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The Reasons Behind Mexico's Slow Economic Growth: A Supply-Side Analysis, 1994–2034

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2) Project Summary

There is broad consensus that one of the main issues affecting the Mexican economy is its low growth rate and the multiple consequences that derive from it across all sectors. However, the causes of this phenomenon are not entirely clear (Loría *et al*., 2022).

The literature that contrasts the high growth rates of the 1960s and 1970s with those of the 1980s and beyond tends to overlook the structural adjustment that Mexico underwent due to the debt crisis, whose effects resulted in a decade of economic stagnation. During that extended period, significant structural changes have taken place.

As an example, since the mid-1990s, Mexico's productive orientation has undergone a radical transformation: from being an isolated country and mono-exporter of raw materials, it has become one of the most globally integrated economies—particularly with the United States—with which it shares intricate production chains that leverage key comparative advantages. This transformation has led Mexico to become an exporter of technically complex manufactured goods and an importer of food and energy products.

Mexico has experienced uneven development, both geographically and structurally. First, it is evident that the southeast presents the lowest growth rates and the poorest economic development indicators. Second, while the formal labor market represents only about 40% of the labor force, it accounts for 80% of total output.

In light of this reality, it is indisputable that the problem must be approached from a different perspective: that of aggregate supply.

This approach fundamentally shifts the analytical framework for studying Mexico's slow economic growth by focusing on the weak growth rates of productive factors—particularly labor—and on its average and marginal productivity. This allows for the use of previous and relevant findings regarding the analysis of labor markets.

It is easy to cast workers as victims by highlighting that the Mexican worker is among those with the fewest vacation days and the lowest wages compared to workers in OECD countries. However, it is also a fact that educational outcomes, as measured by the PISA test, demonstrate low academic performance among Mexican students, which will eventually translate into poor labor skills. Educational backwardness (reflected in the large share of the population with schooling below the upper secondary level or children and adolescents not attending school) is the highest among OECD countries. To this, one must add the inadequacy of Mexico's healthcare system, which was starkly exposed during the COVID-19 pandemic through the high number of excess deaths caused by overwhelmed hospitals.

Recently, the federal government announced the cancellation of official standards for the prevention, detection, diagnosis, treatment, and control of several conditions: systemic arterial hypertension, dyslipidemia, tuberculosis, leprosy, cholera, sexually transmitted infections, taeniasis/cysticercosis, human brucellosis, certain types of cancer, osteoporosis, among others, as reported in the Diario Oficial de la Federación (DOF: 01/06/2023). These conditions are closely related to morbidity and mortality among the Mexican population, and their deregulation will leave workers and their families vulnerable, ultimately affecting the health and quality of the labor force.

Health and education are highlighted because they constitute the pillars of human capital (Schultz, 1961). It has been taken as dogma that a large population is equivalent to a cheap labor force. However, the reality is that human capital is deficient, and no matter how low nominal wages may be, low productivity makes any wage level relatively expensive.

Labor policy has failed to consider the limited accumulation of human capital and its effects on labor costs as a pathway to increasing income and fostering growth; instead, it has focused on raising nominal wages.

The failure to consider the low quality of human capital was one of the reasons why the 2012 labor reform proved precarious and did not significantly boost economic growth (Loría and Salas, 2019). Although the reform reduced informality, the new jobs it generated were precarious, and consequently, economic growth did not accelerate.

In summary, this project aims to analyze how the poor quality of human capital is one of the primary explanations for Mexico's slow growth. This condition has hindered capital accumulation due to the lack of adequately trained personnel for its efficient use. In essence, what exists is a shortage in the supply of productive factors that accounts for the country's low growth.

3) Background

The most recent research projects—(1) "Sociedad y economía PostCOVID en México. Mercado laboral, pobreza, inequidad y lento crecimiento" (IN30802); (2) "Política monetaria y precarización del mercado laboral en México, una explicación alternativa al lento crecimiento 2000–2020" (IN300218); (3) "México: crecimiento, ciclos y precarización laboral 1980–2020" (IN-302514); and (4) "Recesión y mercados laborales en México. Un análisis estructural, 1985–2020" (IN305711)—have all been centered on analyzing the underlying causes of Mexico's slow economic growth. These systematic approaches have consistently identified the labor market as a central explanatory factor.

Analyzing growth determinants from the supply side seeks to address the oversimplification that characterizes conventional explanations for the country's stagnation. A clear example of this is the Plan Nacional de Desarrollo 2012–2018, which failed to account for the quality of

human capital, focusing solely on formal employment status. Loría et al. (2016) demonstrate that the main difference between the formal and informal sectors lies in the capital intensity of the production functions to which they are linked. Based on the hypothesis of deficient human capital, the newly created formal jobs did not accelerate capital absorption nor total factor productivity, as individuals were only incorporated into manual labor due to their limited training.

This condition resolves the apparent paradox posed by Loría and Robles (2020) regarding why the financial reform did not increase the rate of fixed capital accumulation (investment). Firms do not cease investing solely because of limited credit access, but also because they are unable to find personnel with the necessary skills to operate capital—especially high-tech capital.

Thus, the financial reform merely reduced financial costs by facilitating access to formal and more affordable financing for a subset of entrepreneurs, measured in terms of Total Annual Cost.

The hypothesis we propose is that deficiencies in human capital formation are the root cause of the slow growth of investment and, by extension, of the Mexican economy. In other words, the problem of slow growth lies in the inelastic supply of high-quality productive factors.

This approach will be explored through the analysis of production functions estimated using various quantitative economic methodologies.

To support our thesis, we draw upon two historically significant examples. The first is postwar Mexico, when President Cárdenas expanded access to basic education and shifted training costs from the private sector to the public sector. Given the state of technology and the rural-to-urban migration, the massive provision of basic education by the State enabled employers to access a labor force with minimum qualifications, requiring only supplementary training to be integrated into industrial work. This foundation of human capital helps justify the sustained growth of subsequent decades, as it enabled the absorption and effective use of new capital.

The second case is South Korea, a country with scarce natural resources and devastated by a brutal war during the 1950s. The Korean state prioritized the education of its population,

particularly in the hard sciences and technology, such that by the 21st century, it became a wealthy nation through technological exports led by major industrial conglomerates (chaebol) such as Samsung, KIA, and Hyundai.

Conversely, the case of Cuba illustrates a different trajectory. Despite official claims of providing high-quality education—particularly in health sciences—the political regime's inability to incorporate capital has relegated the country to persistent impoverishment.

This analytical framework based on production functions will enable us to contrast the marginal contributions of different segments of the labor market (men and women, formal and informal workers, labor precariousness and flexibility, etc.) and assess the effects of current social welfare policies promoted by the government. For instance, if the new labor reform increases labor costs by extending vacation days and reducing working hours, it is reasonable to expect a rise in informality, as firms will be unwilling to absorb the additional costs without corresponding gains in productivity.

This outcome is explained through a dualist view of informality, in which informality emerges as a cost-reduction strategy by firms. As a result, companies will employ more informal labor, and the benefits of the reform will be concentrated among the most productive workers—ultimately exacerbating the inequality that the reform originally sought to reduce.

4) Project Contribution

The contribution of the project lies in econometrically estimating the marginal contributions of each factor to provide a reasonable explanation for the current causes of slow growth.

This new approach will require a completely novel quantitative approximation. In addition to long-term estimations, we will focus on short- and medium-term effects and responses. For this purpose, we add Bayesian estimation approaches to structural change models, allowing estimation with minimal sample sizes (a single period) to more precisely analyze the phenomena.

This new approach results from the experience we have acquired in the area through the application of historical variance decomposition analysis which, for example, in Loría and Salas (2023), allowed us to detect that the inflationary outbreak experienced by Mexico since

2021 had a completely different nature—specifically, it was due to "inflationary contamination" from the United States.

In summary, addressing the inflationary issue from a more conjunctural approach helped us to provide a better explanation of the nature of this inflationary surge—something that would have been impossible had we continued with a more structural analysis.

For this reason, we intend to incorporate novel econometric approaches and techniques such as the Time Varying Vector Autoregressive (TVAR) and to explore the use of the DSGE methodology, which enables statistically robust analysis with economic interpretability.

Regarding DSGE, we note that Bernanke and Blanchard (2023) modified the rigid theoretical framework and, with a theoretical approach based on five equations, used labor market conditions to explain wage formation and inflation dynamics in the United States.

Likewise, we will apply our experience in analyzing the Mexican labor market to test secondary hypotheses derived from considering the vicious circle in which precarious working conditions condition poverty, and that poverty permeates into educational lag, which in turn reduces productivity, thereby reinforcing precarious employment.

This hypothesis, derived from the estimation of production functions, accounts for qualitative differences among various types of human and physical capital, and it will be possible to consider the real contributions of investment in health and education that help explain the formation (or lack thereof) of high-quality human capital. That is the only way to raise long-term growth capacity.

To expand the scope of the results, in addition to publishing papers and presenting at specialized forums, we plan to develop a comprehensive dissemination strategy. As a first point, throughout the duration of this project, we will align all meetings of the Centro de Modelística y Pronósticos Económicos (CEMPE) [http://www.economia.unam.mx/cempe/index.htm] with the theme of the project. This will allow us to contrast the perspectives emerging from this project with the solid opinions of other experts, fostering the knowledge creation process based on hypotheses, theses, and antitheses.

These meetings are hybrid (in-person and online), allowing us to reach a broader audience through online dissemination. However, due to their length and density of content, we have developed a three-point strategy to create more digestible content: a) First, we will create "short" videos addressing only one topic in less than two minutes; b) Second, we will design infographics to visually express complex relationships (for successful development, we will expand the social service program to attract visual arts students); c) Lastly, we plan to produce a highly accessible podcast. To this end, we will experiment with software such as GarageBand, Zencastr, Adobe Audition, Auphonic, Voicemeeter Banana, Ivoox, Spreaker, Audacity, PodBean, and Talkshoe.

5) Hypotheses

1. Central Hypothesis of the Project

The core hypothesis of this project is that Mexico's slow economic growth is the result of its inability to rapidly accumulate capital—particularly high-technology capital—due to the inelastic supply of high-quality human capital. This hypothesis is analyzed from the perspective of Schultz (1961), who conceptualizes human capital as the set of conditions and aptitudes that enable individuals to integrate into the economy with high productivity, based on their health and education.

2. Hypothesis 2: Lack of High-Quality Human Capital

Health coverage and quality conditions in Mexico are deficient, have deteriorated, and are likely to worsen further following the repeal of official health standards. This was clearly demonstrated during the COVID-19 pandemic and with the dissolution of the Instituto de Salud para el Bienestar (INSABI), which was intended to replace the Seguro Popular and has now shifted responsibility to the IMSS, an institution facing technical insolvency. In addition, the counter-reform in education implemented at the beginning of the current administration will inevitably have detrimental effects on human capital. Educational performance remains poor, as reflected in the results of Mexican students on the PISA assessment.

The limited coverage of upper secondary and tertiary education, along with significant educational lag among the lower strata of society, contributes to the overall low marginal productivity of labor.

3. Hypothesis 3: Low Productivity Associated with Poor Human Capital Quality

Low labor productivity leads to low wages, labor precariousness, working poverty, and a high propensity toward informality—conditions that collectively generate severe social exclusion. This is because the limited income resulting from social disadvantage only permits participation in low-wage, poverty-linked economic activities.

Conditions of poverty and marginalization prevent families from investing in education, as they rationally choose to allocate most of their income to immediate consumption rather than to long-term human capital development. This creates a vicious cycle that can be analyzed through a supply-side perspective.

Ultimately, this situation leads to a societal dynamic in which, due to the poverty trap, substantial resources are allocated to low-productivity activities. This explains the country's low growth rate and the heterogeneity between social strata that can afford to invest in education and healthcare and those that cannot.

These hypotheses require an analytical approach that focuses on the supply side of the Mexican economy and allows for the dynamic examination of changes over time.

6) Objetives

Main Objective

To identify the determinants of slow economic growth from the supply side, rather than from the demand side, which has traditionally been the prevailing approach. There is a body of literature that attributes the lack of growth to insufficient public investment, particularly in infrastructure, given that such investment tends to reduce transaction costs and encourage private investment, thereby fostering economic growth.

We believe that these infrastructure projects often contribute only to short-term growth due to their impact on aggregate demand and the direct and indirect employment they generate during construction. However, their potential to attract long-term investment is frequently overestimated, as these projects often fail to address local needs. For example, the construction of a refinery in the southeast is unlikely to trigger sustainable growth because the region lacks the specialized workforce needed to operate it. This is due to the low quality

of higher education institutions in the area, which will likely necessitate bringing in technical operators from other regions. Furthermore, the region's limited supply of high-skilled human capital makes it improbable that it will generate the supply chain businesses required for the infrastructure project to operate efficiently and profitably. As a result, its products will face elevated costs and underutilization—an ongoing issue for Pemex, which, according to IMCO (2021), had over 50% idle installed refining capacity even before the launch of the new refinery.

Secondary Objective 1

To determine the productivity levels of different subsets of the workforce in Mexico. To illustrate this point, there are substantial differences in productivity across regions, between formal and informal workers, and among individuals with different educational profiles—especially those trained in hard sciences versus those in regions or professions where traditional or qualitative knowledge predominates.

Secondary Objective 2

To analyze, through the lens of human capital theory, the relationship between the provision of public goods (such as education, health, infrastructure, etc.) and labor productivity. This point is essential for formulating economic policy recommendations regarding public spending priorities. In particular, we aim to critically assess the potential benefits of social spending involving direct resource transfers to the most disadvantaged populations, against the potential risk of creating perverse incentives that could entrench poverty.

In contrast, we will examine the implications of a social investment approach that seeks to provide health and education services to individuals experiencing deprivation in these areas. For instance, our proposal will evaluate the benefits of awarding a scholarship to a girl facing social disadvantages as a means to encourage school attendance—despite the risk that she may attend solely to meet the scholarship requirements without actually learning. Alternatively, we propose investing in a health center that would provide her with medical services, enabling her parents to envision a future for her (as she would not die from a preventable illness). This outlook could, in turn, motivate them to send her to school so she

can pursue a better future—also driven by the income effect stemming from the family no longer needing to bear healthcare costs.

7) Annual Goals

In general, for each of the three years, we propose: a) the preparation of two scientific articles to be submitted to high-impact indexed journals, b) participation in one international conference and three national conferences for the presentation of findings and reception of feedback, c) the use and integration of new econometric software packages, particularly those designed for nonlinear analysis.

First Year: Graduation of one student from a specialization program and one undergraduate student. Additionally, we aim to incorporate one doctoral student and one postdoctoral researcher into the project. A macroeconomics textbook will be published, integrating the outputs and advancements of the project.

Second Year: Graduation of three students from specialization programs and two undergraduate students. Launch of a podcast for public dissemination of the project's findings.

Third Year: Graduation of three students from specialization programs and one master's student.

8) Strategy and Methods

Traditional econometrics seeks to identify regularities within the largest samples possible under the assumption of parameter constancy. This provides the basis for the initial modeling approaches built on linear relationships. However, based on the findings of the current project, this assumption of linearity and constancy is no longer sustainable.

Maintaining the need to estimate under the assumption of linearity—implying, in simple terms, that the estimated parameters describing the relationship between variables are restricted to a maximum exponent of one—would significantly limit the explanatory capacity of the models. This would lead to one of two scenarios: a) the estimation samples would need to exclude the most recent observations, or b) the models would be estimated with a very limited number of observations pertaining only to recent events.

For the purposes of this project, neither option is acceptable, as both would prevent a meaningful analysis of the deep structural transformations that labor markets have undergone and their broader implications on economic growth, poverty, inequality, and labor precariousness.

Therefore, it is imperative to adopt nonlinear models capable of addressing: a) the presence of multiple regimes, and b) the insufficient degrees of freedom caused by "restricting" the sample to the specific periods during which such regimes occur.

In the previous project, we experimented with several nonlinear estimation techniques, which has now expanded our toolkit to effectively address the ongoing structural changes. First, we rely on threshold models that allow for estimation with large samples. Within this methodological framework, we identify three specifications.

The first is based on regime changes triggered by threshold levels in a given variable—essentially extending the Box-Jenkins time series methodology to include regime-switching capabilities. To test this, we initiated a study on relative ethnic unemployment in the United States, which affects remittances sent to Mexico. This method revealed that the convergence between Latino and White unemployment rates accelerates when their ratio falls below a certain threshold, and once surpassed, the rates diverge. Beyond identifying the specific threshold, we also analyzed the labor market conditions in the U.S. that generate this phenomenon.

We have also applied this approach within structural models, particularly in the study of public finances. This was achieved using a custom-built algorithm that identified the critical value of the Financial Cost of Public Debt that slows down economic growth. The econometric packages we have recently incorporated enable automatic threshold detection in relationships involving both stationary and non-stationary variables. Specifically, the Non-Linear Autoregressive Distributed Lag (NARDL) model allows us to combine different integration orders, while the Threshold Structural Vector Autoregression (TSVAR) enables nonlinear structural analysis from a systems perspective, consistent with the state of the art in macroeconometric modeling.

While this latter methodology is highly promising, it also presents limitations. Although it allows for structural analysis, it remains grounded in a frequentist framework that demands relatively large samples and involves estimating a large number of parameters, potentially reducing efficiency at the margin.

We propose to incorporate two methodological advancements: the Bayesian approach and artificial intelligence. These allow for the inclusion of a priori information on the variables, which traditional frequentist VAR models do not accommodate.

Introducing a priori information—such as integration order and intrinsic characteristics of the variables—drastically reduces the required sample size for robust estimation and helps to overcome cointegration constraints, which by nature assume a single regime and hinder nonlinear analysis.

This incorporation is achieved through the minimization of a likelihood function that combines the set of available information. By conducting this process ad hoc, it becomes possible to obtain a globally optimal estimator guided by exogenous values within the optimization procedure.

It is important to note that the likelihood function assumes a specific prior structure in the variable relationships, with hyperparameters initially treated as time-invariant constants under the approach of Litterman (1986). Although groundbreaking, Litterman's (1986) framework raises the question: Are the prior values constant over time? Contemporary evidence suggests they are not. While such a restriction might have been valid in the 1980s, the 21st century offers an opportunity to integrate nonlinearity into this framework.

Even if historical values and chosen priors remain fixed, changes in hyperparameters—typically modeling integration order and interdependence—lead to aggregate variations that affect the in-sample forecast. Initially, hyperparameter values may be justified based on forecast performance, yet they would still represent a single set.

With artificial intelligence, however, an algorithm trained on sample data can "select" the optimal parameters for each case, minimizing forecast error variance. Manually selecting hyperparameters for each subsample is impractical due to the high probability of human error. Thus, intensive computing enables a modeling strategy that minimizes the need for degrees

of freedom and allows the hyperparameters to be optimized in each period, transparently and without subjective bias.

This approach elevates the importance of impulse-response analysis and variance decomposition, as these tools uncover the underlying dynamics between variables. The Time-Varying Vector Autoregression (TV-VAR) framework enables more nuanced insights, and in the context of nonlinear but frequentist modeling, Historical Variance Decomposition provides further depth for introspective analysis.

While these are the most cutting-edge methodologies to be implemented, we have also adapted a Categorical Regression algorithm from microeconometric approaches. This method has proven highly effective in modeling qualitative regime changes—such as legal reforms. It was instrumental in identifying the impoverishing effects of the labor reform and the inability of the financial reform to foster capital accumulation, leading to several publications.

Although regime shifts do occur, regimes are not infinite. It is plausible, for instance, to transition from a "high formalization" regime to one of "low formalization." If we assume that such regimes are mutually exclusive yet jointly exhaustive, it becomes essential to determine the duration of each regime and the probability of transitioning between them. To address this, we have conducted estimations based on Markov Chains, which provide answers to these key questions.

Lastly, given the project's supply-side focus, it is most appropriate to analyze a production function and its potential disturbances from a quantitative perspective. For this reason, we intend to apply a theoretically grounded and data-consistent quantitative approach. In this context, we aim to implement general equilibrium models, of which there are two main types: Computable General Equilibrium (CGE) models and Dynamic Stochastic General Equilibrium (DSGE) models. Both are used in theoretical and policy settings to analyze the impact of structural changes on economic equilibrium.

CGE models, being the simpler of the two and with a longer history, have been widely applied to practical policy questions such as the effects of trade agreements. These models compare static equilibrium states, assumed to meet all equilibrium conditions, and are "calibrated"

using parameter values that reflect the real economy at a specific point in time. They are then adjusted—e.g., to model a price change from a free trade agreement—and the new equilibrium is compared to the original.

DSGE models also assume a stationary state equilibrium but allow for real-time dynamics and stochastic shocks on the path toward that equilibrium. This significantly enhances their coherence in terms of scientific philosophy: unlike CGE models, which are calibrated at a single point and lack flexibility to address uncertainty or model fit, DSGE parameters can be estimated from historical data and expressed as probability distributions rather than fixed points. These parameters are typically estimated using Bayesian methods, which is why we favor this approach.

We aim to estimate the differentiated effect of human capital on output by segmenting the production function in the style of Lewis, A. (1968), Reflections on Unlimited Labour, Development Research Project, Woodrow Wilson School Discussion Paper 5 (October).

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