*

The combined dataset is organized as a country-year panel, but the analysis focuses on a cross-sectional sample for the year 2014. WOID reports national input-output tables annually. However, because some control variables are subject to time, we restricted our analysis to 2014, the most recent year available in WOID. The final dataset contains 42 countries.

## *C. Variables*

### *Explanation of Variables.*

Dependent Variable: Internal trade as a percentage of GDP — Measures the domestic economic integration. Higher values indicate a larger share of economic activity occurring inside the country. This is calculated by dividing the total value of interregional trade flows across all industries within a country by its national GDP.

Independent Variable: RAI — Measures the level of decentralization. A country with a high RAI has a stronger regional (subnational) authority, more independent policymaking, and greater regional power sharing at a national level.

#### Controls:

GDP per capita: It is a proxy for economic development. More developed economies may have more diversified production and internal trade patterns. Holding GDP per capita constant helps isolate the effect of decentralization instead of differences in income or productivity.

Population: Captures the internal market size. Larger populations demand more domestic exchange of goods and services, which increases internal trade flows. Controlling population helps to isolate the effect of a decentralized political structure on internal trade as a share of GDP.

Land area: Larger countries face higher transport distances and costs, which can affect the intensity of internal trade. Countries with larger land masses can trade less internally, just because moving goods across long distances is more expensive.

All these variables help ensure that the cross-country comparison accounts for bias in economic and geographic characteristics. There can be other variables that may affect the relationship between regional autonomy and economic integration, yet we believe these are the major representative ones that need to be included.

#### ***Variable Structure and Transformation.***

Most variables are reported yearly. Land area is time-invariant. Internal trade as a percentage of GDP is calculated by dividing the total value of interregional trade flows across all industries within a country by its national GDP. Several variables require scaling before estimation. Population, land area, and GDP per capita originally had extremely large values, which caused numerical instability and made the coefficients difficult to interpret. Therefore, Population and Land Area were divided by 1,000,000 to express them in millions; GDP per Capita was divided by 10,000 for readability.

#### ***D. Analysis Sample***

The analysis uses a cross-section of 42 countries in 2014. The sample is constructed by merging WOID internal trade data, RAI decentralization scores, and World Bank economic indicators. The choice of 2014 includes both the most recent WOID release and the need to maintain consistency across data sources. Using a single year eliminates concerns about time and simplifies the interpretation of the regression coefficients.

### E. Summary Statistics

Table 1: Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Internal trade / GDP (%)	42	0.345	0.201	0.0287	0.803
RAI	42	15.1	10.7	0	37.7
Population (millions)	42	109.0	288.0	0.433	1372.0
GDP per capita (10,000 USD) <sup>a</sup>	42	3.50	2.66	0.155	12.4
Land area (millions km <sup>2</sup> )	42	1.73	3.64	0.00032	16.4

<sup>a</sup> GDP per capita divided by 10,000.

## III. Model

To evaluate how regional autonomy affects internal economic integration, we estimate a regression model where the dependent variable is internal trade as a share of GDP. This variable captures the extent to which goods and services circulate within a country. This makes internal trade as a percentage of GDP a good measure for market integration.

The independent variable is the Regional Authority Index (RAI), which measures the degree of political decentralization in a country. The RAI combines indicators of self-rule and shared-rule. Higher RAI values indicate stronger regional authority, higher constitutional autonomy, and more independent policymaking power. The goal is to test whether higher regional authority is associated with lower levels of internal trade.

We estimated the following regression model:

$$InternalTrade_i = \beta_0 + \beta_1 RAI_i + \beta_2 GDPpc_i + \beta_3 Pop_i + \beta_4 Land_i + \varepsilon_i$$

Where:

- i: indexes countries
- InternalTrade = internal trade as a share of GDP
- $\varepsilon_i$ : error term
- RAI: regional authority index:

- GDPpc: GDP per capita
- Pop: Population
- Land: Land area ( $\text{km}^2$ )

### ***Coefficients.***

The primary coefficient of interest is  $\beta_1$  the coefficient on the Regional Authority Index.

It measures the estimated change in internal trade as a share of GDP associated with a one unit increase in regional authority, holding GDP per capita, population, and land area constant. In other words, how much does internal trade as a share of GDP increase when the regional authority increases by one unit?

A negative and significant  $\beta_1$  means the increase in regional authority reduces internal trade as a share of GDP, indicating a lower internal economic integration.

A positive and significant  $\beta_1$  result means the increase in regional authority increases internal trade as a share of GDP, indicating a higher economic integration.

### ***Specifications.***

Four specifications were estimated to understand the relationship between regional authority and the internal trade as a share of GDP. Each model adds controls incrementally to examine how the coefficient on RAI behaves when additional sources of variation are added.

Specification (1): RAI only — The first model regressed internal trade on RAI only. This specification gives the raw, uncontrolled association between decentralization and internal trade. The coefficient of -0.013 ( $p>0.01$ ) suggests that countries with higher regional authority have lower internal trade shares, even before accounting for economic or geographic differences.

Specification (2): Adding population — The second model adds population to control for market size. Larger countries may require more internal transactions, and failing to

account for this could bias the estimate on RAI. The coefficient on RAI is very similar (-0.012), which indicates that the population does not explain the negative relationship between decentralization and internal trade.

Specification (3): Adding GDP per capita — The third model includes GDP per capita to control for differences in development levels. More advanced economies may have different structures and trade patterns. Once GDP per capita is included, the RAI coefficient is still negative and highly significant (-0.011), suggesting that the relationship between RAI and internal trade is not driven by income differences across countries.

Specification (4): Full model — The final model includes land area to account for geographic scale, which affects transportation costs and domestic trade. In this fully controlled model, the coefficient on RAI remains negative (-0.009) and statistically significant at the 1% level. This indicates that the relationship remains after controlling for structural, demographic, and geographic factors.

### ***Omitted Variable Bias.***

Despite including important controls, there are still unsolved factors that may influence both RAI and internal trade. This opens the possibility of omitted variable bias.

Potential omitted variables include: Infrastructure (countries with better infrastructure trade more internally), national trade regulations or barriers (some governments may impose internal trade restrictions), historical or cultural regional divisions (countries with strong regional identities may lean towards power decentralization and lower economic integration), and internal structure (economies specialized in services versus manufacturing may have better internal trade patterns).

If any of these omitted variables correlate with RAI, the estimated coefficient  $\beta_1$  may be biased. For instance, if countries with strong regional identities decentralize more and trade less internally, the negative effect of RAI on internal trade would be inflated.

We acknowledge this concern and interpret our results as estimations or associations rather than strict causal effects. However, by including GDP per capita, population, and land area, we reduce the risk of omitted variable bias.

### ***Other Considerations.***

Measurement differences across countries — Internal trade made up of sector-level industry flows, and countries have different sectoral composites and data quality. RAI is based on institutional coding that may not reflect political power exactly.

### ***B. Table of Results***

**Table 1: Regression Results**

*Dependent variable: Internal trade as a share of GDP in 2014 (%)*

	(1)	(2)	(3)	(4)
<b>RAI</b>	-0.013*** (0.002)	-0.012*** (0.002)	-0.011*** (0.002)	-0.009*** (0.002)
<b>Population</b>		-0.0002** (0.0001)	-0.0002*** (0.0001)	-0.0002** (0.0001)
<b>GDP per Capita</b>			-0.015* (0.009)	-0.016* (0.008)
<b>Land</b>				-0.015** (0.006)
<b>Constant</b>	0.541*** (0.039)	0.538*** (0.037)	0.585*** (0.045)	0.588*** (0.042)
Observations	42	42	42	42
R <sup>2</sup>	0.482	0.542	0.578	0.638
Adjusted R <sup>2</sup>	0.469	0.519	0.544	0.599
Residual Std. Error	0.146 (df = 40)	0.139 (df = 39)	0.136 (df = 38)	0.127 (df = 37)
F Statistic	37.179*** (df = 1; 40)	23.118*** (df = 2; 39)	17.329*** (df = 3; 38)	16.290*** (df = 4; 37)

Note: \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

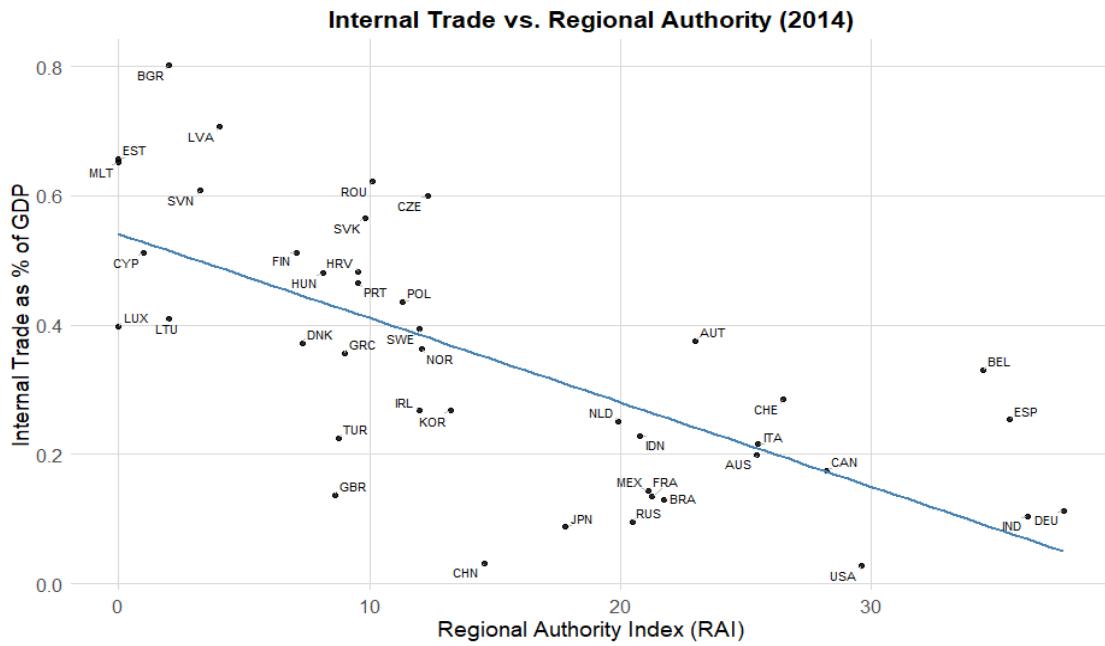


TABLE 1. REGRESSION RESULTS

The results clearly show that higher regional authority is associated with lower internal economic integration. In the scatterplot, countries with strong regional autonomy—such as the U.S., Germany, India, and Canada—cluster in the high-RAI, low-trade region, while more centralized countries appear in the low-RAI, high-trade area. This visual pattern is confirmed by the regression results: the coefficient on RAI is negative and highly significant in every specification, ranging from  $-0.013$  to  $-0.009$  (all  $p < 0.01$ ). The consistency indicates that decentralization reduces internal trade.

For control variables, Population is negative across the controlled models ( $-0.0002$ ), indicating that larger countries may face higher internal barriers. GDP per capita ( $-0.015$ ) and land area ( $-0.015$ ) also reduce internal trade, consistent with trade frictions rising with economic complexity or geography.

To validate these conclusions, additional checks strengthen the model: adding a GDP per capita squared term tests for nonlinear development effects; removing outliers ensures results are not driven by extreme cases. Across these tests, the main conclusion remains robust: greater regional authority is consistently linked to lower internal trade

#### **IV. Discussion**

The results provide evidence that higher regional authority is associated with lower internal trade as a share of GDP. Across all specifications, the RAI coefficient remains negative and highly statistically significant. This consistency suggests that the relationship between decentralization and internal economic integration is not driven by any single control variable.

The interpretation of the coefficient is meaningful at an economic level. A one-unit increase in RAI is associated with about a 0.9 to 1.3 percentage reduction in internal trade intensity. This suggests that decentralization may bring administrative, regulatory, and/or institutional barriers that reduce market integration.

#### ***Specification checks on the Model***

The specification check is conducted by adding squared GDP per capita as another control and comparing the regression results between the original baseline model and the new model.

Original baseline model:

$$InternalTrade_i = \beta_0 + \beta_1 RAI_i + \beta_2 GDPpc_i + \beta_3 Pop_i + \beta_4 Land_i + \varepsilon_i$$

New model for specification check:

*InternalTrade*

$$\begin{aligned} &= \beta_0 + \beta_1 RAI_i + \beta_2 GDPpc_i + \beta_3 (GDPpc_i)^2 + \beta_4 Pop_i + \beta_5 Land_i \\ &\quad + \varepsilon_i \end{aligned}$$

From the original model, we suspect that there might be non-linear patterns between GDP per capita and the Internal trade share. The development may have diminishing or increasing marginal effects on internal trade intensity. For instance, in early stages of development where income/GDP per capita is low, internal supply chains may expand as countries industrialize and thus higher internal trade as a share of GDP; at higher income levels, economies may shift toward external trade, which reduces internal flows. Adding  $\text{GDPpc}^2$  meaningfully differs from the baseline specifications because it relaxes the linearity assumption and allows income to influence internal trade at different marginal rates.

### ***Results for Specification checks***

All numerical references correspond to the baseline results (Columns 1–4) and the extended model with GDP per capita squared (Column 5).

Firstly, comparing the GDP per Capita Coefficient before and after adding  $\text{GDPpc}^2$ , the coefficient on GDP per Capita is  $-0.016$  ( $\text{SE} = 0.008$ , \*) in the baseline model, and it becomes  $-0.040$  ( $\text{SE} = 0.026$ , no stars) after GDP per capita squared is added (Column 5). Since  $-0.040 < -0.016$ , the GDP per capita term becomes more negative in the extended model. Therefore, higher GDP per capita slightly reduces internal trade under the baseline model, and this reduction is bigger under the extended model. However, such a “bigger effect” is not statistically meaningful because the coefficient becomes insignificant after GDP per capita squared is added. This means that this model is not confident that this effect is real (no significance star); In other words, the data do not support a reliable nonlinear income effect—there is no evidence that GDP per capita has

a stronger impact on internal trade at high income levels and a weaker impact at low income levels.

Secondly, comparing the signs of the GDP per capita squared, the coefficient on  $\text{GDPpc}^2$  is +0.002 (SE = 0.002) in Column 5, and the coefficient for GDP per capita is -0.040. This combination of a positive quadratic term (+0.002) and a negative linear term (-0.040) implies a potential U-shaped income–internal trade relationship, yet significance testing is needed to confirm.

Thirdly, comparing adjusted  $R^2$  and residual standard error, the baseline full model

Regression Results with GDP per Capita Squared

	(1)	(2)	(3)	(4)	(5)
RAI	-0.013*** (0.002)	-0.012*** (0.002)	-0.011*** (0.002)	-0.009*** (0.002)	-0.008*** (0.002)
Population		-0.0002** (0.0001)	-0.0002*** (0.0001)	-0.0002** (0.0001)	-0.0002** (0.0001)
GDP per Capita			-0.015* (0.009)	-0.016* (0.008)	-0.040 (0.026)
$\text{GDPpc}^2$					0.002 (0.002)
Land				-0.015** (0.006)	-0.015** (0.006)
Constant	0.541*** (0.039)	0.538*** (0.037)	0.585*** (0.045)	0.588*** (0.042)	0.621*** (0.054)
Observations	42	42	42	42	42
$R^2$	0.482	0.542	0.578	0.638	0.647
Adjusted $R^2$	0.469	0.519	0.544	0.599	0.598
Residual Std. Error	0.146 (df = 40)	0.139 (df = 39)	0.136 (df = 38)	0.127 (df = 37)	0.127 (df = 36)
F Statistic	37.179*** (df = 1; 40)	23.118 *** (df = 2; 39)	17.329*** (df = 3; 38)	16.290*** (df = 4; 37)	13.192*** (df = 5; 36)

Note: \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ .

(Column 4) has an Adjusted  $R^2$  of 0.599 and a Residual Std. Error of 0.127, while the extended model with  $\text{GDPpc}^2$  (Column 5) has an Adjusted  $R^2$  of 0.598 and an identical Residual Std. Error of 0.127. Both values remain virtually unchanged, showing that adding  $\text{GDPpc}^2$  does not materially improve model fit.

Fourthly, comparing the coefficient of the Regional Authority Index (RAI), the baseline full model (Column 4) has an RAI of -0.009 (SE = 0.002, \*\*\*), and the extended model (Column 5) has an RAI of -0.008 (SE = 0.002, \*\*\*). The magnitude

and significance remain nearly identical across models, indicating that the estimated negative effect of regional authority on internal trade is not affected by adding a non-linear GDP per capita. Regardless of whether GDP per capita is modeled linearly or non-linearly, the estimated linear effect of RAI on internal trade as a share of GDP remains almost unchanged.

In conclusion, since in column 5, both GDP per Capita and GDP per capita squared are both insignificant, model fit does not improve, and the RAI coefficient remains stable, the simpler baseline model captures the relationship between independent and dependent variables well, and adding nonlinear income terms does not change the results or improve the model. All evidence listed above from the regression results table confirms that the extended model does not alter the core empirical conclusion: greater regional authority is associated with lower internal economic integration.

### ***Robustness of the model***

**Table 3: Regression Results**  
*Dependent variable: Internal trade as a share of GDP in 2014 (%)*

	(1)	(2)	(3)	(4)
<b>RAI</b>	-0.013*** (0.002)	-0.011*** (0.002)	-0.010*** (0.002)	-0.010*** (0.002)
<b>Population</b>		-0.0002** (0.0001)	-0.0002** (0.0001)	-0.0001* (0.0001)
<b>GDP per Capita</b>			-0.014 (0.009)	-0.018** (0.008)
<b>Land</b>				-0.019** (0.008)
<b>Constant</b>	0.538*** (0.041)	0.534*** (0.039)	0.579*** (0.048)	0.598*** (0.045)
Observations	39	39	39	39
<i>R</i> <sup>2</sup>	0.438	0.505	0.538	0.611
Adjusted <i>R</i> <sup>2</sup>	0.423	0.478	0.499	0.566
Residual Std. Error	0.151 (df = 37)	0.143 (df = 36)	0.141 (df = 35)	0.131 (df = 34)
F Statistic	28.845*** (df = 1; 37)	18.377*** (df = 2; 36)	13.593*** (df = 3; 35)	13.369*** (df = 4; 34)

Note: \*p < 0.1; \*\*p < 0.05; \*\*\*p < 0.01.

To check the robustness of our model, we examined the changes that would occur from eliminating various outlier nations, specifically Australia, Canada, and the United

States. This offers a method to ensure that the results are not being disproportionately impacted by a few countries that have strong federal systems but simultaneously have high levels of regional authority based around their states, provinces, and territories. After running a regression without these three nations, it was evident that the coefficient on RAI was still negative and statistically significant. This indicates that there is a relationship between regional authority and internal trade, not just in countries that have high extremes for the control variables.

## **VI. Conclusion**

This paper investigates whether regional authority reduces economic integration. Using data from WOID, the Regional Authority Index, and the World Bank, a strong negative association between decentralization and internal trade as a share of GDP. The negative effect remains across all specifications and remains stable even after controlling population, GDP per capita, and land area.

These results suggest that countries with more decentralized political systems tend to have lower internal trade. This may lead to an increase in regulatory or administrative fragmentation, divergent regional policies, or reduced coordination in national infrastructure. These findings contribute to a broader debate about federalism and potential economic tradeoffs: regional autonomy strengthens local governance and representation, but it may also weaken market integration.

Future work could explore causal factors more directly, incorporate sector-level variations, or assess if certain types of decentralization have different effects on internal trade flows.

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