The Anatomy of a Growth Trap: Diagnosing Binding Constraints in Tucumán, Argentina*

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August, 2025

Abstract

Traditional approaches to economic growth often emphasize broad structural reforms, yet their effectiveness depends crucially on context. Policies that are transformative in one economy may be ineffective—or even counterproductive—in another. The Growth Diagnostics framework addresses this challenge by focusing on the specific constraints that limit investment and growth in a given place and time. This paper applies the framework to the Argentine province of Tucumán, where persistent gaps in income and productivity suggest the presence of binding constraints to long-run development. The analysis highlights three central obstacles: (i) a scarcity of highly skilled human capital, which depresses social returns; (ii) high tax pressure, which reduces the appropriability of investment returns; and (iii) low economic complexity, which limits opportunities for productive diversification. Beyond these substantive findings, the paper contributes methodologically by adapting Growth Diagnostics to the subnational level through novel empirical tests and sectoral applications. In doing so, it enriches the literature on regional development in Latin America and provides policy-relevant insights for designing reforms tailored to Tucumán's specific challenges.

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*Undergraduate thesis of Bachelor's Degree in Economics, Facultad de Ciencias Económicas - UNT. Guided by MSc. Alejandro Danón

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1 Introduction

Why do some economies flourish while others remain trapped in stagnation? The process of economic growth and the search for explanations of the differences in economic performance across countries has long been one of the most interesting, important, and challenging areas of modern social science (Acemoglu, 2008). Much of the research on growth has focused on identifying its general causes, while devoting less attention to the analysis of potential obstacles to growth in specific contexts (Hausmann, Rodrik, & Velasco, 2008). Although the contribution of classical growth theories and the extensive empirical literature derived from them has provided invaluable tools for understanding the phenomenon of economic growth, many economists have found this set of tools insufficient to diagnose the challenges faced by individual countries (Hausmann et al., 2005).

The Growth Diagnostics (GD) framework developed by Hausmann et al. (2005) represents a methodological shift in this debate. Rather than prescribing universal reforms, GD treats the growth process as constrained by a limited set of binding factors. It asks not "what policies promote growth in general" but "which obstacles most severely restrict investment and entrepreneurship here and now." The framework is operationalized through a decision tree that begins by asking whether low investment stems from low expected returns or high costs of finance, and then branches into progressively narrower hypotheses—such as low social returns, problems of appropriability, or financial intermediation failures. The diagnostic is thus designed not to generate a laundry list of reforms, but to prioritize those interventions with the highest expected payoff.

This paper applies the GD framework to the Argentine province of Tucumán. Located in the country's Northwest, Tucumán is emblematic of a puzzle common across Latin America: regions that outperform in output growth yet remain persistently behind in welfare indicators. The province ranks among the three lowest in Argentina in GDP per capita, and despite registering growth above the national and NOA averages during 2004–2023, it has failed to translate these gains into sustained improvements in wages and household income. These stylized facts raise the hypothesis that Tucumán's economy is constrained by structural bottlenecks that depress its long-run trajectory.

Guided by the Growth Diagnostics framework, this study identifies three restrictions that appear to be binding on Tucumán's long-run growth. First, low social returns are driven by a shortage of highly skilled human capital, as indicated by the province's low levels and quality of education, together with relatively high returns to schooling. Second, high and distortionary tax pressure —identified through evidence of high effective tax burden and the widespread incidence of labor informality, which together create uncertainty about the appropriability of investment returns. Third, low economic complexity, revealed by consistently low values in economic complexity measures and by unfavorable forecasts of future complexity, which limit the province's potential for productive diversification. Taken together, these restrictions align with what the literature has termed "growth traps": self-reinforcing equilibria in which capabilities and opportunities remain limited.

This work contributes to the literature in two main ways. Substantively, it joins a small but growing set of subnational applications of the Growth Diagnostics framework.[1] Previous cases include Buenos Aires (Castro et al., 2014), which identified skilled-labor shortages and coordination failures in the metropolitan area, and Chiapas (Hausmann, Rodrik, & Velasco, 2008) and Oaxaca (Sánchez et al., 2018), which highlighted low-productivity traps and weak economic complexity in lagging Mexican states. Tucumán offers a comparable case, but within the Argentine context of pronounced regional disparities.

Methodologically, the paper extends Growth Diagnostics to a data-scarce subnational setting through several innovations. These include provincial-level estimates of real interest rates to assess financing costs; systematic use of differential-diagnosis tools such as shadow prices, bypass behavior, and composition tests; a sectoral exercise on water-intensive activities inspired by the "camels and hippos" analogy; and the integration of firm-level perceptions via the World Bank Enterprise Survey (2017). Together, these extensions sharpen the diagnosis for Tucumán and illustrate how the framework can be adapted to regional economies where conventional datasets are limited.

The rest of the thesis is structured as follows. Section 2 reviews the relevant literature. Section 3 presents the Growth Diagnostics methodology, distinguishing its theoretical and practical foundations. Section 4 provides a characterization of Tucumán's economy and a long-term growth analysis, which motivates this study. Section 5 evaluates all potential constraints: Section 5.1 examines access to finance; Section 5.2 addresses low social returns, focusing on human capital and infrastructure; Section 5.3 analyzes problems of appropriability, particularly those related to government and market failures. Finally, Section 6 presents the main conclusions.

[1] In total, 21 studies applying Growth Diagnostics were identified, of which 12 correspond to national diagnoses and 9 to subnational ones.

2 Literature Review

A total of 21 studies applying the Growth Diagnostics methodology were identified, of which 12 correspond to national-level diagnoses and 9 to subnational-level ones. Among these, 15 focus on Latin America, highlighting the region's particular relevance as an area of application for this tool. The subnational diagnoses in Latin America include the cases of CABA (2014), Chiapas (2015), Oaxaca (2018), Tabasco (2018), Hermosillo (2018), Campeche (2018), Baja California (2018), Western Australia (2020), and Loreto (2020).

Within this group, some diagnoses are particularly relevant to the case of Tucumán. The case of CABA (Castro et al., 2014) identified as key constraints the shortage of highly qualified human capital and policy coordination challenges in the Buenos Aires Metropolitan Area. These findings are significant because they reflect issues related to capacity accumulation and institutional management—dimensions that also emerge as critical in Tucumán.

The diagnoses of Chiapas (Hausmann et al., 2015) and Oaxaca (Sánchez et al., 2018) are also highly relevant precedents, as both are subnational economies exhibiting lower levels of development and competitiveness within middle-income countries. Both cases reveal traps of low productivity, limited economic complexity, and restricted labor mobility—phenomena that clearly resemble the challenges faced by Tucumán. Chiapas was characterized as an economy trapped in a structure of very low productive sophistication, rooted in the absence of complementary inputs and coordination failures that hinder the emergence of new activities. In contrast, Oaxaca emphasized the interaction of high transport costs, geographic isolation, and institutional fragmentation, all of which reinforced low social returns and impeded productive diversification.

Appendix A of this thesis includes a summary table of the aforementioned studies, outlining the specific constraints identified in each case.

3 Methodology

The Growth Diagnostics methodology (GD) proposes a unified structure that allows us to analyze and formulate growth strategies that are not only feasible but also grounded in solid economic reasoning. In practical terms, it serves to identify the main constraints to growth faced by a country, region, or locality. Unlike traditional economic prescriptions, GD holds that the reasons why an economy may not grow—or grows at a slower-than-expected pace—differ across countries and regions, and vary over time. It assumes that public policies suitable for one economy may not be appropriate for another, and therefore proposes a coherent, unified framework designed to analyze and account for the particularities of each case (Castro et al., 2014).

In this regard, a policy grounded in the Growth Diagnostics approach is based on the following principles:

- **Economic growth as a central goal:** improving people's living standards is the main objective that economic and social reforms proposed by governments should pursue. In this pursuit, economic growth plays a fundamental role. Therefore, reforms should aim to improve growth rates—in other words, they should be *growth-oriented strategies.*

- **Sense of prioritization:** a long list of structural reforms is not particularly useful for governments, especially given the administrative, political, and budgetary constraints they face. The Growth Diagnostics methodology identifies the most pressing issues in the economy, highlighting the urgency of some recommendations over others.

- **Responses to local problems:** reforms based on universal formulas or on the best practices available to date are highly likely to be unsuccessful. The Growth Diagnostics approach considers the local context and focuses on the specific problems and/or opportunities faced by each region, while still adhering to certain global principles, such as property rights and the proper functioning of markets, among others.

3.1 Conceptual Framework of Growth Diagnostics

From a theoretical standpoint, the Growth Diagnostics (GD) approach draws on the fundamental concepts of second-best and partial reform growth theories. In particular, it presents an endogenous growth model that incorporates a set of various distortions. An important property of this model—as well as of many other growth models—is that, along a *balanced growth path*, the rate at which the economy grows is a function of the gap between the expected return to asset accumulation and the cost of those assets for the private agents accumulating them. The larger the gap between the expected return and the acquisition cost of assets, the greater the investment effort. This can be expressed in the following equation:

$$g = \frac{\dot{c}_t}{c_t} = \frac{\dot{k}_t}{k_t} = \sigma[r(1-\tau) - \rho] \tag{1}$$

Where g is the economic growth rate, c and k are per capita consumption and capital, σ is the intertemporal elasticity of consumption substitution, r is the expected social return to investment, $(1-\tau)$ is the share of r that is appropriable, and ρ is the opportunity cost of funds. The greater the gap, the stronger the incentive to accumulate capital, and thus the higher the growth rate.

In addition, the social return to capital is defined as:

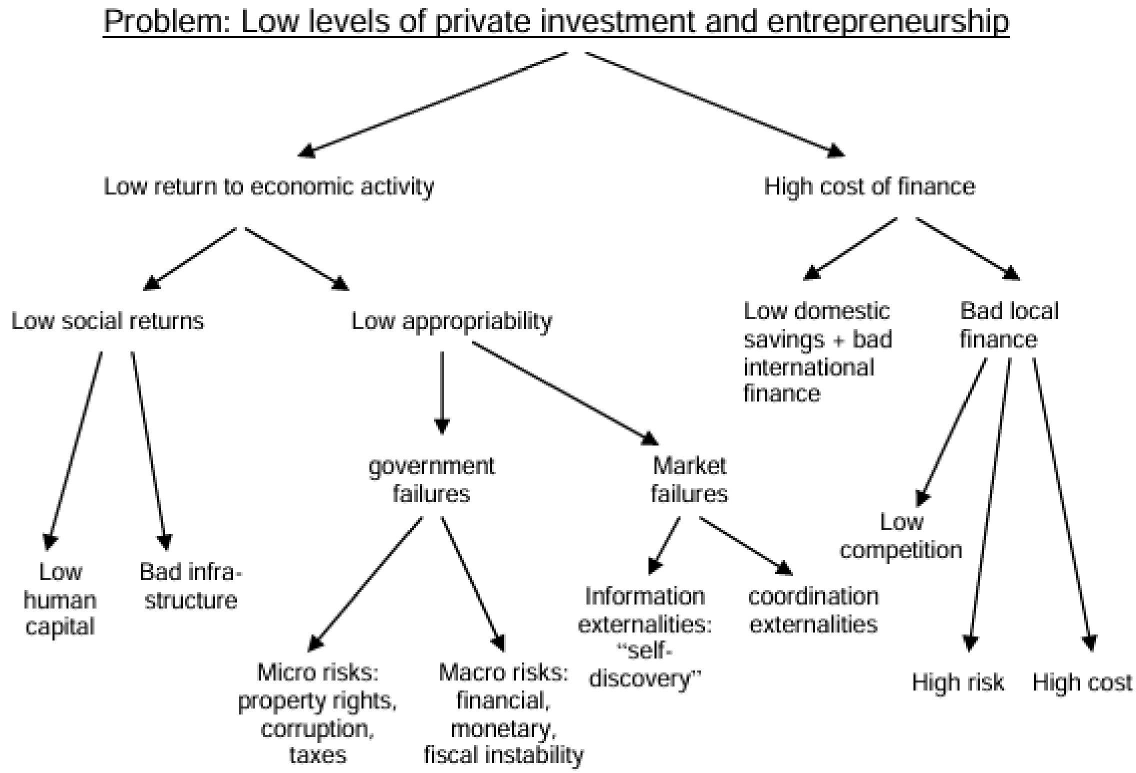
$$r = r(a, \theta, x) \tag{2}$$

Where a is a measure of Total Factor Productivity (TFP), x represents the availability of complementary productive factors (such as human capital and infrastructure), and θ is an externality index (higher θ indicates greater distortion).

This model offers a clear understanding of the potential nature of growth constraints: an economy may fail to grow because the expected private returns to asset accumulation are low (i.e., $r(1-\tau)$ is low), or because the cost of capital is high (i.e., ρ is high). This initial distinction can be broken down into more specific constraints: in the case of low returns, is it due to low social returns r, or to low appropriability $(1-\tau)$? Similarly, what explains the high cost of financing? Is it a shortage of overall savings due to low domestic savings and lack of access to external financing? Or is it a problem of poor financial intermediation?

Given the number and complexity of possible scenarios, the authors propose organizing this information into a *Decision Tree Diagram* (*Figure* **??**). It begins with a root node posing the core question that GD seeks to answer: **What explains the low levels of investment and entrepreneurship in an economy?** From there, the branches lead us to increasingly specific explanations for low growth.

Figure 1: Decision Tree



Source: Hausmann, Klinger and Wagner (2008)

3.2 Growth Diagnostics in Practice

In practice, Hausmann, Rodrik, and Velasco argue that conducting a proper Growth Diagnostics (GD) exercise requires following the five steps below:

1. **Analyze the growth trajectory** of the economy under study.

2. **Conduct a differential diagnosis to identify the binding constraints to growth.** For this purpose, the methodology outlines a set of properties that a constraint must exhibit in order to be considered potentially "binding," which will be discussed in detail below.

3. **Formulate a syndrome.** Once the constraints have been identified, the diagnosis must include a hypothesis that explains why the observed outcomes constitute an equilibrium result. In other words, formulating a syndrome means proposing a causal

explanation for the observed phenomena.

4. **Conduct tests to validate the evidence of the syndrome.** That is, tests should be conducted to confirm the validity of the proposed hypothesis.

5. Iterate between steps (3) and (4) until convergence is reached.

3.2.1 Differential Diagnosis

The differential diagnosis stage is the core of the GD methodology, as it is the point at which the rigidity of the constraints is assessed. To conduct this analysis, a series of properties are defined that a constraint must fulfill in order to be considered potentially "binding":

- **The (shadow) price of the production factor is high:** this is the fundamental principle for identifying constraints. A high shadow price indicates that relaxing the constraint would have a significant impact on the objective function. Although it is often difficult to directly observe this relevant price, other market signals can be used to approximate the shadow price and its dynamics. For instance, consider the hypothesis that the problem in a particular region is the availability of credit. Detecting a low volume of credit is a necessary condition, but not sufficient, to conclude that the issue is a relatively low credit supply. For this to be true, the **shadow price of credit** must also be high, i.e., real interest rates must be high. Analyzing the shadow price of constraints enables a more accurate identification of bottlenecks: focusing only on quantitative indicators provides a limited perspective and may lead to incorrect diagnostic conclusions.

- **Movements in the constraint coincide with significant changes in the objective function:** if a constraint is binding, its relaxation should be associated with improvements in the objective function. In other words, when the constraint is alleviated, one should observe positive effects on economic growth or investment rates. For example, if access to finance is hypothesized as a constraint, increases in credit availability through lower interest rates should boost investment rates, and vice versa.

- **Agents are actively trying to overcome the constraint:** private sector actors are often well aware of the factors limiting their economic progress. A wide range of responses to these obstacles can be observed. For instance, in contexts of frequent electricity outages, many firms invest in private generators to ensure the continuity of their operations.

- **Sectors more intensive in the constrained factor are less likely to thrive, and vice versa:** the hypothesis here is that sectors less intensive in the use of the constrained factor—or with greater capacity to circumvent it—will perform relatively better. In contrast, those more dependent on the constraint will underperform. The authors illustrate this point with a metaphor referred to as the *camels and hippos analysis*. If the goal were to identify what limits animal prosperity in the Sahara Desert, the fact that water-efficient species such as camels thrive while water-intensive species like hippos are scarce suggests that water availability is a fundamental constraint in that environment.

Table 1 summarizes the possible symptoms that can help identify each constraint; each column represents a constraint, and each row corresponds to a symptom. Testing some of these symptoms allows us to distinguish between "families of constraints" (groups of columns), while others enable us to draw more specific conclusions.

Table 1: Matrix test of hypothesis

<table>
<tr><th>Nodo del árbol de decisión</th><th colspan="3">Síntomas</th><th colspan="2">Nodo del árbol de decisión</th><th colspan="6">Síntomas</th></tr>
<tr><td rowspan="4">Bajos retornos a la actividad económica</td><td rowspan="6">Bajo Crédito/PBG</td><td rowspan="4">Bajas tasas de interés reales</td><td rowspan="4">Inversión poco elástica respecto a la tasa de interés</td><td rowspan="2">Bajos retornos sociales</td><td>Bajo capital humano</td><td>Altos retornos a la educación</td><td>Industrias capital humano-intensivas tienen mejor performance relativa</td><td>Retornos a la educación procíclicos</td><td>Altos niveles de desempleo calificado</td><td></td><td></td></tr>
<tr><td>Baja infraestructura</td><td>Baja infraestructura vial respecto a grupo de comparación</td><td>Baja o deficiente provisión de servicios públicos</td><td>Costos de transporte elevados</td><td>Industrias intensivas en infraestructura tienen peor performance relativa</td><td></td><td></td></tr>
<tr><td rowspan="2">Baja apropiabilidad</td><td>Fallas de Estado</td><td>Alta presión fiscal</td><td>Altos niveles de Deuda/PBG</td><td>Baja calidad institucional</td><td>Baja calidad regulatoria</td><td>Alta tasa de informalidad laboral</td><td>Mayor uso de efectivo para transacciones</td></tr>
<tr><td>Fallas de mercado</td><td>Bajo CEI</td><td>Bajo COI</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Altos costos de financiamiento</td><td rowspan="2">Altas tasas de interés reales</td><td rowspan="2">Inversión elástica respecto a la tasa de interés</td><td colspan="2">Bajo ahorro total</td><td>Altas tasas de interés para depósitos</td><td>Altos niveles de deuda soberana</td><td>Altos niveles de déficit de cuenta corriente</td><td>Control de capitales</td><td></td><td></td></tr>
<tr><td colspan="2">Malas finanzas locales</td><td>Alto spread</td><td>Mark ups elevados</td><td>Altos costos de intermediación</td><td></td><td></td><td></td></tr>
</table>

Source: Own elaboration based on Hausmann et al. (2008)

3.2.2 Adapting the Methodology to a Subnational Economy

While in theoretical terms the Growth Diagnostics (GD) framework poses no restrictions for its application to subnational economies, from a practical standpoint the constraints faced by such economies—and especially the tools available to overcome them—are significantly different from those at the national level. In particular, subnational governments cannot use economic policy to influence key macroeconomic variables such as inflation or the exchange rate. Moreover, although local governments manage their own revenues and expenditures, their borrowing and investment capacity largely depends on the national government (Castro et al., 2014).

Finally, an additional challenge in applying GD at the subnational level is the lack of long-term statistical data for subnational economies. Several socioeconomic indicators essential for the application of GD are unfortunately not available at the subnational level, such as statistical information on private investment (Castro et al., 2014).

3.2.3 Peer Selection

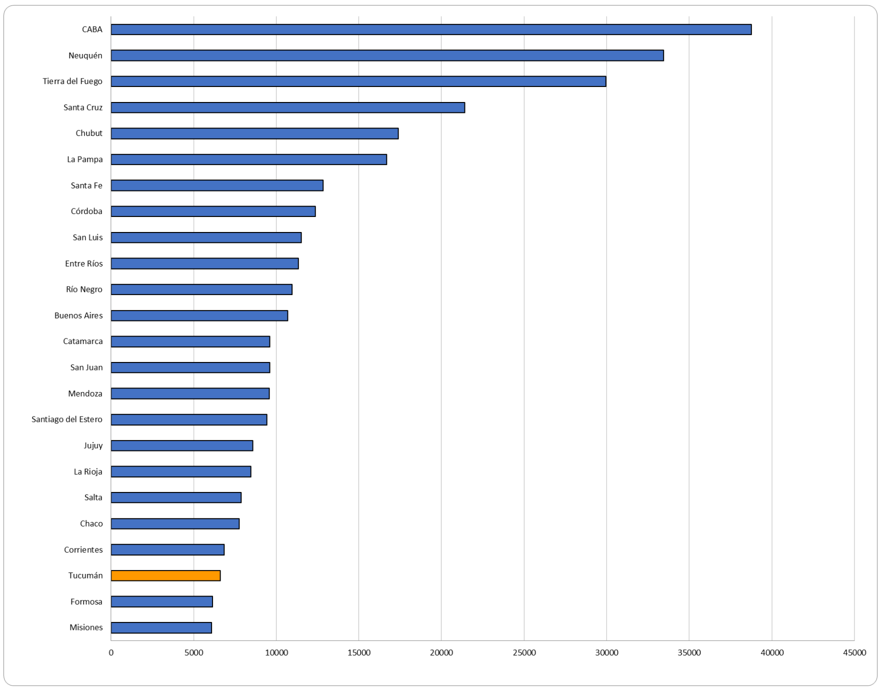
Carrying out a growth diagnostic requires the use of comparative analysis. Rather than analyzing each economy's growth performance in isolation or as an average, GD focuses on understanding the idiosyncrasies that differentiate an economy from a *benchmark*. Some of these differences may be particularly relevant in explaining why an economy grows—or why its growth is constrained. To conduct this type of analysis, it is necessary to build a "control group" composed of economies similar to the one under study. In the case of Tucumán, this group consists of the other Argentine provinces, which are the most comparable economies as they share similar institutional, economic, social, and political frameworks, all operating under the same national government.

4 Characterization of the Province of Tucumán and Growth Trajectory

Tucumán is part of the Northwestern region of Argentina (NOA), along with five other provinces. With a total area of 22,524 km^2, it is the smallest province in the country, yet one of the most densely populated.[2] Its capital, San Miguel de Tucumán, is the largest city in Northern Argentina and the fifth largest and most populous in the country, with over one million inhabitants in its metropolitan area. In 2023, its Gross Provincial Product (GPP) amounted to $3,925,294 million current pesos.

As of 2023, **Tucumán was among the three provinces with the lowest per capita GPP in the country**, equivalent to less than 50% of the national per capita GPP average (*Figure 2*).

Figure 2: Per Capita GPP of Argentine Provinces at 2004 Constant Prices. Year 2023



Source: CEPAL and INDEC

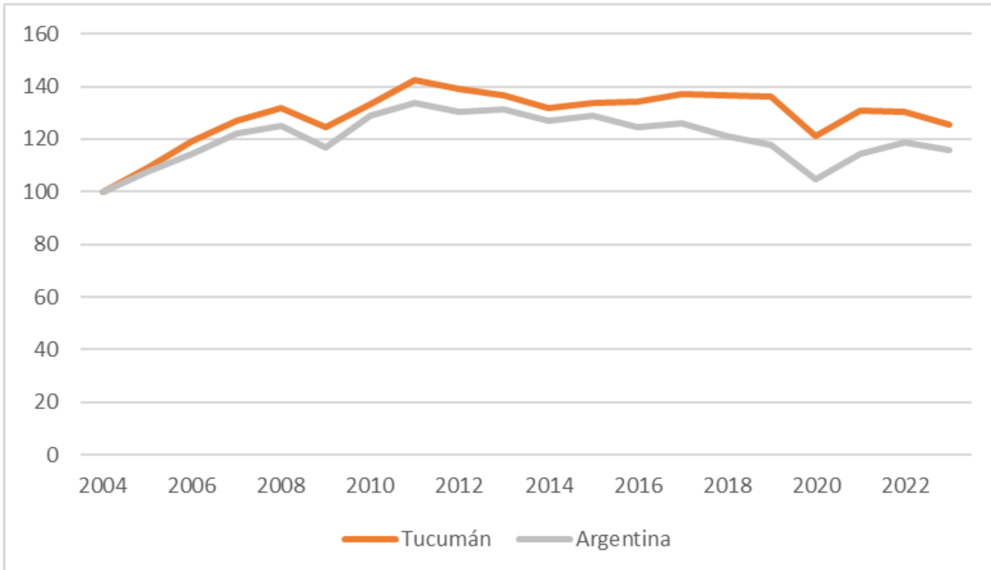
Between 2004 and 2023, Tucumán's per capita GPP grew by 25%, corresponding to an annual growth rate of 1.34%. This outpaced the national growth over the same period (18%) and even the NOA regional average (19%).

Tucumán's GPP growth remained consistently above national GDP growth throughout the entire period (*Figure 3*). Moreover, a strong correlation can be observed between both series, due to their similar trajectories. However, Tucumán's GPP displayed less

[2]According to data from the 2022 National Census, Tucumán has a population density of 75.6 $inhabitants/km^2$.

volatility than the national GDP. For instance, during the 2008–2009 global financial crisis, Argentina's per capita GDP dropped by 6.9%, while Tucumán's decline was only 5.5%.[3]

Figure 3: Evolution of Tucumán's GPP and Argentina's GDP, 2004–2023. Index 2004=100

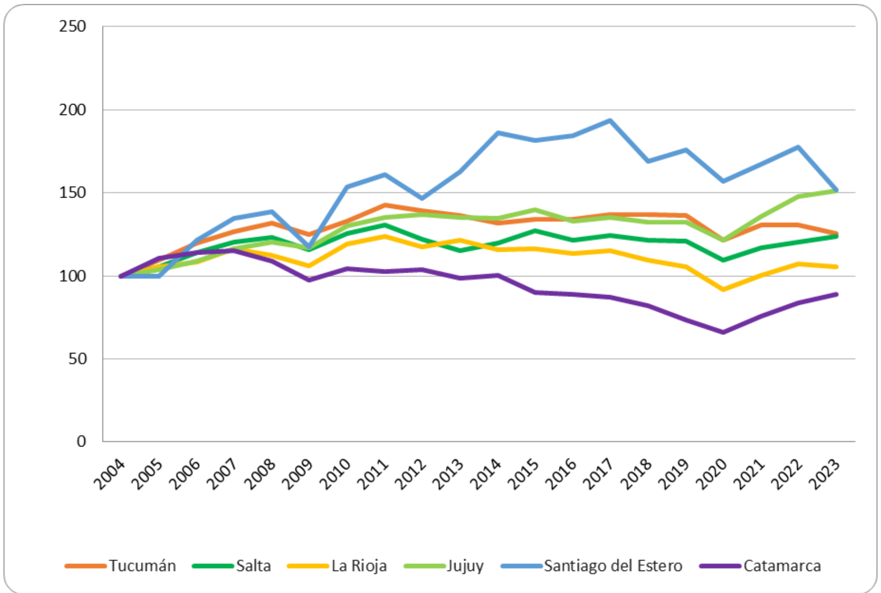


Source: CEPAL and INDEC

From a regional perspective, **Tucumán's economic performance was intermediate relative to the rest of the NOA provinces.** Santiago del Estero and Catamarca stand out, but for different reasons: the former experienced growth of 52% between 2004 and 2023, while the latter saw a decline in economic activity of 11% (*Figure 4*).

[3]There were even periods in which Tucumán grew while Argentina was in recession. Between 2014 and 2019, Argentina's per capita GDP fell by 7%, whereas Tucumán experienced cumulative growth of 3.2%.

Figure 4: Evolution of Per Capita GPP in NOA Provinces. Index 2004=100



Source: CEPAL and INDEC

According to estimates from the Economic Commission for Latin America and the Caribbean (CEPAL) for Tucumán's GPP, and national GDP data published by INDEC for 2023, **the leading economic sector in the province is Trade (COME), accounting for 18% of Gross Value Added (GVA)**, followed by Real Estate Activities (ACTINMOB) and Manufacturing Industry (INDU), both contributing 14%. This structure differs from the national average, as **Tucumán has a relatively larger public sector (PUB) and social and health services sector (SERSAL), while its manufacturing and mining sectors are proportionally smaller** (see Appendix).[4]

The evolution of the province's productive structure over the past 19 years also shows a relative decline in the Agricultural sector (AGROP), with a drop of 4 percentage points, and in Manufacturing (INDU), which declined by 3 points. In contrast, the Real Estate (ACTINMOB), Public, and Social and Health Services (SERSAL) sectors increased their shares by 2 to 3 percentage points (see Appendix).

In this context, **Tucumán's cumulative economic growth between 2004 and 2023 was primarily driven by non-tradable sectors**, with notable contributions from Real Estate (9%) and the Public Sector (9.8%), alongside Trade (10.5%), which was the most dynamic individual sector (see Appendix).

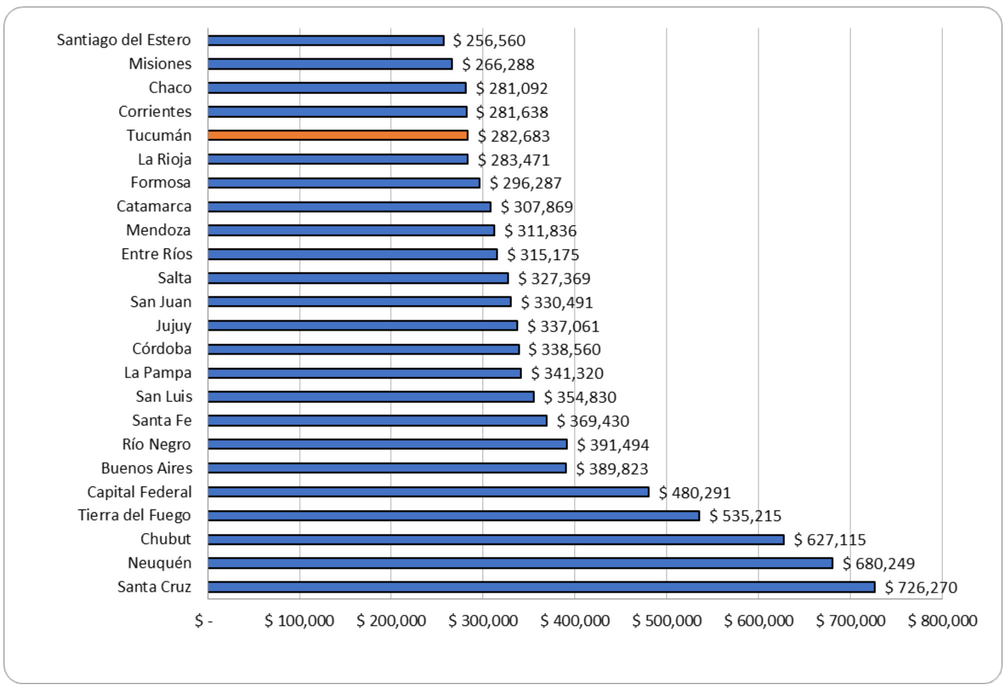
[4]Tucumán lacks exploitable mineral resources, which explains the low share of mining in its economy—this is more a reflection of its factor endowments than a developmental limitation.

4.1 Other Income Indicators

In addition to analyzing per capita GPP across Argentine provinces, it is relevant to examine other variables that, alongside output levels, are strongly correlated with a region's economic growth. We will see that Tucumán's weak performance in terms of per capita GPP is also reflected in other income-related indicators.

In 2023, **Tucumán ranked among the provinces with the lowest wages in the registered private sector.** Within the NOA region, it ranked above only Santiago del Estero in terms of remuneration (*Figure 5*).

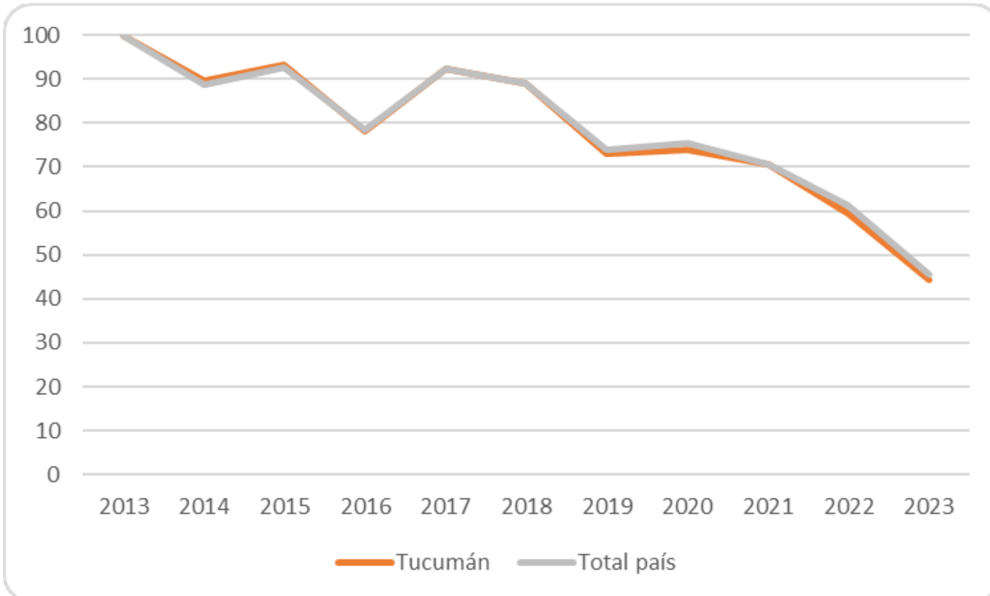
Figure 5: Average Wage of Registered Workers in the Private Sector. Year 2023



Source: Employment and Business Dynamics Observatory – MTEySS – based on SIPA

Between 2013 and 2023, **the average real wage of registered workers in the private sector declined by 56%**. However, the downward trend in wages observed in the province over the last decade mirrors the national pattern (*Figure 6*).

Figure 6: Real Average Wage Dynamics in the Private Sector. 2004–2023

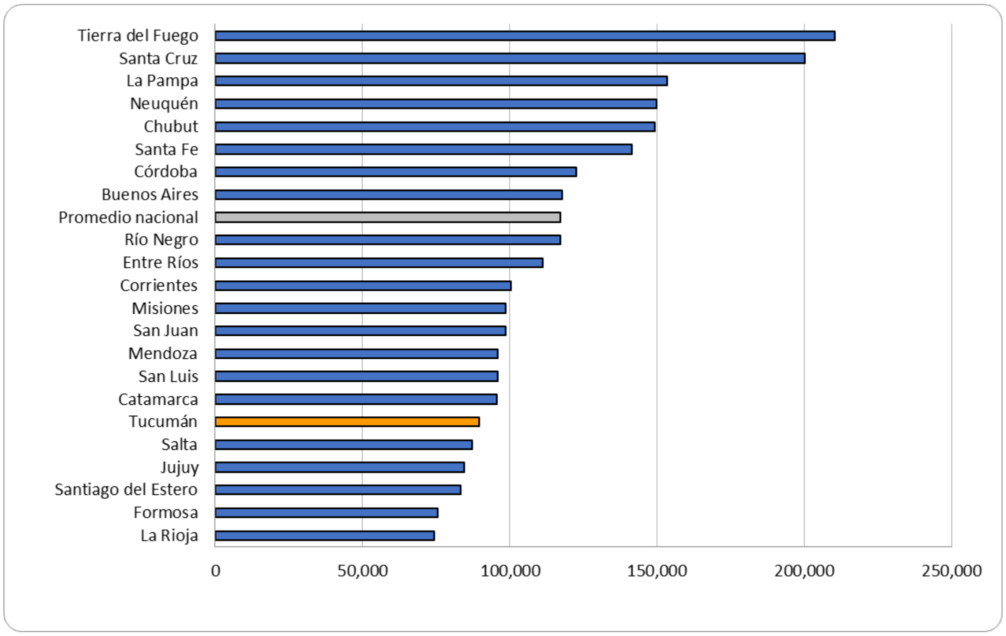


Source: Employment and Business Dynamics Observatory – MTEySS – based on SIPA

On the other hand, **Tucumán ranks as the sixth province with the lowest average household per capita income in the country** (*Figure 7*). While in this case it performs slightly better than most other NOA provinces (except for Catamarca, which ranks just above), Tucumán's per capita income remains significantly below the national average.[5]

[5] In the third quarter of 2023, Tucumán's average per capita income represented only 74% of the national average.

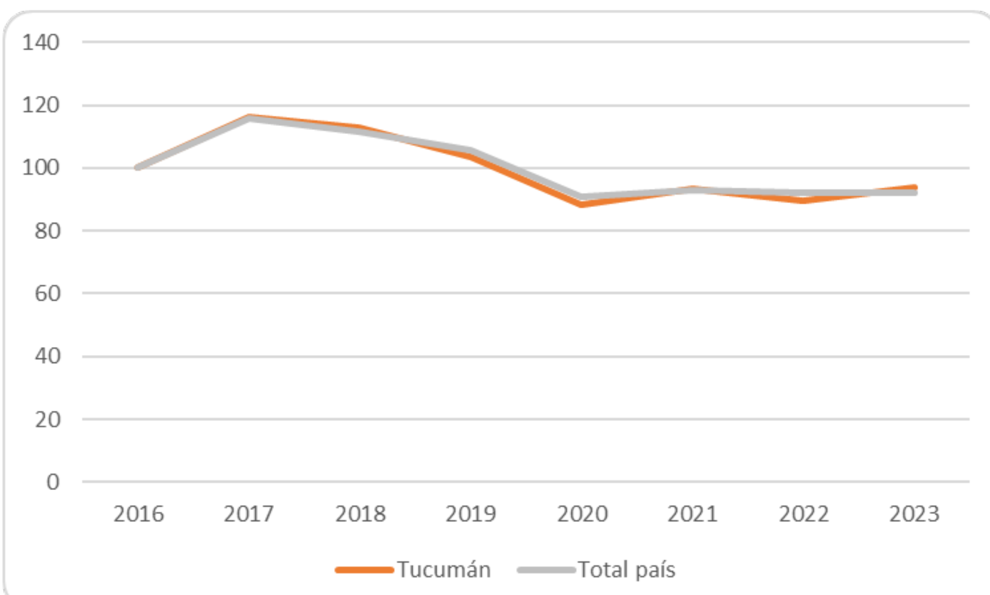
Figure 7: Average Household Per Capita Income. Year 2023



Note: The values shown correspond to the third quarter of each year.
Source: EPH – INDEC

Between 2016 and 2023, **Tucumán's average household per capita income experienced a real decline of 6%**. As with wages, this trend closely mirrors the national indicator's trajectory (*Figure 8*).

Figure 8: Average Household Per Capita Income. 2016–2023



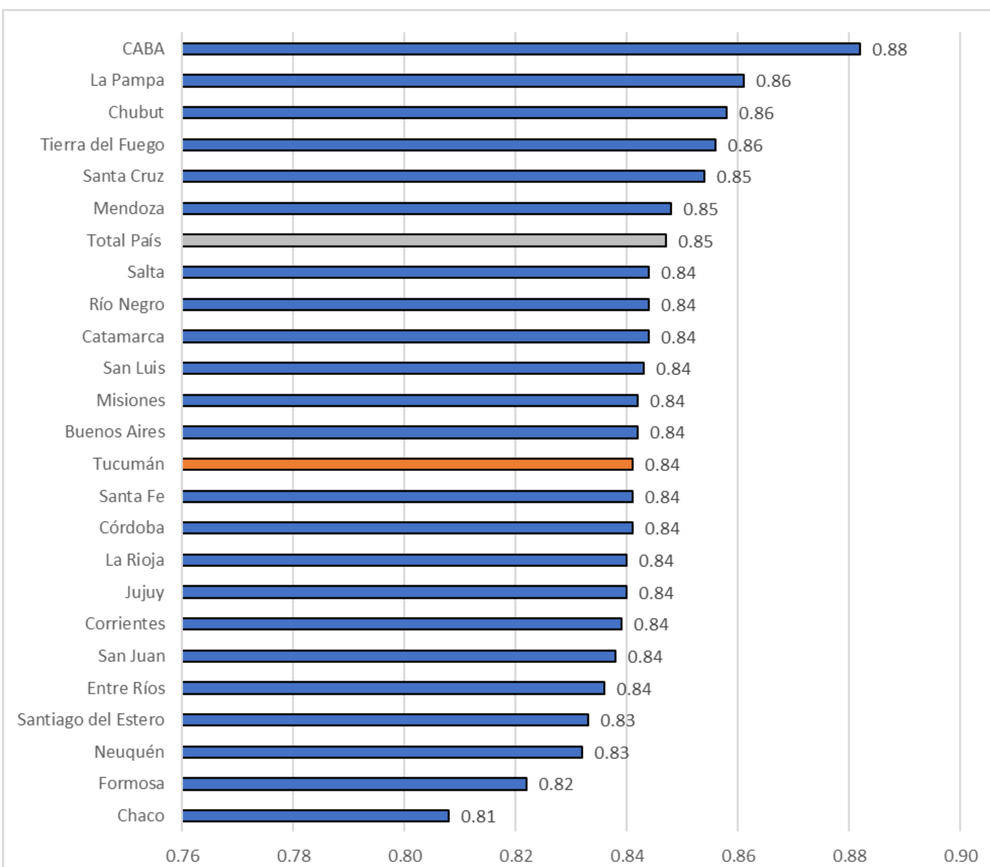
Note: The values shown correspond to the third quarter of each year.
Source: EPH – INDEC

4.2 Well-being Indicators

Using per capita GDP as the sole indicator of economic well-being is limited, as it fails to capture essential dimensions of a society's quality of life. In this regard, the Human Development Index (HDI) offers a more suitable measure, as it incorporates not only per capita income but also health and education indicators, providing a more comprehensive approximation of a population's level of development.

The Human Development Index (HDI) published by UNDP is a multidimensional indicator that evaluates provincial performance across three dimensions: health, education, and income. In the case of Tucumán, **the value recorded in 2021 was 0.84, below the national average and in line with the other provinces of the NOA region** (*Figure 9*).[6] Regarding its evolution, the index showed an upward trend until 2016—when it reached a peak of 0.85—followed by a slight decline in recent years (*Figure 10*).

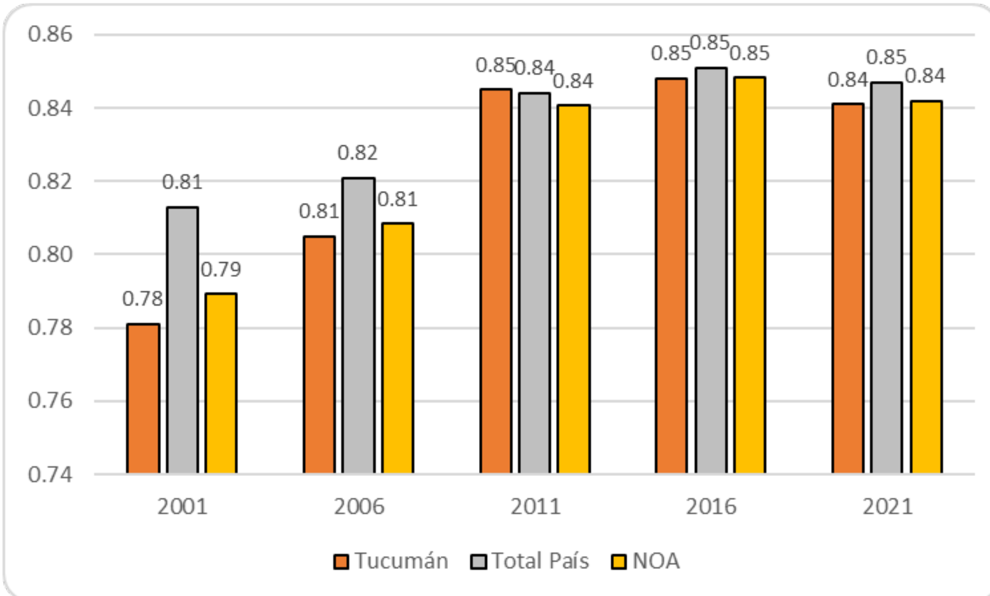
Figure 9: Human Development Index. Year 2021



Source: UNDP.

[6]The HDI ranges from 0 to 1. The closer the value is to 1, the higher the level of human development achieved.

Figure 10: Human Development Index. 2001–2021



Source: UNDP.

In summary, although Tucumán's economy showed relatively strong performance over the 2004–2023 period, its current per capita GPP remains among the lowest in the country. The analysis of other income indicators—such as average wages for registered workers and household per capita income—confirms the province's current weak economic standing. Furthermore, the HDI, as a proxy for well-being, shows that the population's quality of life faces additional limitations. Altogether, these findings suggest the presence of constraints that may be affecting Tucumán's economic growth and its long-term sustainability.

5 Differential Diagnosis

Following the Decision Tree of the Growth Diagnostics framework presented in *Section 3*, this section analyzes the main constraints to growth in Tucumán from a long-term perspective. *Section 5.1* explores whether there are binding constraints related to access to finance in the province. Then, *Section 5.2* evaluates the presence of low returns to economic activity, particularly focusing on the availability and quality of productive factors such as human capital and infrastructure. Finally, *Section 5.3* attempts to identify constraints linked to low appropriability of returns on investment.

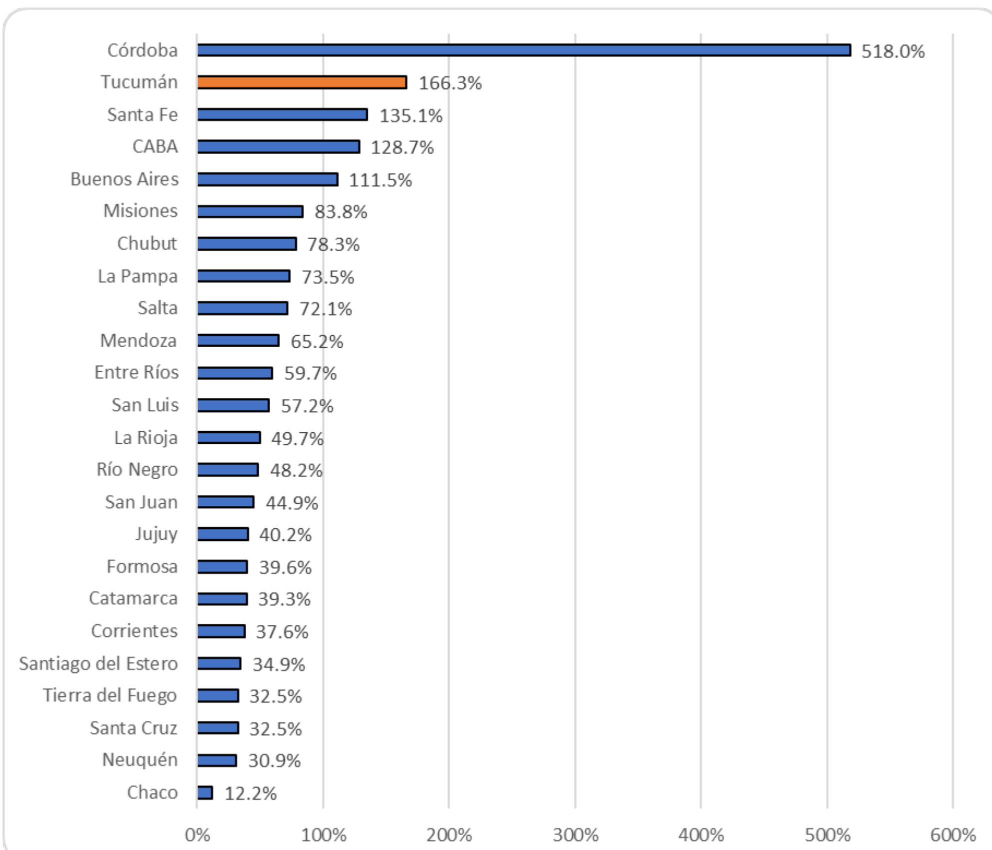
5.1 Access to Finance

To evaluate whether access to finance constitutes a constraint on Tucumán's economic growth, two types of variables are considered: (i) access to credit and (ii) the cost of credit. In particular, a combination of low credit availability and high borrowing costs (as reflected in interest rates) would suggest that credit supply is a limiting factor for the province's growth.

In the case of Tucumán, **the relative share of loans slightly exceeds its share of national GDP.** In other words, the province makes greater use of loans than the national average relative to the size of its economy (*Figure 11*).

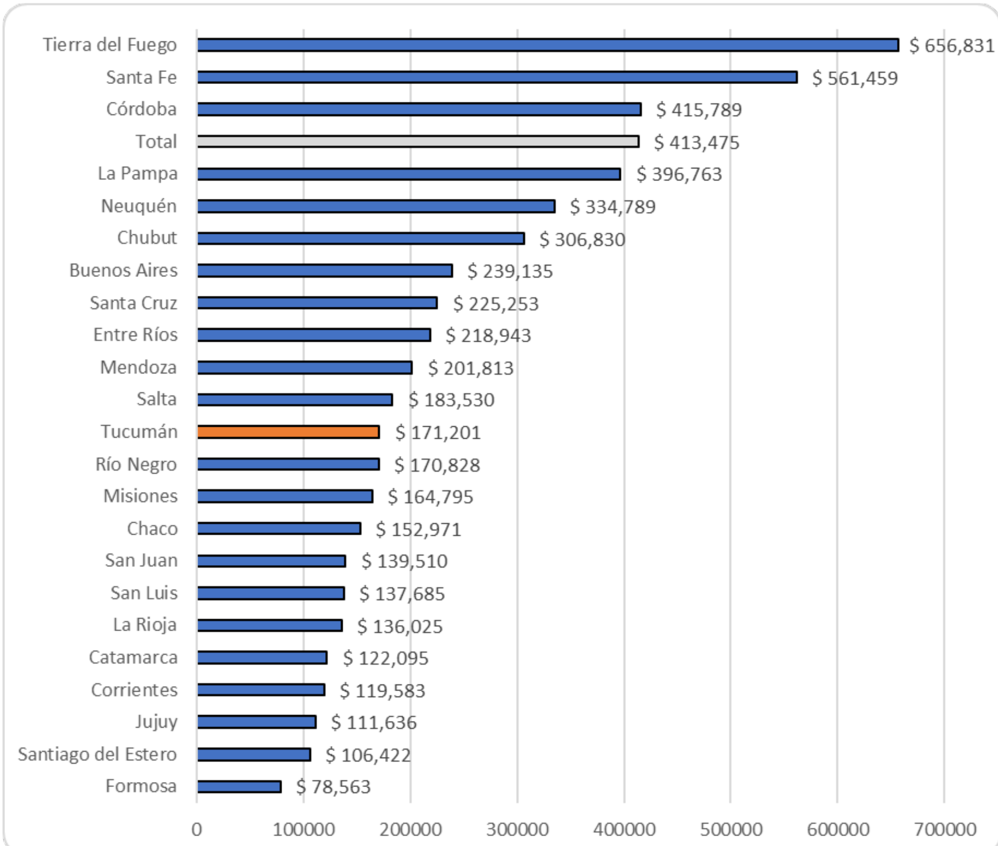
On the other hand, when considering per capita loans, Tucumán occupies a middle position but remains well below the national average (*Figure 12*).

Figure 11: Relative Share of Loans vs. Share of Provincial GDP. Year 2023



Source: Own elaboration based on BCRA data

Figure 12: Per Capita Loans. Year 2023



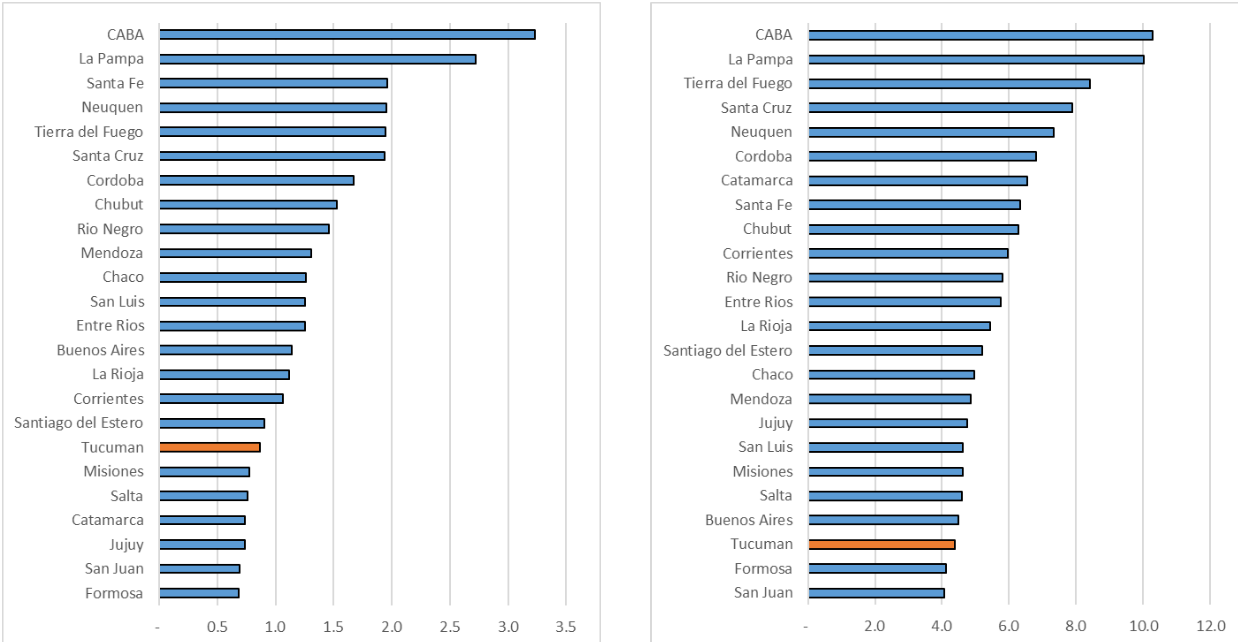
Note: CABA is excluded due to its high per capita loan value of $2,206,841.

Source: Own elaboration based on BCRA data

Credit access in Tucumán can also be evaluated by analyzing the number of bank branches, ATMs, and businesses with point-of-sale terminals.

As shown in *Figure 13*, **Tucumán has a relatively low number of physical bank branches and ATMs compared to other Argentine provinces.**

Figure 13: Number of Physical Bank Branches and ATMs per 10,000 Adults. December 2024



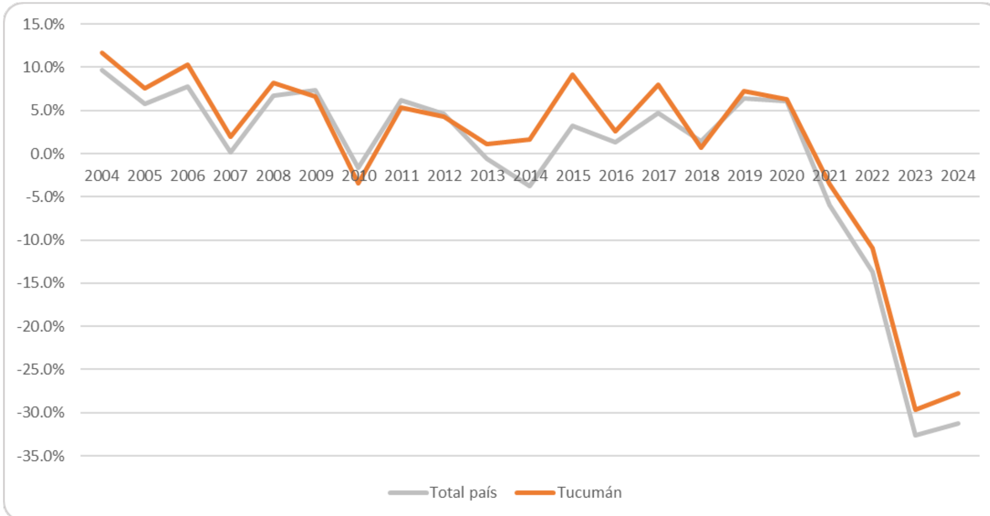
Source: Own elaboration based on BCRA data

So far, we may conclude that access to credit in the province is limited based on the number of branches, ATMs, and low per capita credit. However, the share of loans relative to Tucumán's GPP in national GDP is relatively high. Further indicators must still be analyzed.

Between 2004 and 2024, **the average real interest rate[7] in the province followed a nearly identical pattern to that of the national average and remained at comparable levels throughout the period.** This is consistent with the fact that Tucumán is a subnational economy and that there is free movement of capital within the country (*Figure 14*).

[7]Nominal annual interest rates were deflated using different price indices depending on the period. Between January 2007 and March 2016, during the INDEC intervention, the San Luis CPI was used. From April to November 2016, the Greater Buenos Aires CPI was used. Since December 2016, the National CPI published by INDEC has been applied.

Figure 14: Real Interest Rates for Argentina and Tucumán. 2004–2024



Source: Own elaboration based on BCRA, INDEC, and San Luis Statistics Directorate

Having ruled out the high cost of financing as a growth constraint for Tucumán, we now turn to the hypothesis that low returns may be limiting the province's economic growth.

5.2 Low Social Returns

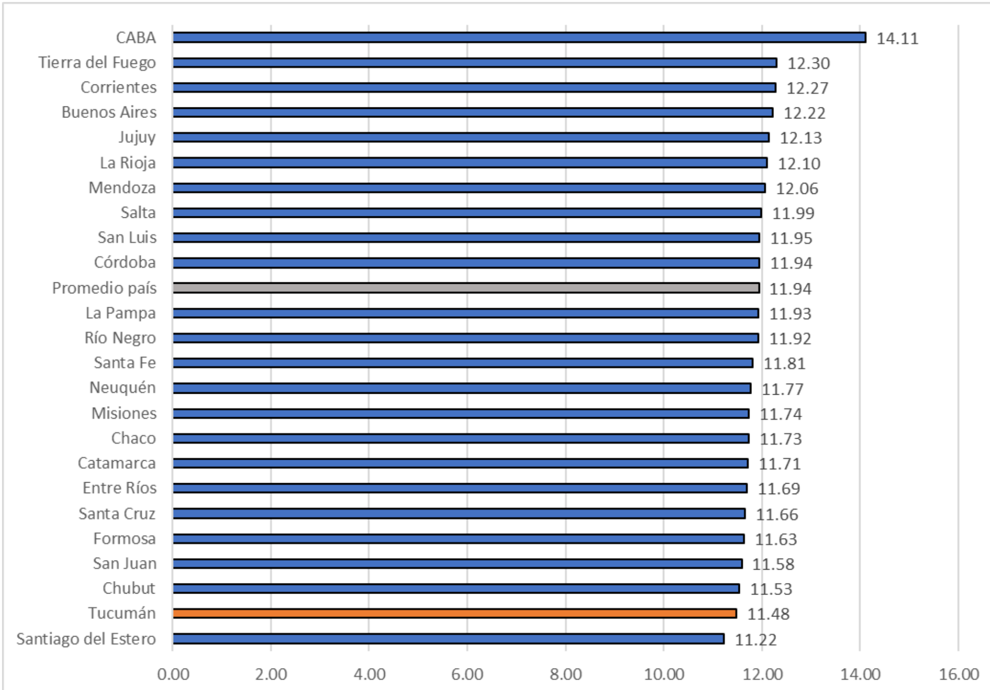
Another hypothesis that may explain low levels of investment and entrepreneurship in Tucumán is that social returns on investment are low due to the limited availability and/or poor quality of human capital and infrastructure. These factors serve as complements to physical capital in the production process and play a key role in the development of industries in an economy.

5.2.1 Human Capital

To evaluate whether human capital is a binding constraint on the province's growth, two sets of variables are analyzed: (i) education levels and (ii) associated returns. Specifically, a combination of low educational attainment and high returns to education indicates underprovision of human capital.

As of 2024, Tucumán ranked as the second-lowest province in terms of average years of schooling. Only Santiago del Estero ranked lower, and the province is well below the national average (*Figure 15*).

Figure 15: Average Years of Schooling by Province. Year 2024

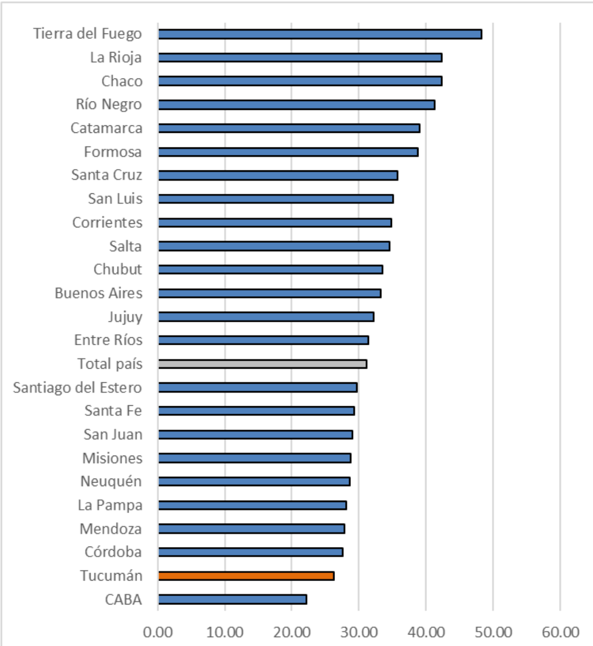


Source: Own elaboration based on EPH.

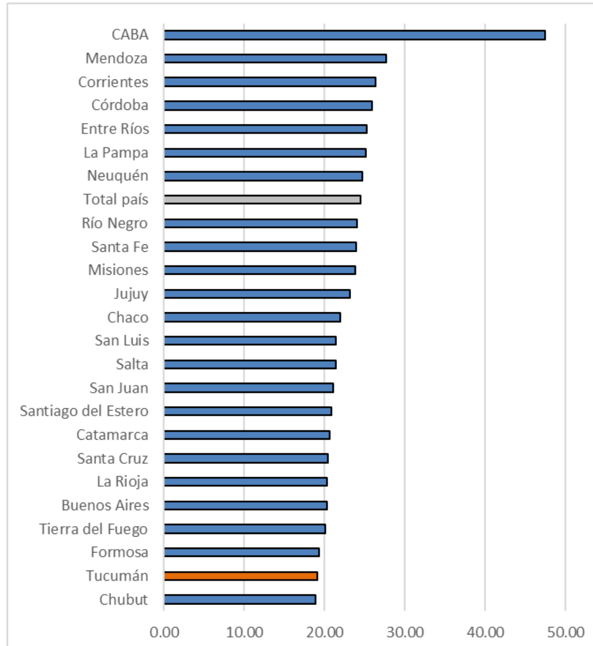
Note: Average years of education for individuals in the labor force aged 15–65.

Disaggregating human capital by educational attainment shows that Tucumán has the second-lowest share of individuals with completed secondary education (26.25% vs. a national average of 31.17%) and with completed tertiary education (19.11% vs. 24.47%) (*Figure 16*).

Figure 16: Share of Workers with Completed Secondary and Tertiary Education. Year 2024



(a) Completed Secondary



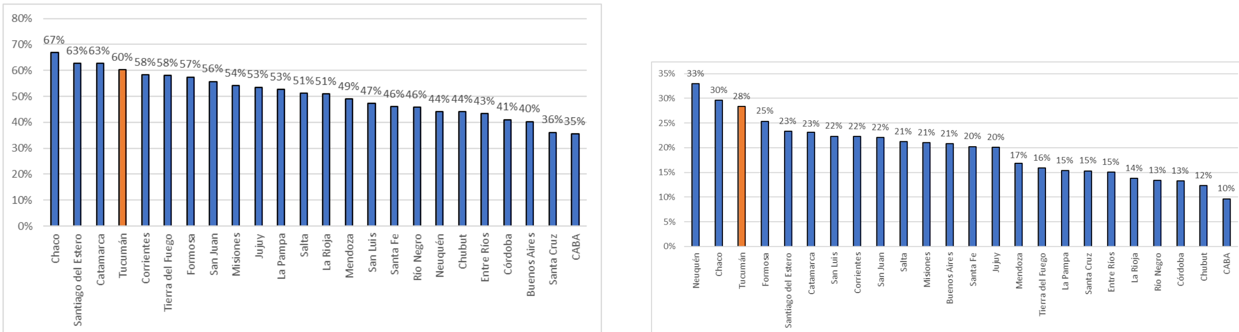
(b) Completed Tertiary

Note: Percentages calculated for individuals in the labor force aged 15–65.
Source: Own elaboration based on EPH.

To assess educational quality in Tucumán, we consider the results of the *Aprender* standardized assessments, last conducted in 2024.[8] According to the results, **Tucumán ranked fourth among provinces in terms of the highest share of students scoring "Below Basic" in Mathematics and third in Language** (*Figure 17*). Poor performance persists even when disaggregating by school type and setting (see Appendix).

[8]These assessments are administered to primary and secondary students (5th and 6th years) in both public and private schools across the country. Students are evaluated in Mathematics, Language, Social Sciences, and Natural Sciences, and classified into four categories: Below Basic Level, Basic, Satisfactory, and Advanced.

Figure 17: Share of Students Scoring “Below Basic Level” in Aprender Tests, by School Type. Language. Year 2024



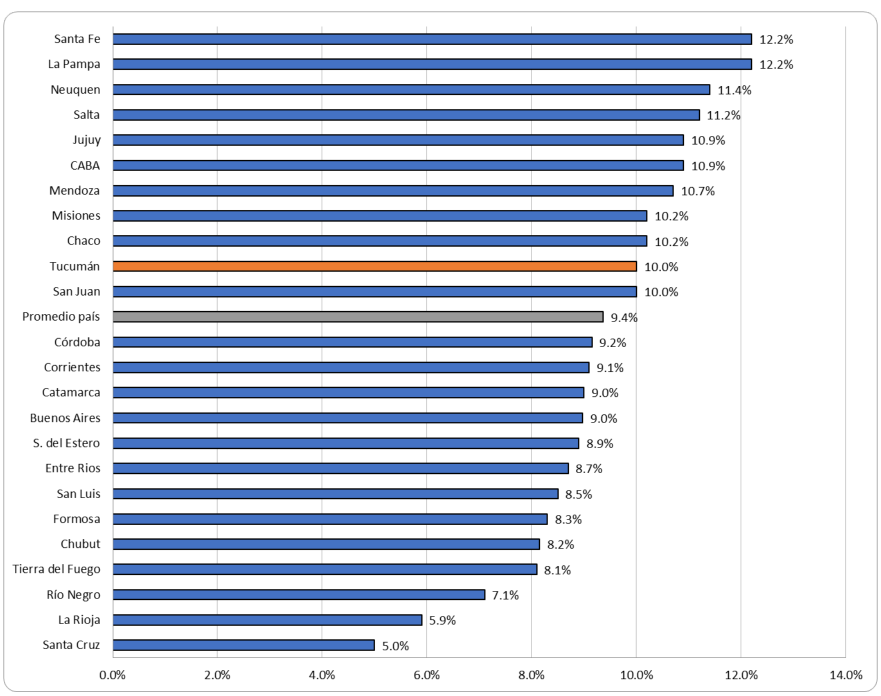
(a) Mathematics (b) Language

Source: Own elaboration based on Aprender test results.

Following the Growth Diagnostics framework, and having identified a low stock of human capital, it is appropriate to analyze its shadow price—i.e., returns to education. This allows us to determine the relative scarcity of human capital in the province and confirm whether it constitutes a constraint on growth.

Figure 18 shows that the return to an additional year of education in Tucumán is 10%, above the national average and higher than most regional peers, except Salta and Jujuy.

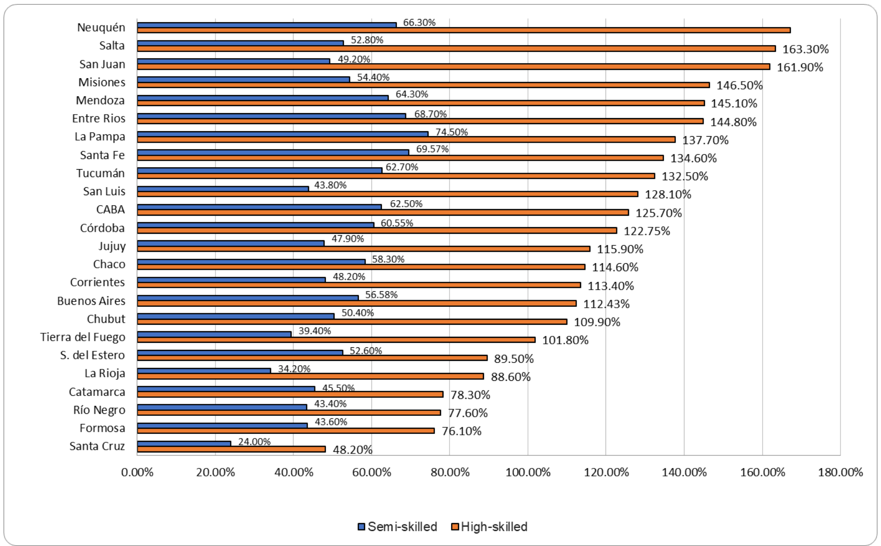
Figure 18: Returns to Education. Year 2024



Source: Own elaboration based on EPH.

Figure 19 offers more insight: comparing the wage premium by educational attainment level (skilled vs. semi-skilled),[9] we find that skilled workers in Tucumán earn 1.3 times more than the rest of the provincial workforce.

Figure 19: Returns to Higher Education. Year 2024



Source: Own elaboration based on EPH.

In conclusion, Tucumán exhibits a low average level of educational attainment, accompanied by reduced percentages of the population with completed secondary and higher education, as well as deficiencies in educational quality. This scenario, combined with relatively high returns to education, clearly indicates that **the shortage of qualified human capital constitutes a central constraint to provincial growth.**

5.2.2 Infrastructure

This section presents a series of indicators related to the current state of infrastructure in Tucumán, specifically regarding freight transport, access to electricity and water, and mobility, with the aim of determining whether infrastructure represents a constraint on the province's economic growth.

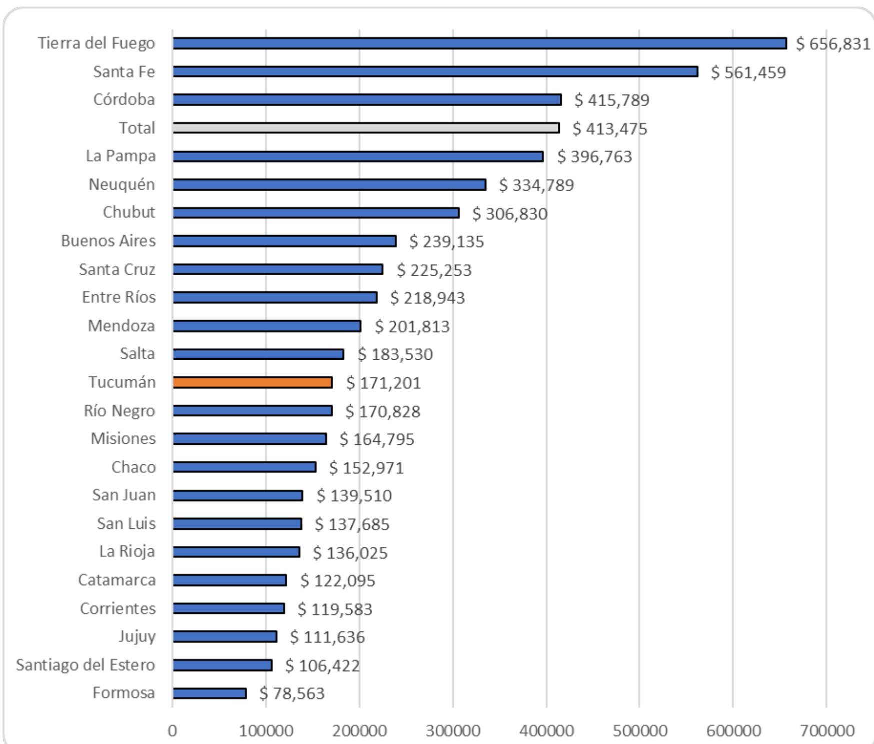
To outline the general picture of Tucumán's economy in terms of infrastructure, it is worth noting that in 2024, capital expenditure represented 6.5% of total provincial public spending, **placing Tucumán among the ten provinces with the lowest proportion of capital**

[9] Skilled: more than 17 years of education; Semi-skilled: between 12 and 17 years.

investment in the country (*Figure 20*). At the regional level, it only exceeds Salta, but falls well below its other peers, particularly Santiago del Estero, which reached 24.6%.

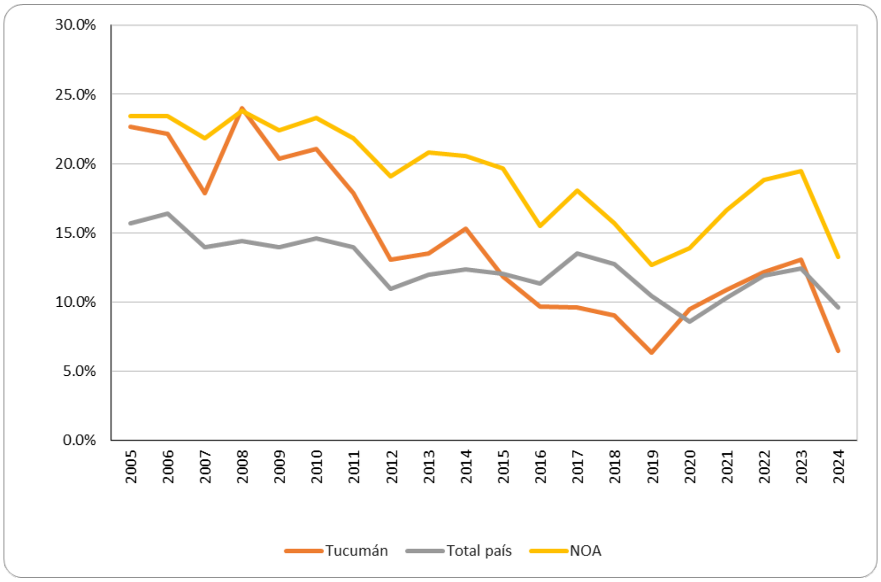
The situation worsens when analyzing the historical trend: in 2005, the capital expenditure/total expenditure ratio was 22.6%, implying a decrease of 16.2 percentage points compared to the current value. This dynamic could lead to serious difficulties in developing new infrastructure investments and maintaining existing works, although it does not necessarily mean that it constitutes a constraint on the province's growth.

Figure 20: Capital expenditure as a percentage of total public spending. Year 2024.



Note: The province of La Pampa is not included in the graph due to lack of data for 2024.
Source: Own elaboration based on data from the National Directorate of Provincial Affairs.

Figure 21: Capital expenditure as a percentage of total public spending. 2005–2024 period.



Source: Own elaboration based on data from the National Directorate of Provincial Affairs.

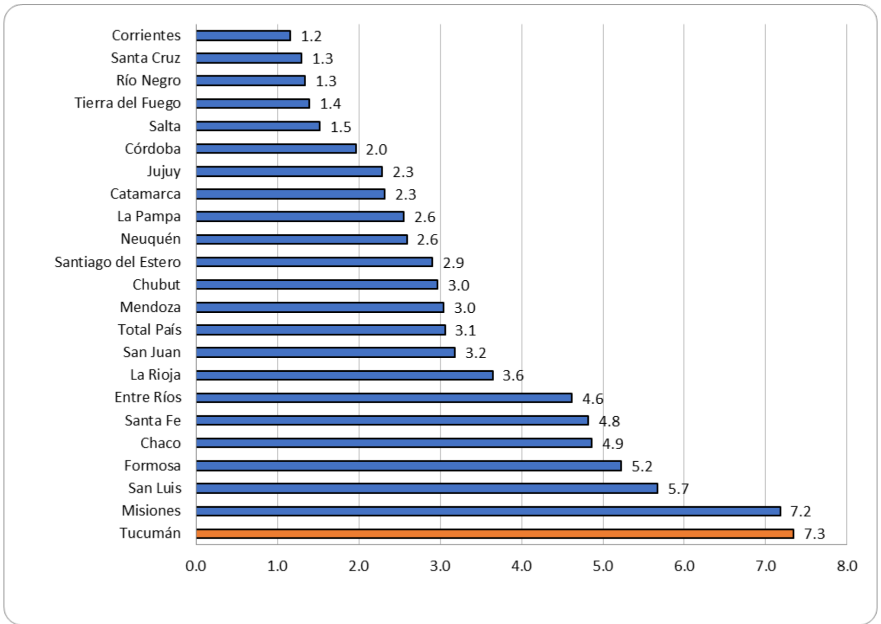
The following section analyzes the most important domestic freight transport networks for Tucumán's production, namely road and rail transport.[10]

Freight Transport

According to data from the Dirección Nacional de Asuntos Provinciales (DNAP), in 2023 **Tucumán ranked first in the number of paved kilometers per 100 square kilometers** (*Figure 22*). If we consider the total number of paved roads relative to the total number of roads, the province is just below the national average with a ratio of nearly 93% (*Figure 23*).

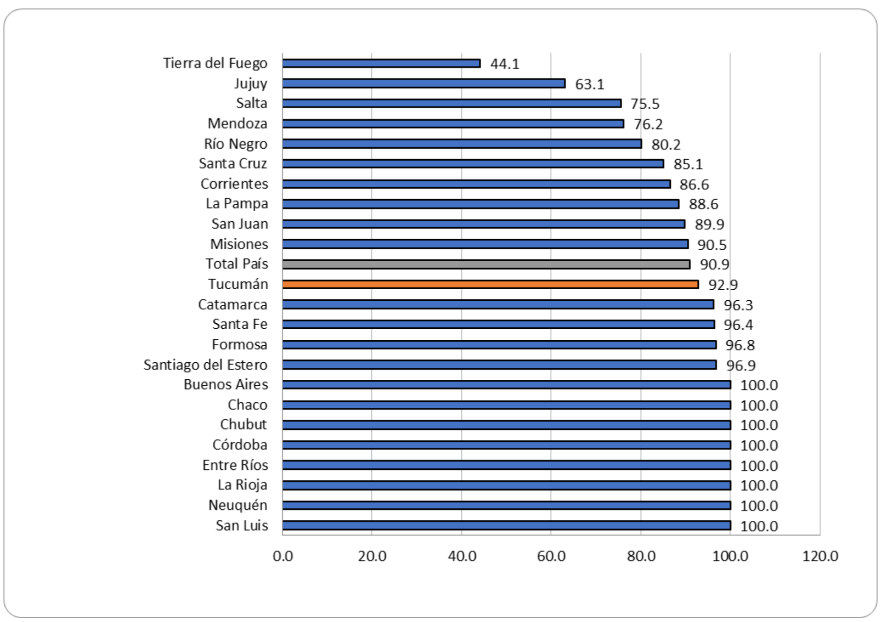
[10] In 2016, over 79% of the freight originating in Tucumán was transported by truck, while the remaining 20% was transported by rail.

Figure 22: Percentage of paved national roads per 100 km^2. Year 2023



Source: Own elaboration based on data from the National Directorate of Provincial Affairs.

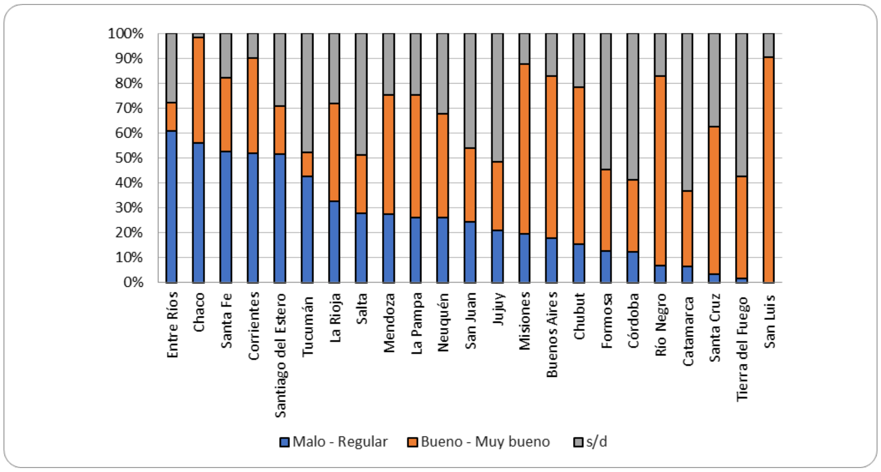
Figure 23: Percentage of paved national road kilometers relative to total national roads.



Source: Own elaboration based on data from the National Directorate of Provincial Affairs.

However, focusing on the quality of the road network, we find that more than 40% of the paved roads in Tucumán were rated as being in "Poor" or "Fair" condition (*Figure 24*). It is worth noting, however, that the information is partial, since about 47% of the network has not yet been surveyed.

Figure 24: Condition of the National Road Network by province. Year 2023



Source: Own elaboration based on data from the Federal Logistics Observatory (CFI).

In terms of rail freight transport, there are currently two operators transporting cargo from our province: Trenes Argentinos de Carga (TAC) Belgrano and Nuevo Central Argentino S.A. (NCA), the latter being the more important.[11]

With respect to the condition of the national railway network, it is observed that **neither of the two operators mentioned has 100% of their infrastructure operational**. In the case of NCA, the percentage reaches 75%, while for TAC Belgrano, only 55% of the network is operational. Of this percentage, it is reported that 33.7% of the TAC Belgrano network is in "Poor" or "Fair" condition, while for the NCA network the percentage is 46.3%.[12]

In summary, the freight transport situation in Tucumán reflects a mixed picture. While the province has a relatively high road density and a paved network close to the national average, the poor quality of much of its infrastructure limits its efficiency. At the same time, rail transport also faces severe constraints, as the available network is not yet fully operational and a significant proportion of its segments require improvements. This raises the hypothesis that these limitations—both in truck and rail transport—could be generating additional costs for freight movement. In this regard, CEPAL et al. (2023)—based on interviews with local transport operators—identifies high road transport costs as one of the main challenges facing

[11]In 2023, the operator NCA transported more than 95% of the total rail cargo flow from the province.

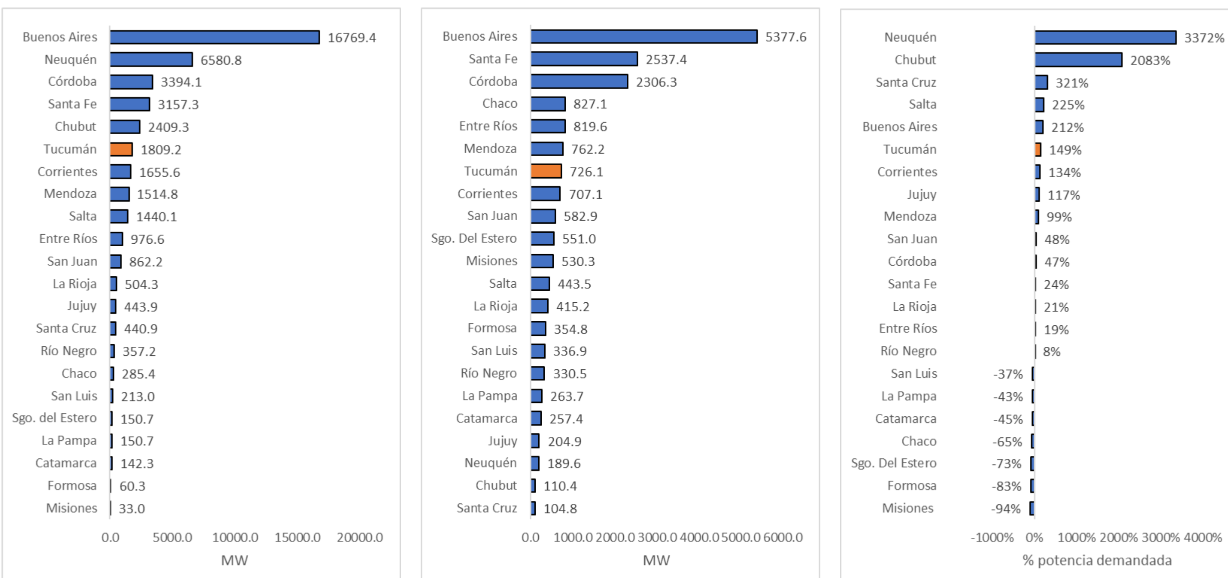
[12]There is also a percentage of the network classified as "Not in use" (45.3% for TAC Belgrano and 9.6% for NCA).

the sector.

Electricity

Tucumán is **the sixth province with the highest installed network capacity**. Furthermore, if we analyze the maximum power demand in 2024 for each province, we see that Tucumán reached a maximum demand of 726.1 MW, a level above all provinces in the NOA region. Given that the installed capacity for the same year was 1,809.2 MW, the resulting positive balance—expressed as a ratio over peak demand—indicates that the province **has an installed capacity 2.49 times greater than the maximum required by the system during the period considered (*Figure 25*).**

Figure 25: Electric power infrastructure indicators. Year 2024



(a) Installed capacity (b) Peak power demand (c) Net installed capacity

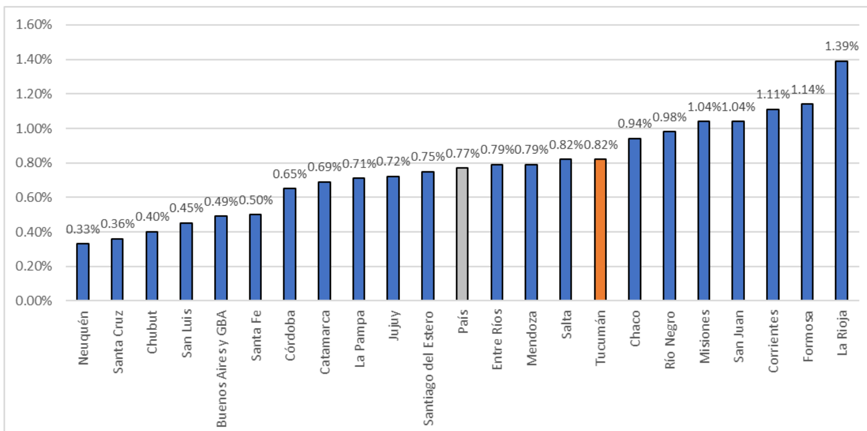
Source: CAMMESA

Although the infrastructure currently available in the province does not appear to be a constraint on Tucumán's economy, *energy cost* is also a decisive factor when assessing economic competitiveness, as it affects all productive sectors (Einstoss et al., 2025).

Despite the complexity of regional tariff structures, which makes comparison and analysis difficult, the *Instituto Interdisciplinario de Economía Política de la UBA* published a special report in 2025 analyzing the impact of electricity costs on the value of production in different economic sectors at the provincial level for the period 2018–1° semester 2024.[13]

According to the results of the study, during the period 2018–first semester 2024, **a non-residential user in Tucumán allocated on average 0.82% of their billing to electricity costs**. This places Tucumán 9th in the national ranking, above the national average (0.77%) and most of its regional peers (*Figure 26*).

Figure 26: Energy expenditure incidence in General Non-Residential Demand (<300 KWh) by province as % of Gross Value Added of Production. Average 2018 – 1st Semester 2024



Source: Instituto Interdisciplinario de Economía Política (UBA-CONICET).

Although it is not possible to obtain detailed evidence on electricity market prices, the analysis of other variables can still be informative. The presence of *rationing* in the provision of electricity may indicate that there are agents willing to demand electricity at current prices, but unable to access it (Hausmann, Klinger, & Wagner, 2008).

The World Bank Enterprise Survey (WBES) is a firm-level survey conducted in over 160 economies, providing valuable data on topics such as access to finance, corruption, and infrastructure. In terms of electricity infrastructure, it includes questions related to power outages, firms' perceptions of the severity of the issue, and more—useful for estimating the shadow price of electricity.[14]

In 2017, **56.3% of Tucumán firms reported experiencing power outages during the**

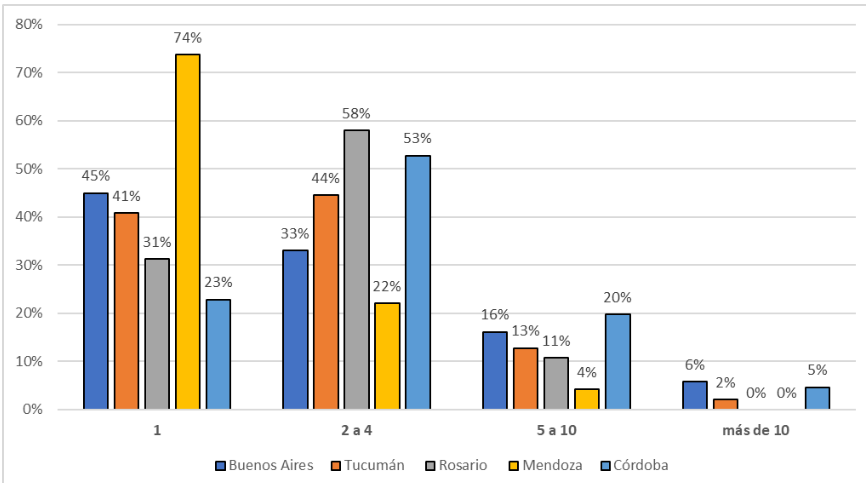
[13] The study includes a microeconomic impact analysis covering general (non-residential) users in the commercial and industrial sectors with power demand below 300 kW per month.

[14] The data used here comes from the survey conducted between March 2017 and March 2018, covering firms in Buenos Aires, Mendoza, Rosario, Córdoba, and Tucumán. Of the 991 firms surveyed, 118 were from Tucumán (11.9%).

previous year, a mid-level percentage compared to other provinces.[15]

Among the firms in Tucumán that experienced outages, 41% reported only one outage in a typical month, and only 2% reported more than 10 outages. According to *Figure 27*, the province does not seem to face unusually severe issues in electricity provision.

Figure 27: Number of power outages experienced in a typical month in the last fiscal year. Year 2017



Source: World Bank Enterprise Survey (WBES).

In response to the question *"To what extent is electricity an obstacle to your business activity?"*, 50% of Tucumán firms considered electricity provision to be a moderate or severe obstacle. However, **Tucumán was the province with the highest share of firms that stated electricity was not an obstacle or was only a minor one for their production (*Table 2*)**.

[15] In Córdoba, 93.8% of firms experienced outages in the past year, while in Mendoza only 39% did.

Table 2: Perception of electricity service as an obstacle in different Argentine cities

City	Not an obstacle / Minor	Moderate obstacle	Major / Severe obstacle	Don't know
Buenos Aires	37%	16%	47%	0%
Tucumán	48%	12%	38%	2%
Rosario	31%	9%	53%	7%
Mendoza	41%	7%	52%	0%
Córdoba	36%	20%	44%	0%

Source: Own elaboration based on data from World Bank Enterprise Survey (WBES).

In conclusion, Tucumán shows no signs that electricity infrastructure or service provision currently pose immediate constraints on economic growth. The province has a level of installed capacity that far exceeds its maximum demand, and the frequency of outages reported by firms does not differ significantly from other provinces. Furthermore, a considerable number of firms do not perceive electricity as an obstacle to their production. In terms of costs, from 2018 to the first half of 2024, non-residential users in Tucumán spent, on average, 0.82% of their turnover on electricity—slightly higher than the national average.

Therefore, the evidence suggests that electricity infrastructure, provision, and cost are not currently bottlenecks for the provincial economy. However, given the importance of energy costs for competitiveness across all productive sectors, a more detailed analysis of electricity tariffs in future studies is crucial to either reinforce—or challenge—the evidence presented here.

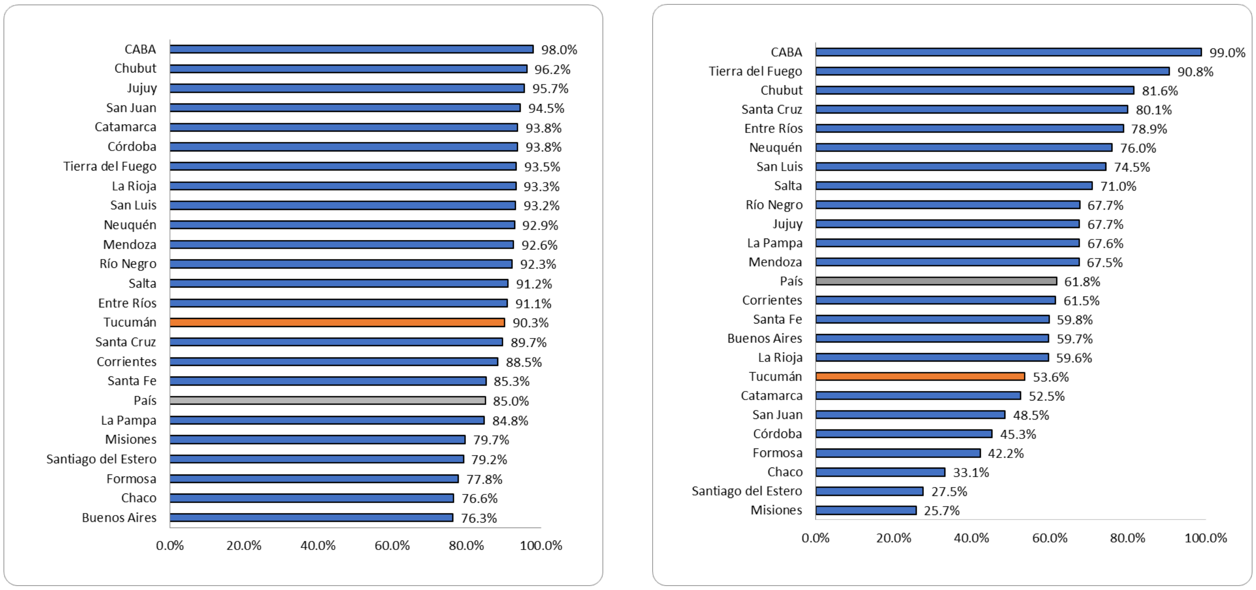
Water and Sanitation

To evaluate whether water provision constitutes a constraint to Tucumán's economic growth, three dimensions were considered: (i) household access to water and sewer networks, (ii) the relative performance of water-intensive productive sectors, and (iii) the level of satisfaction among economic units with the service provision.

According to data from the *Censo Nacional de Población, Hogares y Viviendas 2022*, **90.3% of households in Tucumán had access to the public water network**. This places the province in 11th position nationwide, within a broader context of high coverage rates (*Figure*

28 (a)). On the other hand, panel (b) of the same figure shows that **Tucumán has a sewer network access rate of just 53.6%, one of the lowest in the country**.[16]

Figure 28: Access to water and sanitation services. Year 2022



(a) Access to water

(b) Access to sewer network

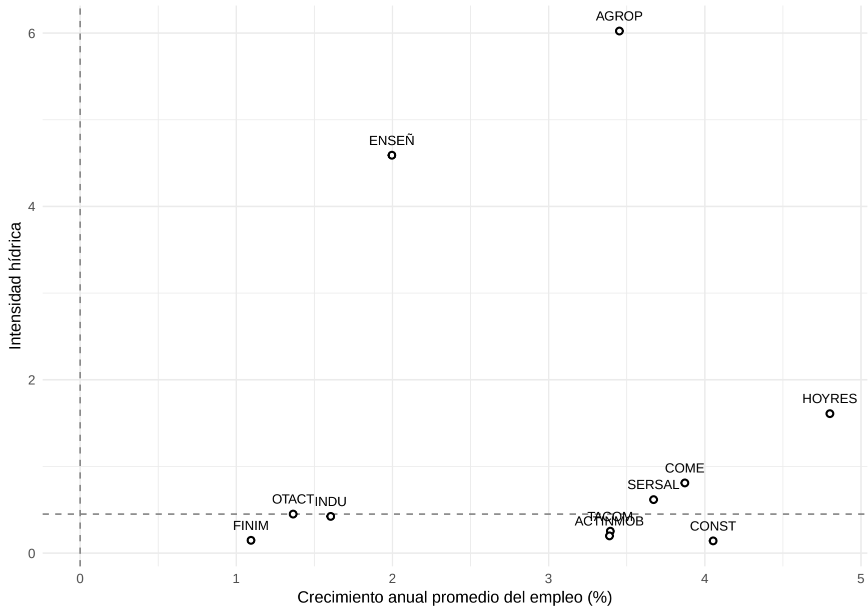
Source: Own elaboration based on CENSO 2022.

To test the "camels and hippos" hypothesis proposed by HRV (2005), we analyzed the relationship between sectoral water intensity[17] and the average annual employment growth. In Tucumán, **no negative relationship is observed between these two variables (*Figure 29*)**. Sectors such as Agriculture, livestock, hunting, and forestry (AGROP), which show the highest water intensity in the provincial economy, do not exhibit low employment growth; in fact, they show comparable or even higher growth rates than less water-intensive sectors such as Commerce (COME) or Social and health services (SERSAL). Likewise, sectors such as Construction (CONST) and Manufacturing (INDU), with medium-low water use, are among those with the highest growth rates . This suggests that the most water-intensive sectors do not show relatively worse performance in terms of job creation.

[16]Unlike the previous case, this occurs in a broader context of generally low sewer access levels in most provinces. These results highlight the lack of complementarity in the expansion of water and sewer services, with a considerable deficit in the latter, which forces households to rely on less secure sanitation methods. The presence of cesspools connected, at best, to septic tanks, becomes an increasingly severe issue in urban areas where construction takes place near water sources (Acuña et al., 2018).

[17]The methodology used to construct this indicator is detailed in Appendix B.

Figure 29: Average annual registered employment growth and water intensity by economic sector.



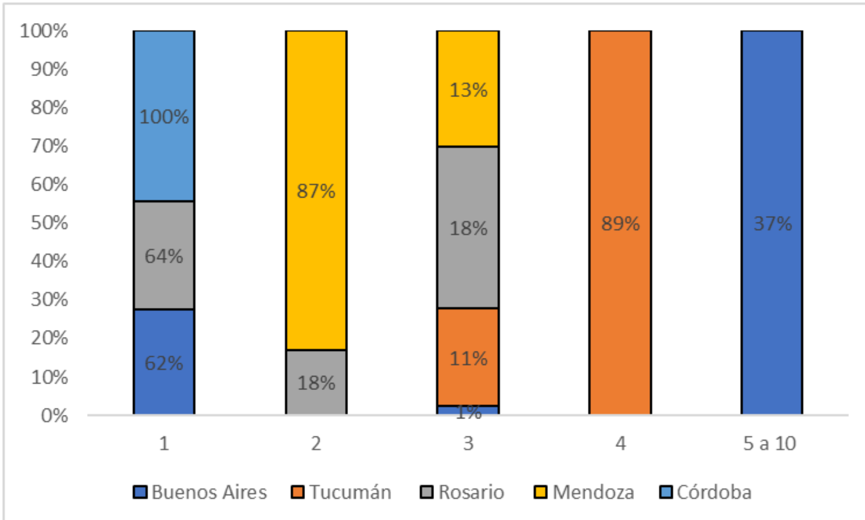
Source: Own elaboration based on data from Bureau of Economic Analysis (BEA) and Observatorio de Empleo y Dinámica Empresarial (OEDE).

The WBES also provides information on water service provision. Among surveyed Tucumán firms, **33% reported experiencing water outages during the year prior to the survey**, the highest percentage among the provinces surveyed.[18]

Among those firms in Tucumán that reported outages, **89% experienced 4 water outages in a typical month in the previous year, while the remaining 11% reported only 3 outages** (*Figure 30*). Compared with other provinces, the number of outages is relatively high—except for Córdoba, where 100% of firms reported between 5 and 10 monthly outages.

[18]In Rosario and Mendoza, only 8% of firms experienced outages; in Buenos Aires, the rate was 9%, and in Córdoba just 3%. However, in all cases, a proportion of firms responded "Don't know" (see Appendix).

Figure 30: Number of water outages experienced in a typical month in the last fiscal year. Year 2017



Source: World Bank Enterprise Survey (WBES).

In summary, the analysis of water provision in Tucumán does not offer conclusive evidence that this factor constitutes an immediate constraint on economic growth. In terms of household access, the province occupies a middle position regarding connection to the water network, while access to the sewer network remains limited. This highlights a notable gap in sanitation infrastructure, though its impact is more direct on quality of life than on short-term productive expansion.

Regarding the productive sector, the analysis of sectoral water intensity does not suggest that water availability is restricting employment dynamics: the most water-intensive sectors do not show weaker performance than those with lower intensity. Finally, evidence from the World Bank Enterprise Survey shows that a significant proportion of firms reported facing water supply interruptions. While these episodes reflect service quality deficiencies, they do not appear to constitute a decisive obstacle to economic activity in the province.

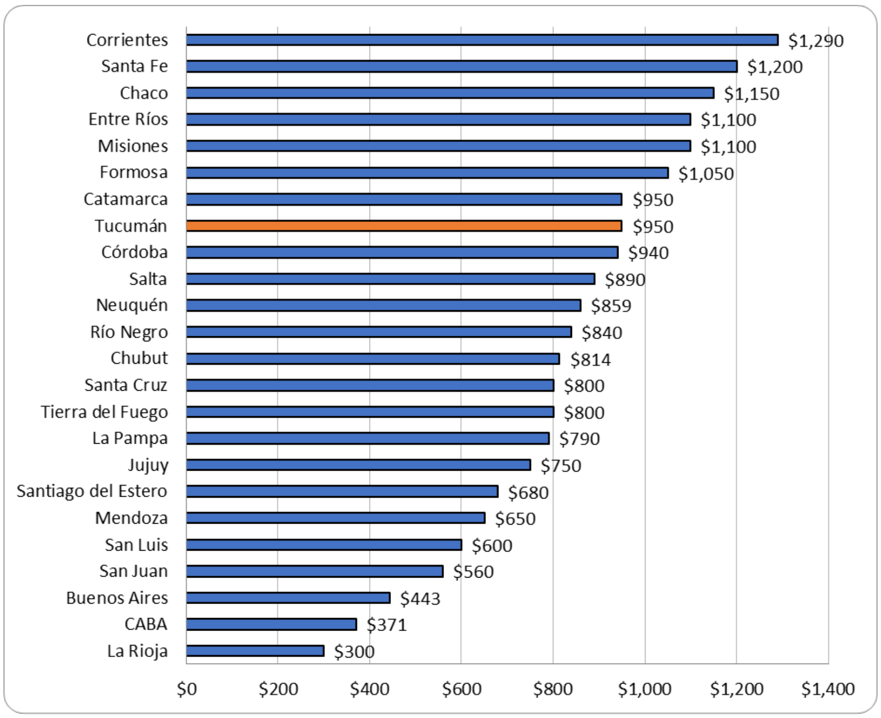
Taken together, the results suggest that, although there are challenges in terms of sanitation infrastructure and service quality for firms, water availability does not currently appear to be a constraint on Tucumán's economic growth.

Mobility

To evaluate whether urban mobility constitutes a constraint on growth in Tucumán, two specific dimensions will be analyzed: (i) public transport fares and (ii) the motorization rate.

In *Figure 31*, it can be observed that the general public transport fare in Tucumán is among the highest in the country. At the regional level, it is surpassed only by the province of Catamarca.

Figure 31: General urban passenger transport fare. Year 2024

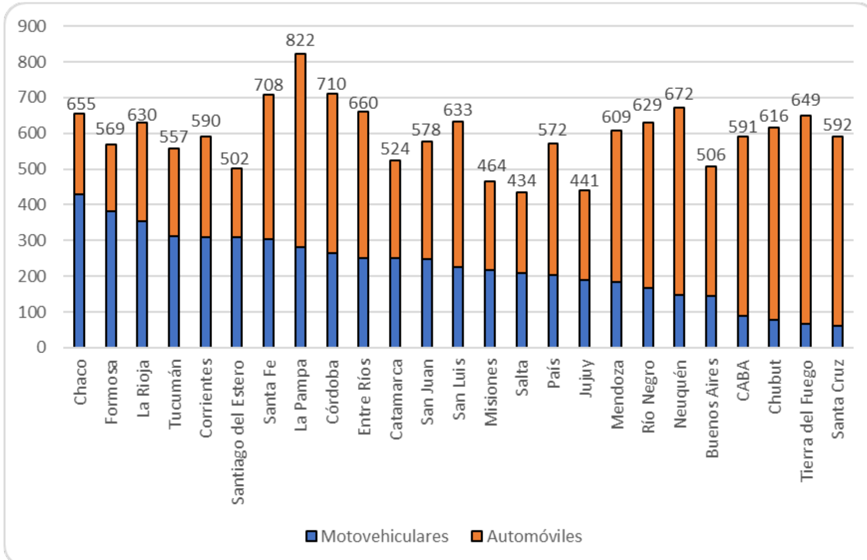


Source: Own elaboration based on Observatorio de Tarifas – Universidad Nacional de Cuyo.

On the other hand, Tucumán has a motorization rate[19] of 557 vehicles. Focusing on the number of motor vehicles specifically, the province ranks 4th nationwide; only the provinces of Chaco, Formosa, and La Rioja have higher rates (*Figure 32*).

[19]We define motorization rate as the number of automobiles and motor vehicles per 1,000 inhabitants.

Figure 32: Number of automobiles and motor vehicles per 1,000 inhabitants. Year 2020



Source: Own elaboration based on Dirección Nacional de Observatorio Vial.

In conclusion, in the case of Tucumán, the available data reveal two relevant phenomena: on the one hand, the province has relatively high public transport fares in the national context; on the other hand, it shows a high motorization rate—especially if we focus on motor vehicles. A plausible hypothesis is that the increased use of motorcycles may be operating as a substitute for public transport, due to their flexibility and relatively lower cost. However, the lack of information regarding public transport usage patterns, travel times, and travel purposes limits the possibility of validating this hypothesis conclusively. In this regard, the evidence should be interpreted as preliminary, suggesting the need for further research on transport costs and modes of transport in Tucumán.

5.3 Low Appropriability

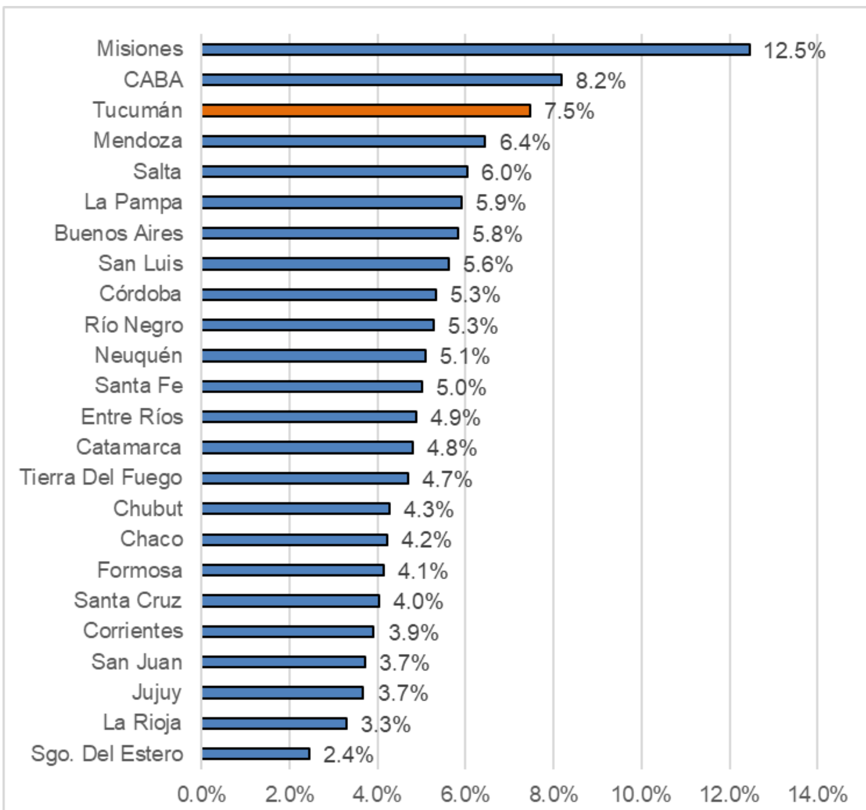
In the following two sections, we will analyze whether the main constraints to growth in Tucumán may be linked to difficulties in realizing the returns on private investment.

5.3.1 Government Failures

This section examines the relevance of government failures as a constraint to growth in the province of Tucumán. The presence of high levels of corruption, macroeconomic volatility, tax burden, regulatory uncertainty, market entry barriers, crime, and weak property rights reduces incentives for private investment by increasing the discount rate required for capital commitment by the private sector (Castro et al., 2014). Given that this is a sub-national study, we focus on local-level variables that may explain the province's weak economic performance compared to other provinces.

Tax collection in the province of Tucumán relative to its GPP is among the highest in Argentina. The province displays an effective tax burden—measured as provincial revenue as a percentage of GPP—of 7.5%, significantly above other provinces and well above the NOA regional average of 4.6% (*Figure 33*).

Figure 33: Effective Tax Burden. Year 2023



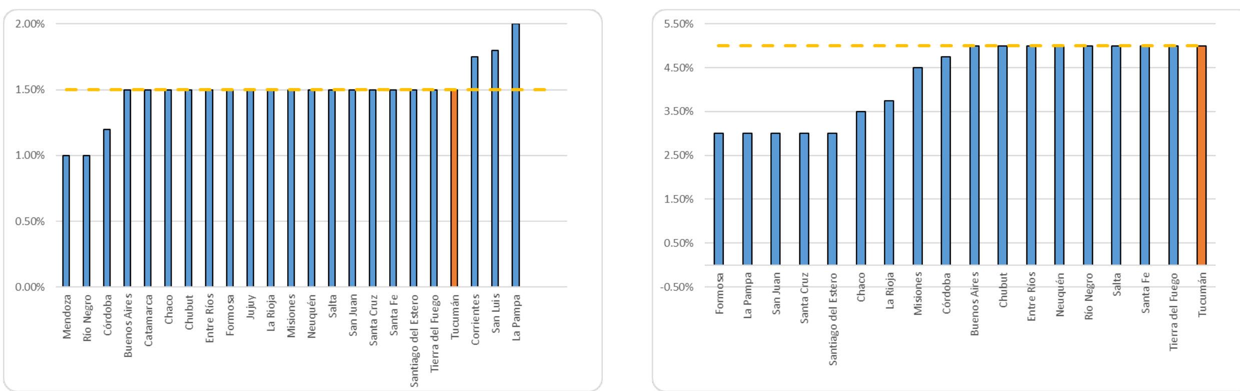
Source: Dirección Nacional de Asuntos Provinciales.

Variations in effective tax pressure may result from legal tax changes (e.g., modifications to tax rates) and/or from improvements in tax administration and collection mechanisms that enhance efficiency. Therefore, effective tax burden analyses should be complemented by studies on **legal tax pressure**, which offer a more complete and accurate view of the tax structure and its evolution. However, measuring legal tax burden is much more complex than constructing indicators of effective pressure, as it requires an in-depth analysis of current tax regulations at the provincial level and across sectors (Oficina Técnica de Presupuesto de la Legislatura de la Provincia de Córdoba, 2019).

For this reason, the analysis now focuses on the *Impuesto a los Ingresos Brutos (IIBB)* . This tax is the main source of provincial own revenues and directly impacts business activity.[20]

One of the commitments made under the *Consenso Fiscal* signed in 2017 was to implement exemptions and establish ceilings on tax rates. According to data from the Dirección Nacional de Recursos Provinciales (DNAP), **Tucumán is among the provinces that comply with the limits set by the agreement regarding sectoral tax rates.** Specifically, in the Manufacturing and Commerce sectors, the province applies the maximum allowed rates of 1.5% and 5%, respectively (*Figure 34*).

Figure 34: IIBB Tax Rates by Selected Sectors. Year 2024



(a) Manufacturing

(b) Commerce

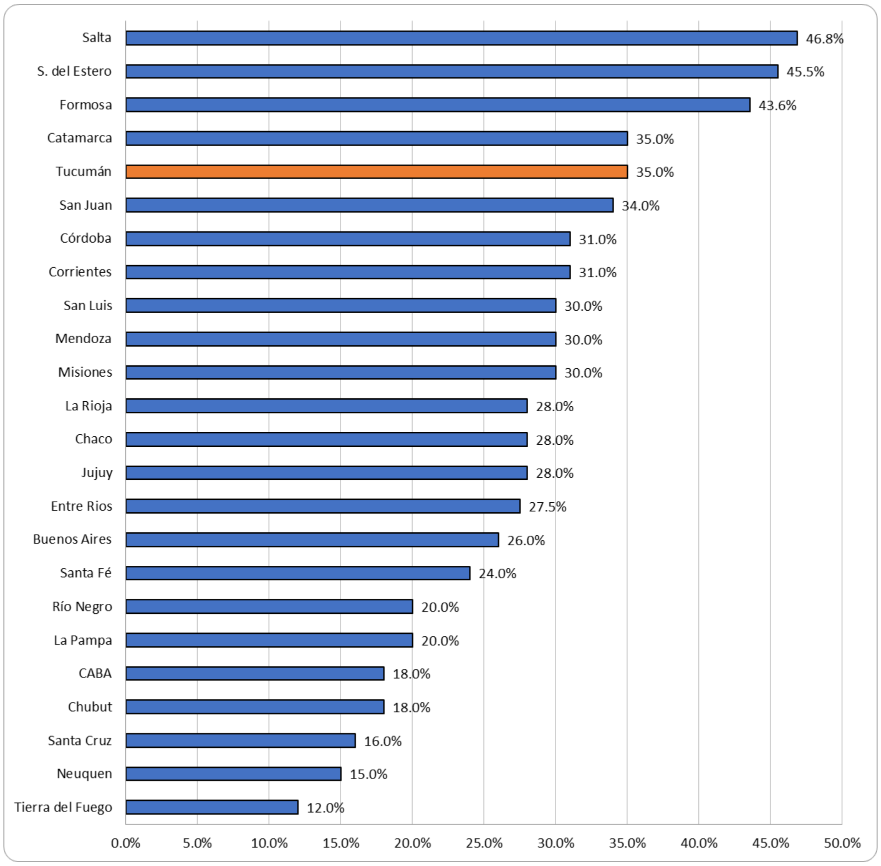
Source: DNAP.

Although Tucumán complies with the regulatory ceilings in terms of IIBB rates, its effective tax burden remains high compared to other provinces. This raises the concern that such conditions may have adverse effects on formal economic activity, potentially by encouraging tax evasion or informality.

[20]In fact, in 2017, the national government, 21 provinces (all except San Luis and La Pampa), and CABA signed the *Consenso Fiscal*, which sought to gradually reduce IIBB rates across all economic activities and mitigate the cascading effects this tax imposes throughout the production and commercialization process.

Tucumán ranks as the 5th province with the highest proportion of informal wage workers in the country (*Figure 36*). In fact, labor informality appears to be a structural issue across the NOA: in four of the six provinces in the region, informal employment rates are among the highest nationwide.

Figure 35: Proportion of Informal Wage Workers. Year 2024



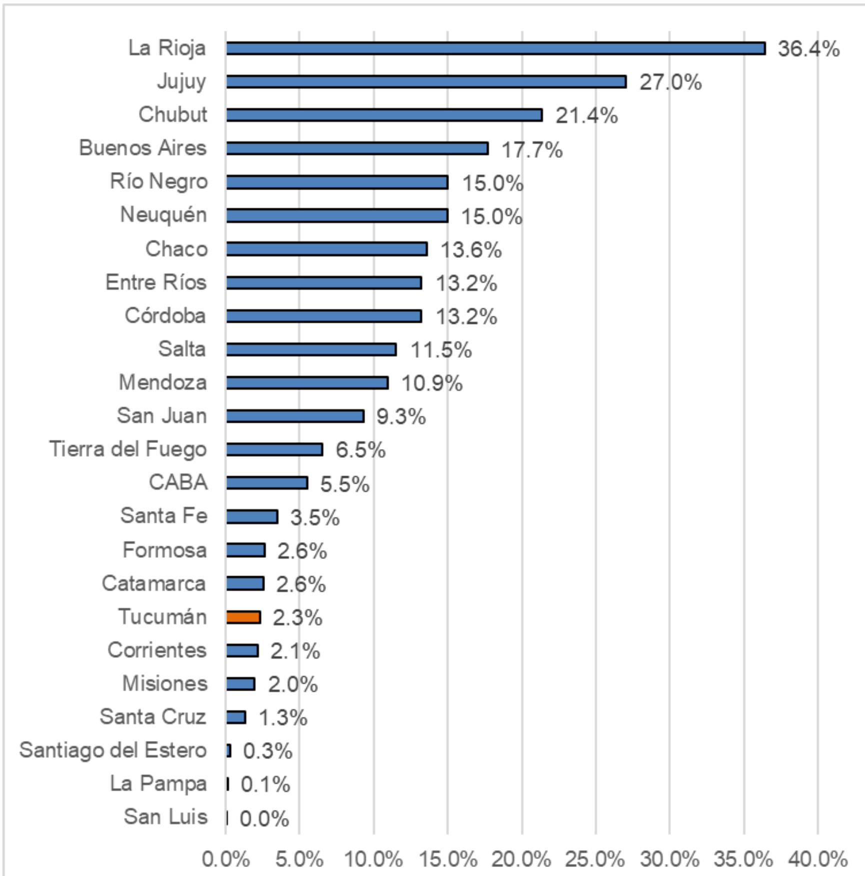
Note: Informal workers are defined as employed individuals aged 15–65 who do not receive pension contributions.
Source: Own elaboration based on EPH.

This analysis provides an overview of the current tax environment. However, to fully assess whether the tax system constitutes a constraint to growth, **it is also necessary to consider the province's public accounts.** Specifically, a scenario of high tax burden coupled with elevated debt levels or persistent deficits increases the likelihood of future tax hikes, thereby negatively affecting the expected returns on investment.

We observe that **Tucumán is among the provinces with the lowest public debt burden in the country.** With a Public Debt-to-GPP ratio of 2.3%, it ranks below all other NOA provinces except Santiago del Estero (*Figure 36*). Furthermore, between 2004 and

2023, the province reduced its debt stock from nearly 41% of PBG to 2.3% (see Appendix). This allows us to conclude that the likelihood of future tax increases is low, thus reducing uncertainty around expected returns on investment.

Figure 36: Public Debt as a Percentage of GPP. Year 2023



Source: Dirección Nacional de Asuntos Provinciales.

In summary, the combination of a high effective tax burden and a similarly high rate of labor informality suggests that Tucumán faces problems of low appropriability stemming from an excessive tax environment, which constitutes a constraint to economic growth. While the province's low and declining Public Debt-to-GPP ratio indicates a low probability of future tax increases, available evidence suggests that the current tax structure may be generating disincentives to investment in the province.

Institutional Quality

The quality of institutions determines transaction costs and the degree of certainty with which economic agents can plan and invest. Weak institutions discourage productive investment and hinder growth (North, 1991). In federal systems such as Argentina, provinces enjoy considerable autonomy in the adoption and amendment of laws (Araóz, 2023). In this context, evaluating the situation of Tucumán's economy in comparison with the rest of the Argentine provinces becomes particularly relevant.

To assess this dimension, two indicators will be used. The first is the *Índice de Calidad Institucional Provincial (ICIP)* [21], which is constructed by combining four dimensions and ten indicators, and represents an index of political institutions.[22] Secondly, the *Índice de Transparencia Presupuestaria Provincial (ITPP)* published by CIPPEC is analyzed. This index evaluates the timely and accessible availability of information on the use, origin, and application of provincial budget resources.[23]

For the 2011–2020 period, Tucumán's ICIP value is 8.9, which **places it among the lowest-ranked provinces in the country** (*Figure 37*). At the regional level, it occupies an intermediate position—above La Rioja and Santiago del Estero, but below Catamarca, Salta, and Jujuy.[24]

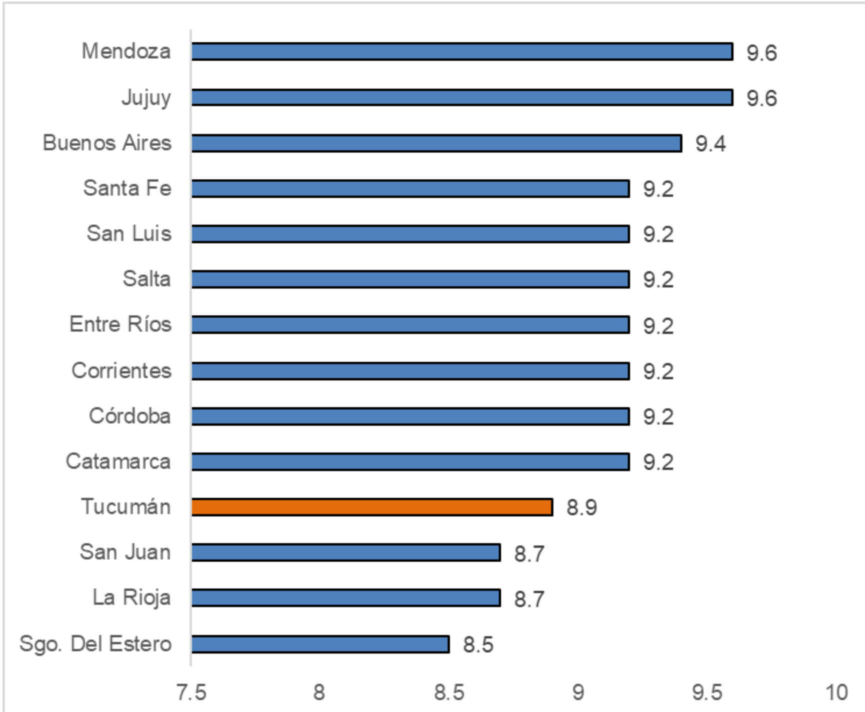
[21] Araóz, María Florencia (2023). *Dinámica Electoral, Instituciones Políticas y Desempeño Institucional: las Provincias Argentinas en el Largo Plazo.* Documento de trabajo RedNIE N°294.

[22] The ICIP ranges from 0 to 10 and is built from four dimensions: (i) electoral integrity, (ii) concentration of power, (iii) legitimacy and limits in the exercise of power, and (iv) constraints on executive power.

[23] The ITPP also ranges from 0 to 10 and includes four dimensions: (i) budget; (ii) execution and accountability; (iii) resources; (iv) dissemination.

[24] It is worth noting that the index has limited coverage, as it only includes those jurisdictions that had provincial status at the beginning of the 20th century.

Figure 37: Provincial Institutional Quality Index (ICIP). Average 2011–2020

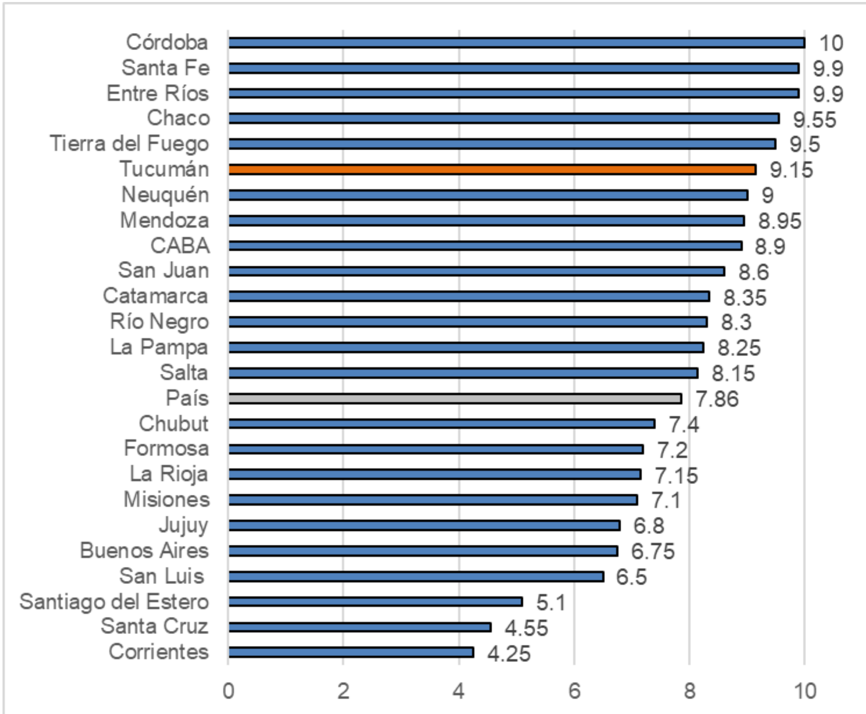


Note: For methodological consistency, the cited work only calculated the index for the fourteen districts that held the rank of "province" at the beginning of the 20th century.

Source: Own elaboration based on Aráoz (2023).

In contrast, the ITPP places Tucumán **in the 6th position nationwide**, above the national average and all other provinces in its region (*Figure 38*).

Figure 38: Provincial Budget Transparency Index (ITPP). Year 2023



Source: Own elaboration based on CIPPEC.

In conclusion, although the ICIP places Tucumán among the provinces with the weakest institutional quality, this result should be interpreted with caution since the indicator does not cover all jurisdictions. On the other hand, the ITPP shows a relatively strong performance for the province, suggesting that—despite the weaknesses highlighted—there are also strengths in terms of budget transparency that nuance the institutional diagnosis.

Regulatory Quality

Another dimension to be assessed is regulatory quality. The World Bank publishes the "Doing Business" index. One of its components is the *Starting a Business* indicator, which allows for the objective measurement and comparison of business regulations.[25] Although there is no subnational data available for Argentina, the *Observatorio de Empleo, Producción y Empresas de Tucumán (OEPET)* managed to quantify the indicator and compare it with other provinces that have conducted similar studies.

According to *Table 3*, **starting a business in Tucumán is considerably more expensive:**

[25]This indicator records all the formal procedures required to establish a commercial or industrial firm, examining key variables such as the number of procedures, the time they take, and the cost, expressed as a percentage of per capita income.

it requires 20 procedures, 100 days, and 21% of per capita income, while in other provinces no more than 16 procedures and fewer than 50 days are needed (in CABA, under one month and at half the cost).

Table 3: Regulatory Quality — Starting a Business Indicator

Indicator	Tucumán (2017)	Rosario (2010)	Salta (2010)	CABA (2010)	CABA (2017)
Number of procedures	20	16	14	15	14
Time (days)	100	46	48	27	25
Cost (% of per capita income)	21%	15.3%	14.2%	11.0%	9.3%

Source: Laham and Rodríguez (2018)

In conclusion, the regulatory results—and in particular Tucumán's weak performance in the "Starting a Business" dimension of the 2017 Doing Business index—suggest that the business climate may be limiting the establishment of new firms in the province, although this alone does not conclusively indicate an effective constraint to economic growth.

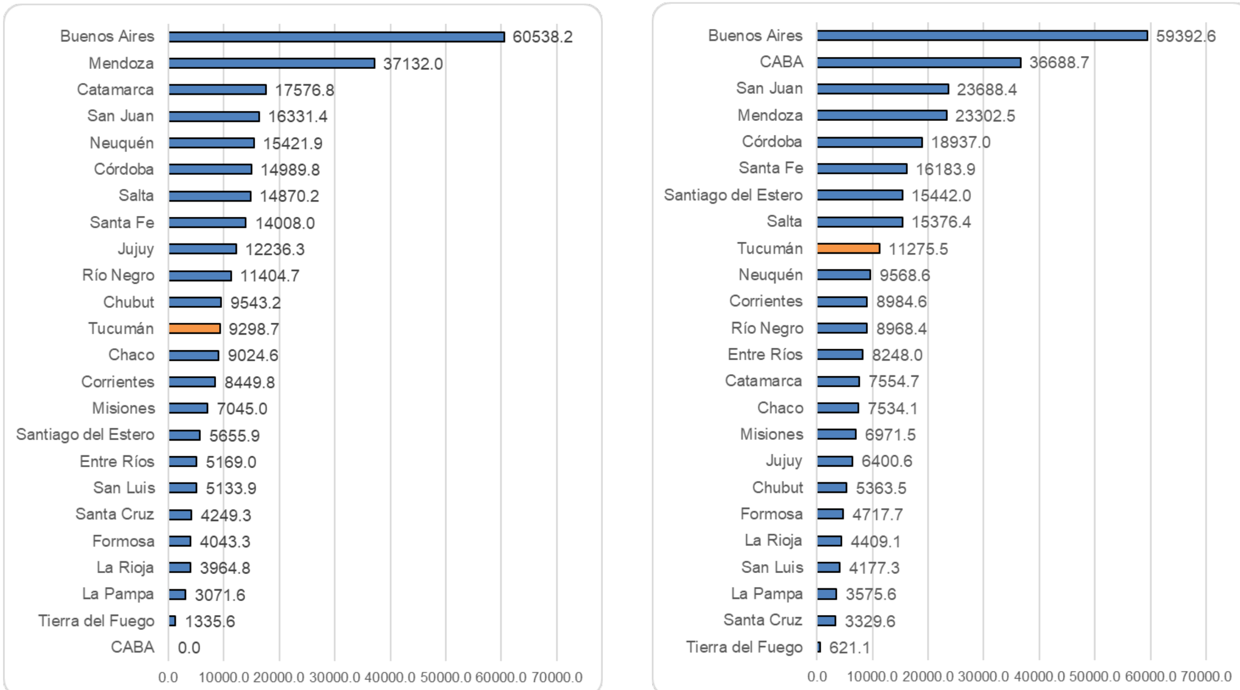
Insecurity

The ability to secure a predictable return on investment is one of the most powerful incentives to attract capital. Since investment in human capital, physical capital, and other forms of capital contributes to growth, the level of insecurity in an economy becomes a key determinant of its development (Lloyd-Ellis & Marceau, 2003).

To assess Tucumán's situation in this dimension, we analyze two indicators: (i) robbery rate per 100,000 inhabitants and (ii) intentional homicide rate per 100,000 inhabitants. These quantitative results are complemented with qualitative information from the WBES.

In 2014, Tucumán ranked 12th among provinces with the highest robbery rate, with nearly 9,230 incidents per 100,000 inhabitants. Ten years later, in 2024, it climbed to 9th place, surpassing most of its regional peers—except for Santiago del Estero and Salta. This represents a **21% increase in the robbery rate over the last ten years** (*Figure 39*).

Figure 39: Robbery rate per 100,000 inhabitants. Years 2014 and 2024

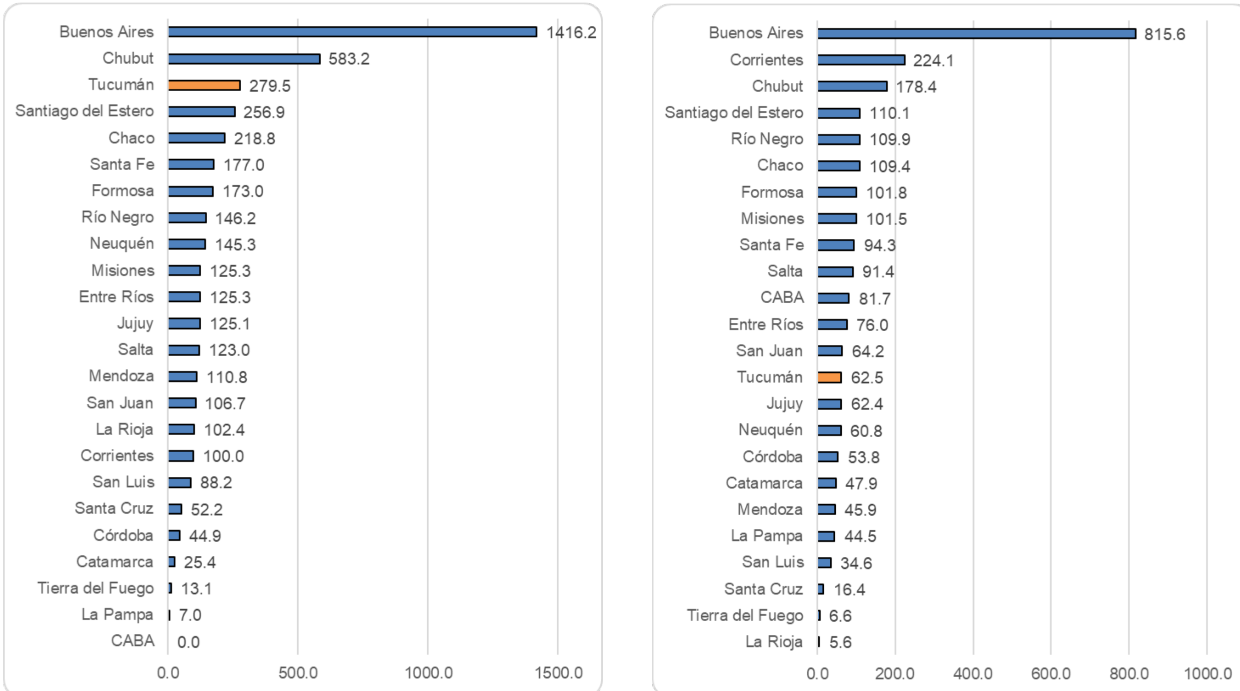


(a) 2014 (b) 2024

Note: Attempted robbery and theft records are included in each year's calculation.
Source: Sistema Nacional de Información Criminal (SNIC)

On the other hand, in 2014, Tucumán ranked third among provinces with the highest intentional homicide rates per 100,000 inhabitants. However, between 2014 and 2024, **this indicator recorded a cumulative drop of 78%**, allowing the province to improve its position to 14th place in the national ranking (*Figure 40*).

Figure 40: Intentional homicide rate per 100,000 inhabitants. Years 2014 and 2024



(a) 2014 (b) 2024

Source: Sistema Nacional de Información Criminal (SNIC)

The WBES also includes a question about firms' perceptions of how crime and theft affect their operations. According to the survey, half of the firms in Tucumán consider insecurity a significant obstacle, while the other half do not. In other provinces, the results are more conclusive. For example, in Buenos Aires, 63% of firms stated that crime is not an obstacle to their production (*Table 4*).

Table 4: To what extent are crime, theft, and disorder an obstacle to your business operations?

City	Not an obstacle / Minor obstacle	Moderate obstacle	Major / Severe obstacle	Don't know
Buenos Aires	63%	26%	10%	1%
Tucumán	50%	34%	16%	0%
Rosario	30%	34%	33%	3%
Mendoza	57%	22%	21%	0%
Córdoba	47%	29%	23%	0%

Source: Own elaboration based on World Bank Enterprise Survey (WBES).

In summary, the evidence on insecurity in Tucumán presents mixed results. While the robbery rate increased by 21% between 2014 and 2024—reflecting a deterioration in this indicator—the intentional homicide rate dropped significantly, by 78%, improving the province's national ranking. Additionally, results from the World Bank Enterprise Survey indicate that local firms do not perceive crime and insecurity as a major obstacle to their operations. Altogether, these results suggest that although certain security indicators show unfavorable trends, crime does not currently appear to be one of the most significant constraints on the province's economic growth.

5.3.2 Market Failures

The **self-discovery process**—through which a location identifies new products and services it can produce competitively—is a key driver of productive diversification and structural transformation. By its nature, this process tends to be subject to numerous failures that inhibit or delay the redeployment of existing productive capacities toward new, higher value-added industries. The economic literature classifies these failures into information-related market failures and coordination failures, linked to the difficulty of organizing the collective efforts required for the emergence of new productive activities (Hausmann and Rodrik, 2002).

Information failures are related to the costs of discovering whether a new economic activity can be profitable in a particular location. An entrepreneur who makes a successful discovery may capture only a small share of the benefits generated by their knowledge, since others can quickly imitate it. As a result, entrepreneurs will tend to invest less in innovation than what would be socially optimal, delaying economic transformation (Hausmann & Rodrik, 2002).

In this sense, patents serve as important incentives for knowledge development, as they allow inventors to appropriate the returns from their discoveries for a limited period. Unfortunately, due to the lack of available subnational data on patent registration in Argentina, it is not possible to evaluate Tucumán's performance on this front.

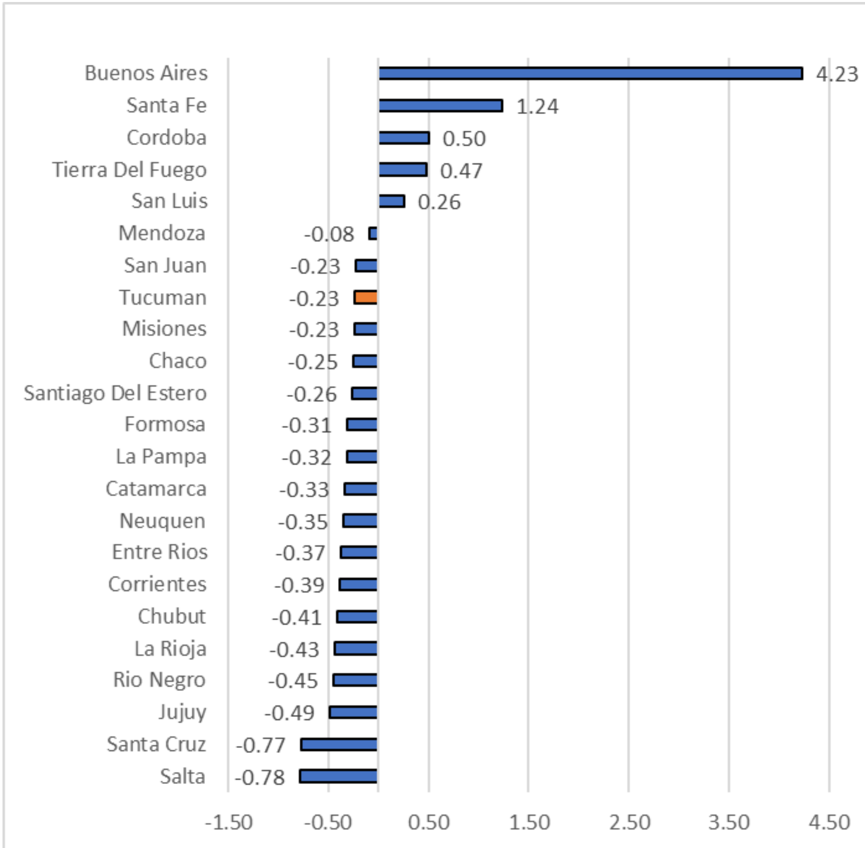
In addition, there are also *coordination failures* that affect the emergence of new activities and the increase in their complexity. The notion of economic complexity proposed by (Hausmann et al., 2011) offers a particularly useful analytical framework to understand this phenomenon. From this perspective, the capacity of an economy to grow and diversify depends not only on the accumulation of traditional production factors, but also on the variety and interconnectedness of its productive capabilities. More complex goods require a larger number of specific capabilities—technical knowledge, specialized suppliers, certification institutions, financing, logistical services, among others—which must be simultaneously present to enable their production. In this context, low productive diversification or the difficulty in shifting toward more sophisticated goods can be interpreted as the manifestation of a coordination failure.

To analyze the level of sophistication and complexity of Tucumán's productive structure, we use the *Economic Complexity Index (ECI)* and the *Complexity Outlook Index (COI)* calculated by Fundar for Argentine provinces for the year 2021. These indices were constructed using employment data for all Argentine provinces, which is especially useful for subnational analyses, as it allows for the inclusion of the services sector and interprovincial trade dynamics.[26]

In 2021, **Tucumán's ECI was** -0.23, placing it in 8^{th} position in the national complexity ranking—above all other NOA provinces (*Figure 41*).

[26]This differs from the original methodology used to calculate these indicators. Initially, the literature relied on export data to determine the existence of *Revealed Comparative Advantages* in the production of goods or services. In contrast, the results presented here are based on the calculation of RCAs using employment data.

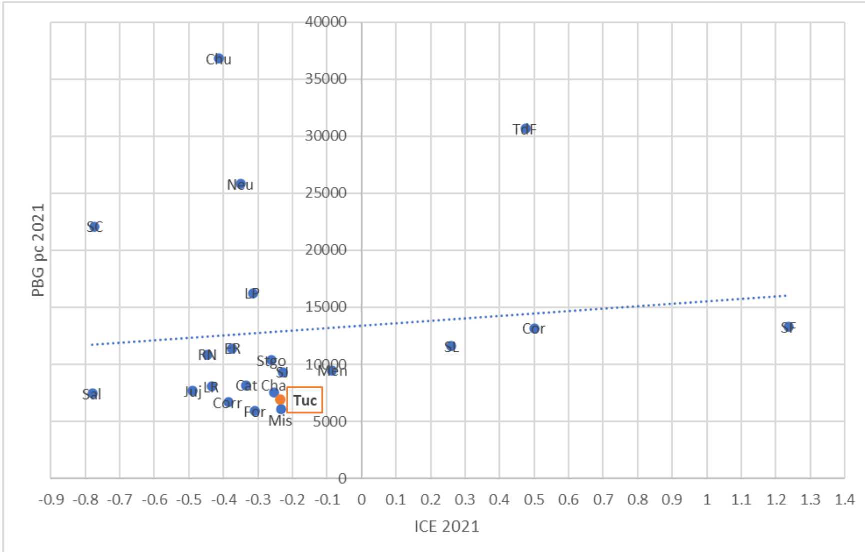
Figure 41: Economic Complexity Index. Year 2021



Source: Fundar.

However, although Tucumán has a relatively high level of sophistication and productive know-how compared to other Argentine provinces, its income level is lower than would be expected given its productive knowledge (*Figure 42*).

Figure 42: Relationship between Economic Complexity Index and GPP per capita

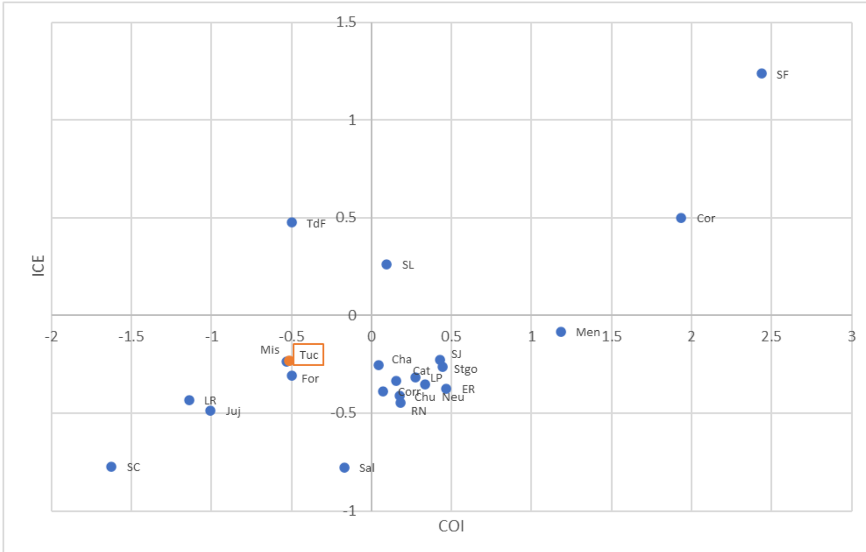


Source: Fundar and CEPAL.

Beyond the ECI, Hausmann et al. (2011) also developed another complexity-related indicator: the *Complexity Outlook Index (COI)*. Economies tend to diversify into sectors that require productive capabilities similar to those they already possess, which means it is easier to move into activities that are "closer" to existing ones. The COI aims to capture whether the products in which Tucumán already has revealed comparative advantages are near to more complex products, which would define a path of increasing diversification and sophistication of the productive matrix.

Tucumán shows a relatively complex productive basket compared to other Argentine provinces, based on its ECI score. However, **its COI is lower than that of most jurisdictions in the country.** Within the regional context, the province outperforms the rest of the NOA provinces (*Figure 43*).

Figure 43: Complexity Outlook Index and Economic Complexity Index



Source: Fundar.

This pattern suggests that, while the set of capabilities and productive knowledge currently present in the province is relatively sophisticated, the immediate potential to diversify toward more complex goods is limited. Regardless of the underlying reasons, in order to sustain its current income levels and achieve long-term growth, Tucumán must be able to enhance its economic complexity. However, the opportunities to do so are "distant," and therefore require a significant push for their realization.

6 Conclusions

Between 2004 and 2023, Tucumán's per capita GPP growth showed a relatively favorable performance compared to other Argentine provinces. However, its current low GPP per capita and poor performance in other income and social well-being indicators raise suspicions that there may be constraints hindering its growth. Moreover, the fact that a non-tradable sector has been the main driver of growth over the past 19 years raises the question of whether the current productive structure will be able to sustain long-term growth, especially considering its limited diversification potential in a context of highly volatile national economic policies.

Given this scenario, the key question becomes: *What structural factors prevent Tucumán's economy from growing sustainably?* This document explored a set of indicators in order to identify the main constraints on the province's growth and the development of new industries.

The potential factors analyzed include: credit market constraints; possible scarcity of complementary factors to production (human capital, public goods infrastructure); and limitations to the appropriability of returns, either due to government failures (excessive taxation, low institutional quality, weak regulatory environment, insecurity, etc.), or market failures (economic complexity, diversification opportunities).

In terms of access to credit, **Tucumán does not show signs of an active constraint.** Although physical access to credit—as measured by the number of physical branches and ATMs—appears to be low in the province, the share of credit relative to its GPP share in national output ranks among the highest in the country. Moreover, provincial real interest rates remain at levels similar to the rest of Argentina.

By contrast, **Tucumán's economy shows clear signs of a shortage of human capital.** Not only are average education levels low, but education quality is also poor, as reflected in the province's low performance in the Pruebas Aprender standardized tests. This, combined with relatively high returns to education, supports the hypothesis that the province faces a major challenge in improving the productivity of its workforce.

In terms of infrastructure, multiple indicators and data sources were analyzed, allowing for some preliminary conclusions. However, a more in-depth analysis is needed to determine more precisely whether infrastructure constitutes an active constraint to growth.

More specifically, in terms of freight transport, Tucumán is well positioned in rankings of paved road kilometers, although road quality appears to be poor. The railway network shows signs of limited coverage and low quality, which may create logistical bottlenecks for industry and consequently raise costs. Regarding worker mobility, the province has relatively high public transportation fares and a high motorization rate, especially in motorcycle use. While the coexistence of these two phenomena could be interpreted as evidence of public transport weaknesses, available evidence is insufficient to confirm this conclusively, and this issue deserves deeper investigation.

With respect to electricity supply, **infrastructure does not appear to represent a binding constraint to growth.** Tucumán has one of the highest levels of net installed capacity in the country, which suggests that the system is capable of meeting provincial demand. However, as previously mentioned in this report, a detailed analysis of provincial electricity tariffs is needed to determine the actual cost of electricity for businesses.

On the other hand, in the area of water and sanitation, significant access issues persist. According to the 2022 National Census, Tucumán ranks among the provinces with the lowest coverage of both piped water and sewage networks, in addition to quality issues reported by firms in the World Bank Enterprise Survey. However, the sectoral analysis of water intensity does not indicate that more water-intensive activities have experienced relatively worse employment performance. This suggests that although there are deficiencies in service provision and quality, **there is no clear evidence that water constitutes an active constraint on economic growth at present.**

Regarding government failures, the province's effective tax burden is among the highest in the country and coincides with high levels of informality—**a clear indication that appropriability issues are a constraint for business activity in Tucumán.** Although the province's public debt levels are not high and show no worrying trend—reducing the risk of future tax increases—the existing tax structure appears to create disincentives for investment.

As for the institutional environment, the province performs well in public budget transparency indicators (ITPP), but poorly in those related to its political ecosystem (ICIP). Regarding regulatory quality, the financial and bureaucratic costs of starting a business appear relatively high in Tucumán. However, it would be desirable to have more recent data and to further investigate these aspects in order to draw more precise conclusions.

Insecurity also does not appear to be a major issue in the province. Although the robbery rate has increased over the last decade, the low levels of intentional homicides—together with the perceptions of local firms gathered by the WBES—suggest that insecurity does not constitute a significant obstacle to economic growth in Tucumán.

Finally, in terms of economic complexity, **Tucumán exhibits an unfavorable combination of current complexity and complexity outlook, which clearly points to a growth constraint.** This places the province in a precarious situation: its per capita income level does not appear to be supported by its current productive capabilities, while the opportunities to diversify and sustainably expand its productive base seem distant.

In conclusion, the main constraints to Tucumán's future economic growth and productive diversification appear to be associated with the scarcity of highly qualified human capital, the high effective tax burden, and the combination of low economic complexity and low complexity outlook.

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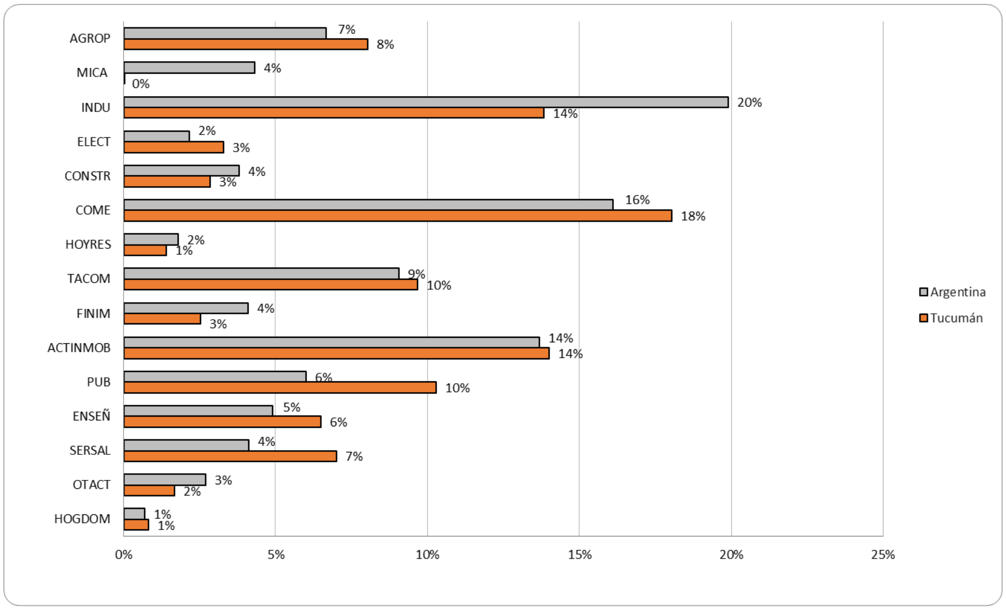
A Tables and Figures

Table A1: Summary of Literature Review

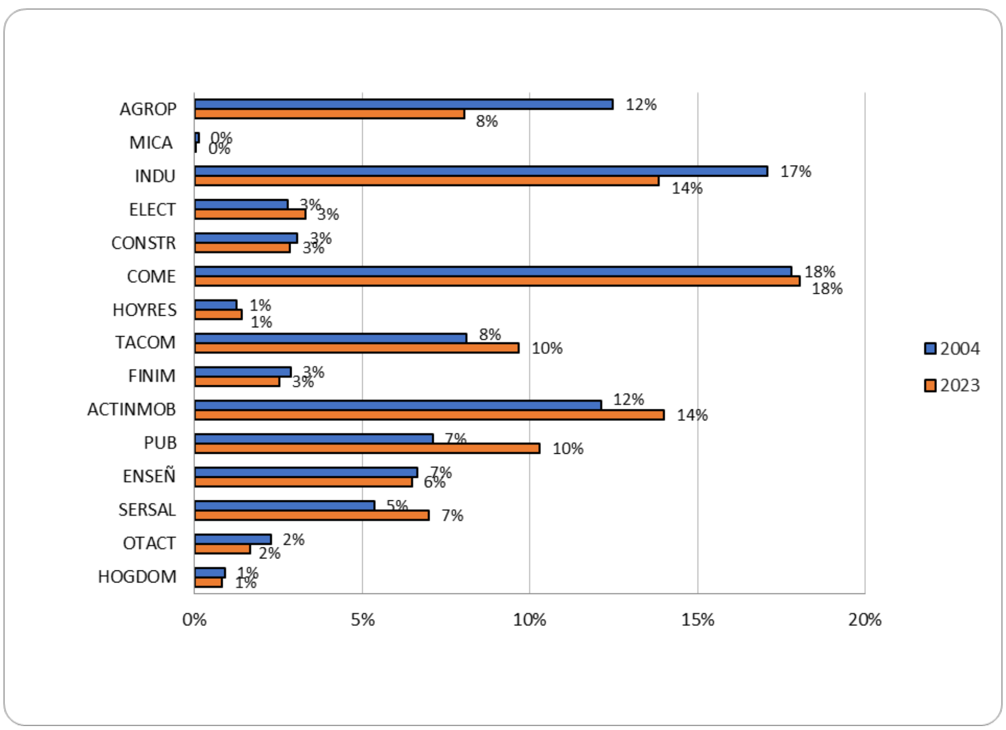
Autor/es	Año	Región	Economía	Restricciones identificadas
Hausmann et. al	2023	Kazajstán	Nacional	- Incertidumbre y volatilidad macroeconómica - Entorno microeconómico poco competitivo - Falta de diversificación hacia exportaciones no petroleras
Hausmann et. al	2022	Namibia	Nacional	- Baja complejidad económica - Escaso capital humano - Limitada inclusión financiera y empresarial
Cheston et. al	2021	Bolivia	Nacional	- Dependencia de renta gasífera y gasto público - Incertidumbre política - Bajo capital humano
Grisanti et. al	2020	Western Australia, Australia	Subnacional	- Baja complejidad económica - Escasez de capital humano - Lejanía geográfica y altos costos de transporte
Hausmann et. al	2020	Loreto, Perú	Subnacional	- Problemas de conectividad fluvial - Fallas de coordinación asociadas al proceso de "autodescubrimiento" - Provisión eléctrica ineficiente
Barrios et. al	2018	Tabasco, México	Subnacional	- Provisión deficiente de servicios públicos: agua y energía eléctrica. - Percepción de inseguridad elevada - Complejidad y pronóstico de complejidad económica bajos
Barrios et. al	2018	Campeche, México	Subnacional	- Provisión deficiente de servicios públicos: agua y energía eléctrica - Complejidad y pronóstico de complejidad económica bajos
Hausmann et. al	2018	Hermosillo, México	Subnacional	- Insuficiente provisión de servicios públicos - Sobrerrepresentación del sector público en el empleo - Baja inversión directa e inmigración
Sánchez et. al	2018	Oaxaca, México	Subnacional	- Escasa movilidad laboral - Incertidumbre institucional
Hausmann et. al	2018	Sri Lanka	Nacional	- Limitada diversificación de las exportaciones - Escasez de capital humano calificado
Barrios et. al	2018	Baja California, México	Subnacional	- Alta exposición a shocks externos - Falta de diversificación productiva - Inseguridad
Hausmann et. al	2016	Panamá	Nacional	- Escasez de mano de obra calificada - Políticas migratorias restrictivas - Alta corrupción y baja calidad regulatoria
Hausmann, Espinoza y Santos	2015	Chiapas, México	Subnacional	- Baja complejidad económica y diversificación productiva
Hausmann et. al	2014	Uganda	Nacional	- Bajo dinamismo exportador y diversificación económica
Castro, Rozemberg y Lotitto	2014	CABA, Argentina	Subnacional	- Deficiencias en la calificación del empleo y escasa vinculación entre el sistema educativo y los requerimientos empresariales - Ausencia de mecanismos de coordinación metropolitana - Baja profundidad del sistema financiero
Hausmann	2008	Brasil	Nacional	- Altos costos de financiamiento - Carga impositiva elevada - Infraestructura deficiente - Baja integración comercial y diversificación - Baja calidad institucional
Hausmann y Klinger	2008	Perú	Nacional	- Baja complejidad económica y falta de diversificación - Fallas de información y coordinación para desarrollar nuevos sectores - Limitaciones de capital humano calificado - Infraestructura insuficiente en áreas clave
Hausmann y Klinger	2007	Paraguay	Nacional	- Provisión de infraestructura ineficiente - Altos niveles de corrupción y baja calidad regulatoria
Hausmann y Klinger	2007	Belice	Nacional	- Bajos niveles de ahorro y acceso a financiamiento internacional limitado - Altos costos de financiamiento doméstico
Hausmann y Rodrik	2006	Marruecos	Nacional	- Rigideces laborales - Carga impositiva elevada - Baja flexibilidad macroeconómica - Sesgo anti-exportador debido a políticas proteccionistas
Hausmann y Rodrik	2005	El Salvador	Nacional	- Falta de diversificación productiva

Figure A1: Composition of Tucumán's GPP and National GDP, 2023



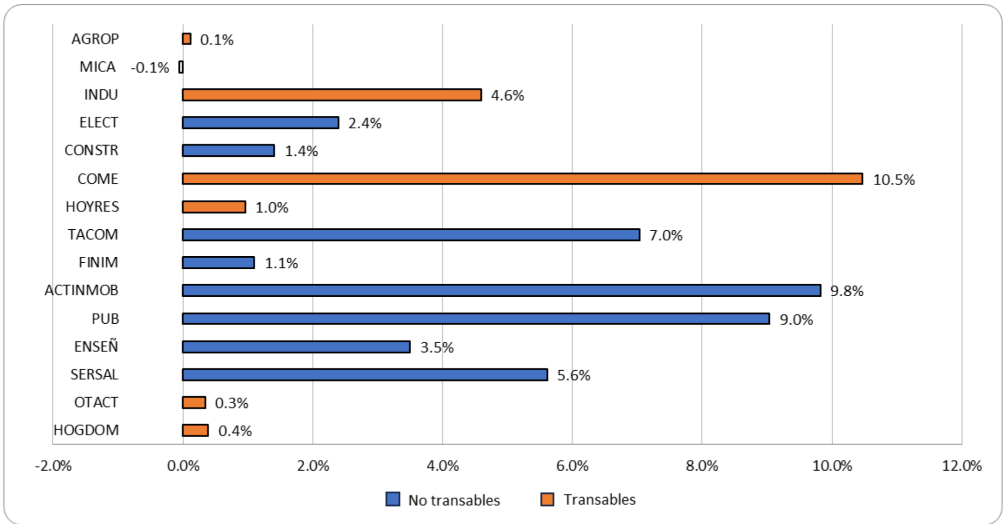
Source: CEPAL and INDEC

Figure A2: Changes in sectoral composition of GPP. 2004 vs 2023.



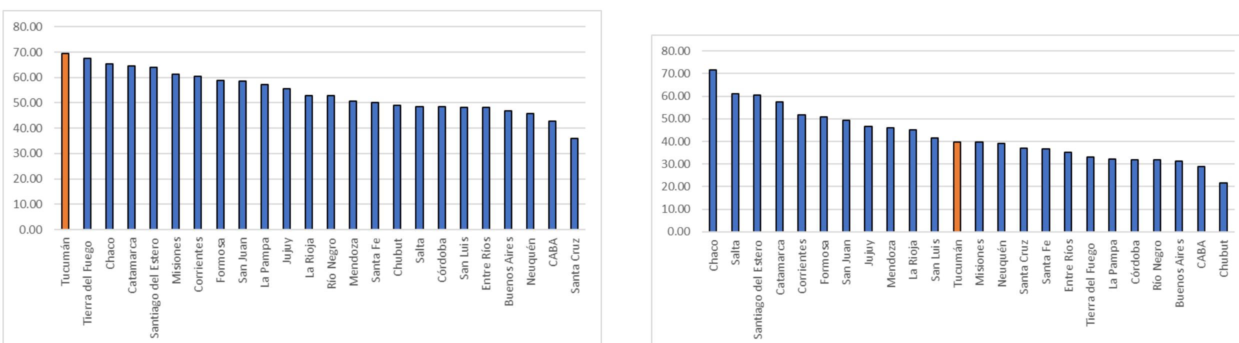
Source: CEPAL and INDEC

Figure A3: Sectoral contribution to Tucumán's GPP annual growth (in 2004 pesos). 2004–2023



Source: Own elaboration based on CEPAL and INDEC.

Figure A4: Percentage of students scoring "Below basic level" in the Aprender tests, by school type. Mathematics. Year 2024

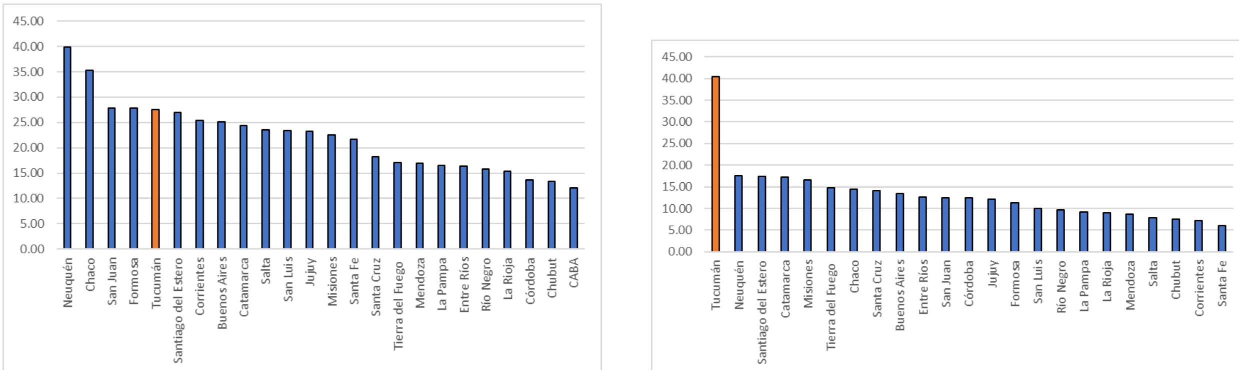


(a) Public

(b) Private

Source: Own elaboration based on Aprender test results.

Figure A5: Percentage of students scoring “Below basic level” in the Aprender tests, by school type. Language. Year 2024

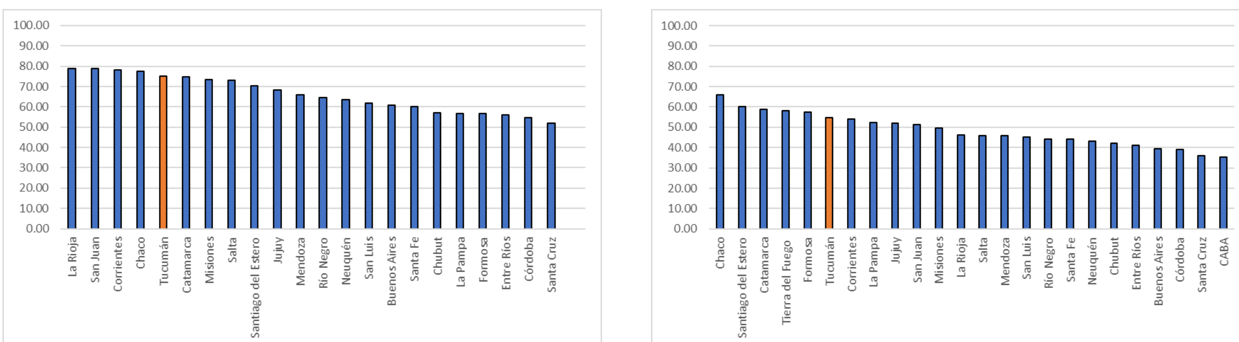


(a) Public

(b) Private

Source: Own elaboration based on Aprender test results.

Figure A6: Percentage of students scoring “Below basic level” in the Aprender tests, by location. Mathematics. Year 2024



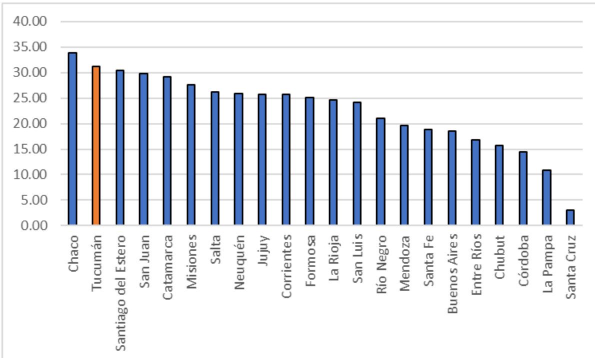
(a) Rural

(b) Urban

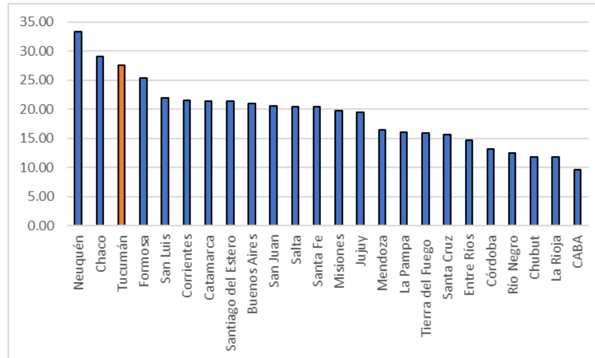
Note: Tierra del Fuego is not shown in the left chart due to a lack of data for rural schools.

Source: Own elaboration based on Aprender test results.

Figure A7: Percentage of students scoring “Below basic level” in the Aprender tests, by location. Language. Year 2024



(a) Rural



(b) Urban

Note: Tierra del Fuego is not shown in the left chart due to a lack of data for rural schools.

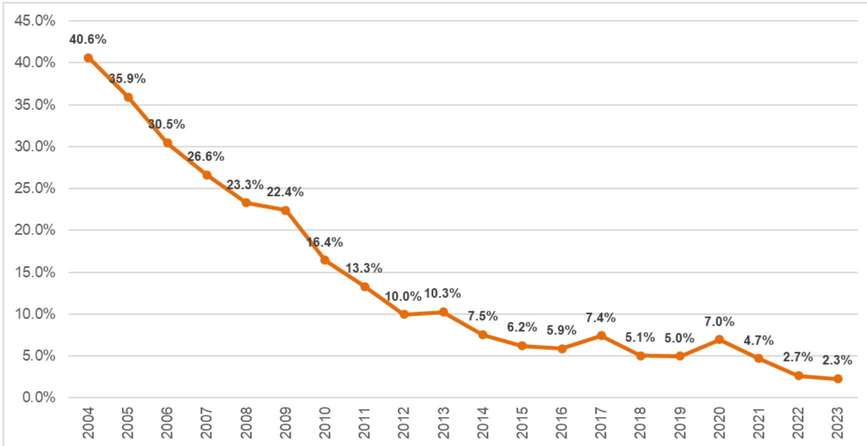
Source: Own elaboration based on Aprender test results.

Table A2: In the last fiscal year, did the establishment experience water supply cuts?

City	Yes	No	Don’t know
Buenos Aires	9%	82%	9%
Tucumán	33%	65%	2%
Rosario	8%	76%	16%
Mendoza	8%	77%	15%
Córdoba	3%	96%	1%

Source: Own elaboration based on World Bank Enterprise Survey data.

Figure A8: Evolution of public debt stock as a percentage of Tucumán's GPP. 2004–2023



Source: Dirección Nacional de Asuntos Provinciales.

B Methodological note

Methodological note: construction of the water use intensity measure and its linkage with employment

To calculate sectoral water use intensity, input-output tables published by the U.S. Bureau of Economic Analysis (BEA) were used. In particular, the direct consumption matrix was employed, which captures intermediate demand by industry for various commodities, expressed in millions of dollars.

Based on this, a relative intensity indicator was constructed, analogous to the revealed comparative advantage (RCA) index used in other growth diagnostics. Formally, the measure corresponds to the ratio between: (i) the share of water within the total intermediate consumption of industry i and (ii) the share of water in the total intermediate consumption of the economy:

$$RCA_i^{water} = \frac{\text{Water\_spending}_i/\text{Intermediate\_consumption}_i}{\text{Water\_spending}_{\text{total}}/\text{Intermediate\_consumption}_{\text{total}}} \tag{3}$$

Thus, a value greater than 1 indicates that the industry is relatively more water-intensive than the average of the economy.

From these matrices, a measure of water use intensity was derived for each industry, based on the share of this input in its intermediate consumption.

Then, sectoral reclassification was carried out to apply the indicator to the Argentine case. The NAICS 2017 codes used by the BEA were matched with the ISIC Rev. 3 codes (International Standard Industrial Classification, Revision 3), which are used by the Observatorio de Empleo y Dinámica Empresarial (OEDE). This correspondence enabled assigning a water intensity measure to each 4-digit sector in Argentina.

Finally, to assess the relative economic performance of sectors, the intensity measure was combined with OEDE employment data. Specifically, the intensity of each sector was weighted by its employment level in the base year (2004), and average annual employment growth rates were calculated for the 2004–2023 period. This allowed linking water use intensity with sectoral employment trends in Tucumán, to explore whether more water-intensive sectors exhibited different employment growth paths.