REPUBLIC OF SLOVENIA

SELECTED ISSUES

May 2024

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REPUBLIC OF SLOVENIA

SELECTED ISSUES

April 10, 2024

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CONTENTS

BOOSTING PRODUCTIVITY IN SLOVENIA

Slovenia's convergence to the EU average income level has slowed since the Global Financial Crisis (GFC). Since the scope for future labor contributions to growth in Slovenia is limited for demographic reasons—apart from further improvements to labor quality—the focus of economic growth policies should be on reinvigorating private investment, which has been low over the past decade, and pursuing labor and product market reforms that boost total factor productivity growth.

A.   Introduction

1.   Starting transition with relatively high income, Slovenia converged even closer to the EU average ahead of the GFC, but convergence has slowed since. Slovenia had one o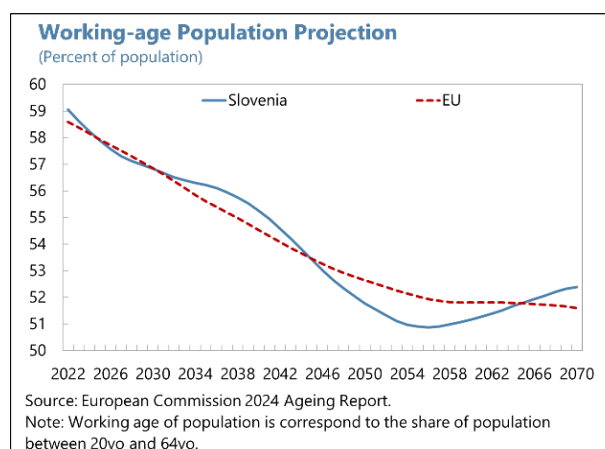f the highest per capita incomes in Central and Eastern Europe after gaining independence. Strong growth performance in the years leading up to and after joining the European Union (EU) in 2004 ensured steady convergence of income levels. Between 1995 and 2008, the income gap relative to the EU average narrowed by 14 percentage points to less than 10 percent, the lowest among new EU member states. The GFC and the subsequent banking crisis in Slovenia in 2013 had, however, a major negative impact on economic activity and reversed many of the gains from the previous decade. Convergence resumed in 2016 but as of 2022, relative income per capita was still below the earlier peak.

GDP Per Capita in Purchasing Power Standards
(EU27=100)

Source: Eurostat.
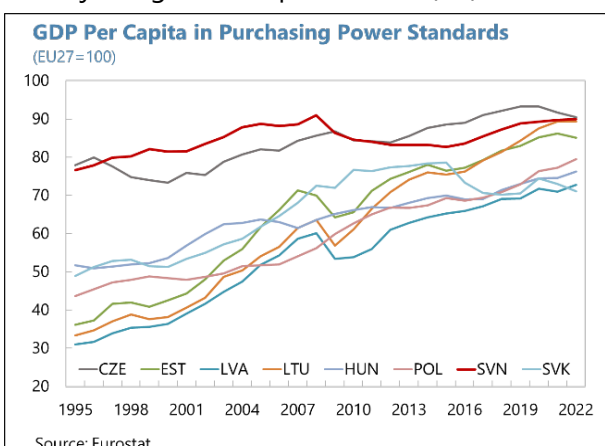
2.   Boosting productivity is essential for Slovenia to accelerate growth convergence and is the focus of this Selected Issues Paper. Slovenia's ageing population sets a constraint on the contribution of labor to GDP in the long run. Sustained increases in income and living standards can, therefore, only be achieved through investment in physical and human capital and, more importantly, through enhancing productivity, historically the key growth driver. This paper summarizes historical trends in growth and productivity in Slovenia (Section B), examines the country's strengths and weaknesses in terms of key factors affecting productivity identified in the literature (Section C), and presents conclusions and initial policy implications (Section D).

Working-age Population Projection
(Percent of population)

Source: European Commission 2024 Ageing Report.
Note: Working age of population is correspond to the share of population between 20yo and 64yo.

B.   Growth and Productivity Trends

3.   The composition of growth in Slovenia has changed markedly over the last two decades. In the years prior to and immediately following EU accession, growth in Slovenia was driven by strong capital accumulation and rapid total factor productivity (TFP) growth. This reflected in turn strong investment activity, including FDI inflows. Labor contributed very little to growth in this earlier period, unlike in other EU countries, where the contribution of the various factors was more balanced. The growth composition in Slovenia changed markedly after the GFC as low public and especially private investment saw capital make negative contributions to growth, while labor played a positive role during this period. TFP remained an important driver of GDP growth, apart from during 2008–13, with this strong overall role likely reflecting technological improvements and efficiency gains from past investment, as well as higher factor utilization and reforms. In recent years, however, TFP growth has slowed which, along with the declining capital intensity, has affected labor productivity.[1] Staff's shift-share analysis (Annex I) offers insights into the sectoral distribution of labor productivity and the extent to which reallocation of labor has occurred from less to more productive activities.

Figure 1. Slovenia GDP and EU Growth Composition, 1997–2022

SVN: GDP Growth
(Period average, percent year on year and percentage points)

Sources: Haver Analytics, Eurostat and IMF staff calculations.

EU: GDP Growth
(Period average, percent year on year and percentage points)

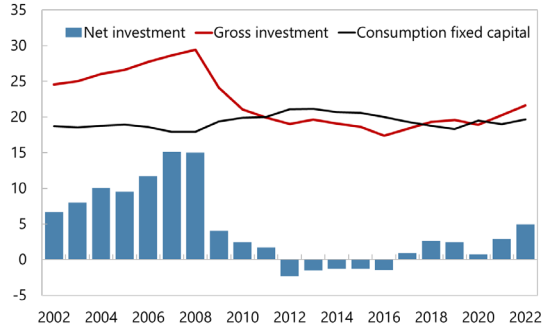Sources: Haver Analytics, Eurostat and IMF staff calculations.

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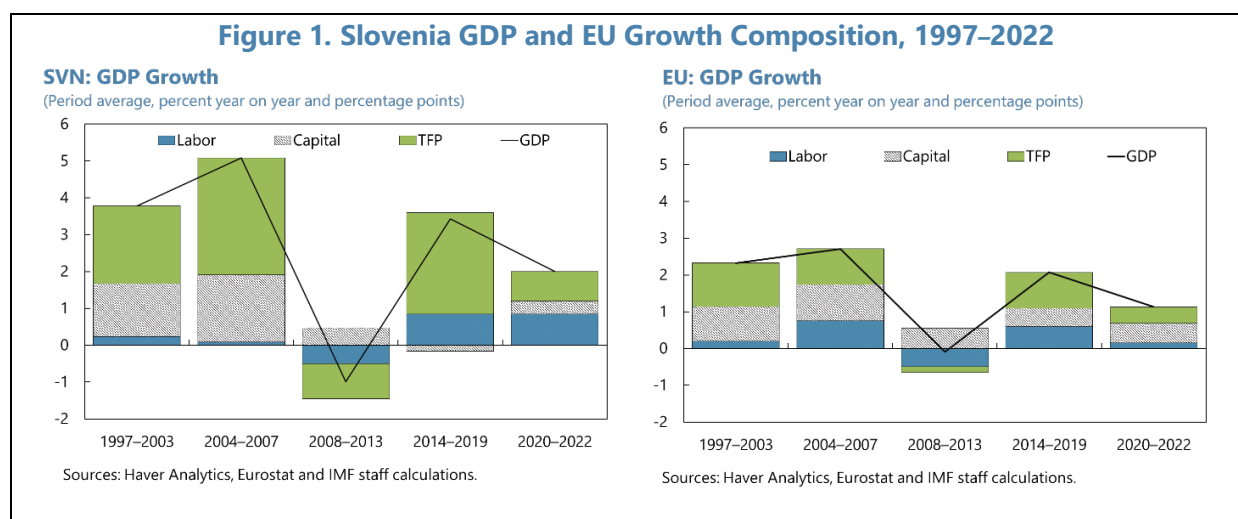
[1] In the case of a Cobb-Douglas production function, the growth in output per worker can be represented as the sum of TFP growth and capital intensity multiplied by the share of capital.

Figure 2. Slovenia: Investment and Capital Stock

Investment lagged depreciation after the GFC lowering the capital stock...

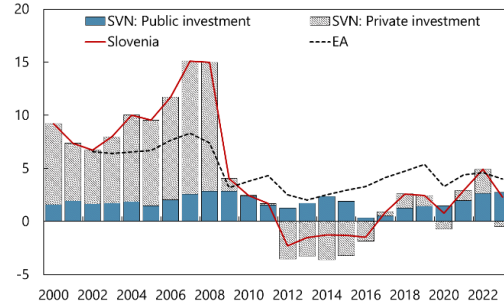**Non Financial Investment (Net)**
(Percent of GDP)

Sources: Eurosat, Haver Analytics and IMF staff calculations.

...led by private investment declines.

Net Investment
(Percent of GDP)

Sources: Haver Analytics, Eurostat and IMF staff calculations.

Capital stock has still not recovered to its earlier peak...

Capital Stock
(Percent of GDP)
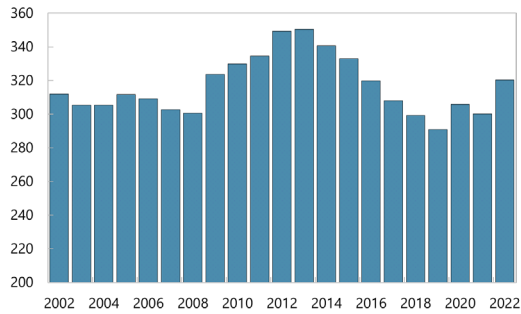
Sources: Haver Analytics, AMECO and IMF staff calculations.

...but is on an upward trend.

Capital Stock
(Percent of GDP)
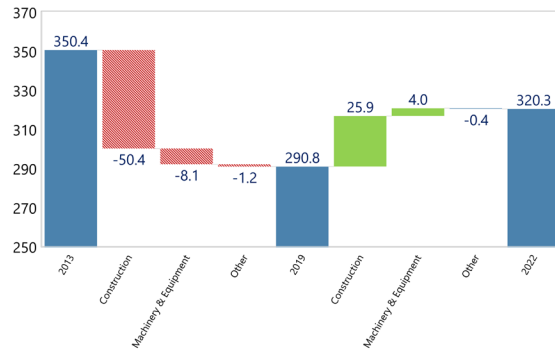
Capital intensity fell in Slovenia...

Capital Intensity
(Index, 1995=100)

Sources: Haver Analytics, European Commission and IMF staff calculations.

...and the capital stock per worker is low.

Capital Intensity
(Index, EA=100)
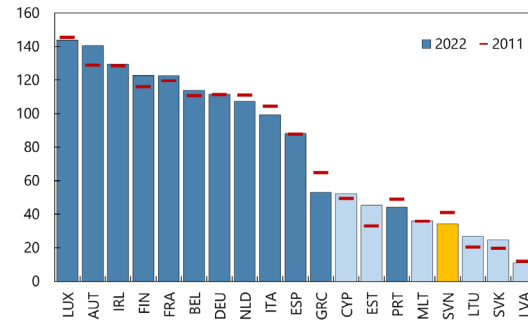
Sources: Haver Analytics, Eurostat and IMF staff calculations.

Figure 3. Slovenia: Labor Market Indicators

Recent labor contributions to growth reflect rising activity and falling unemployment...

Employment and Unemployment
(Thousand persons)

...while average hours worked have declined as in other EU countries.

Average Hours Worked per Week
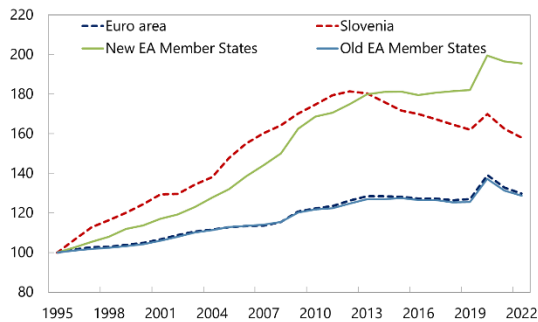(Number of hours)

Sources: Haver Analytics and IMF staff calculations.
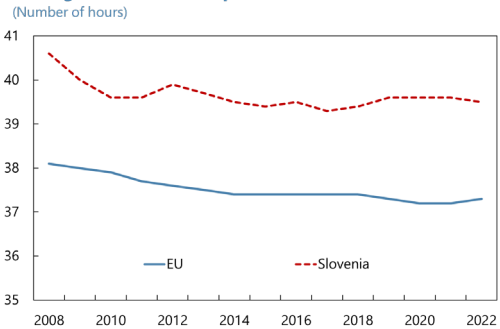
Source: Eurostat.

The overall activity rate in Slovenia is above the EU average...

Activity Rate
(Percent of population)
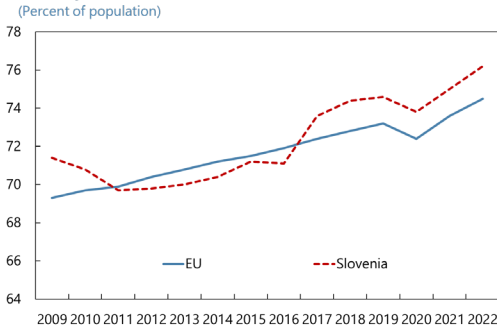
...although it is lower in the age groups 20–24 and 60–64.

Difference in Activity Rates by Age Group (Slovenia - EU)
(Percentage points)

Source: Eurostat.
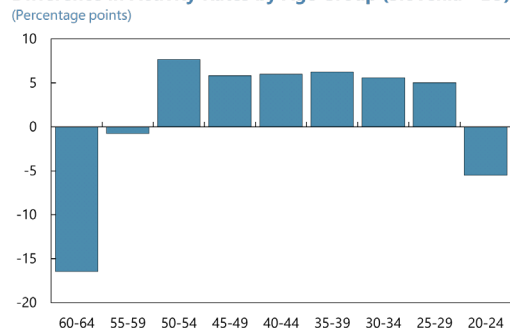
Sources: Haver Analytics and IMF staff calculations.

An increasing inflow of foreign workers is helping to ease demographic constraints...

Net Inflow of Foreign Workers
(Percent of the labor force)
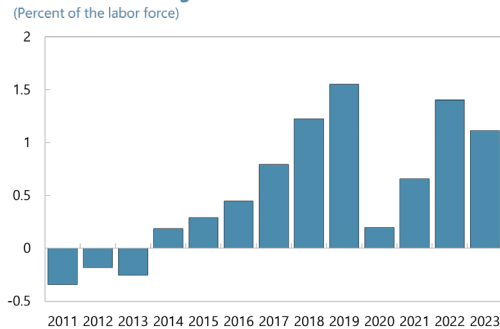
...and the share of foreign workers in total is increasing.

Foreign Employment in Slovenia
(Percent of total)

Sources: SURS and IMF staff calculations.
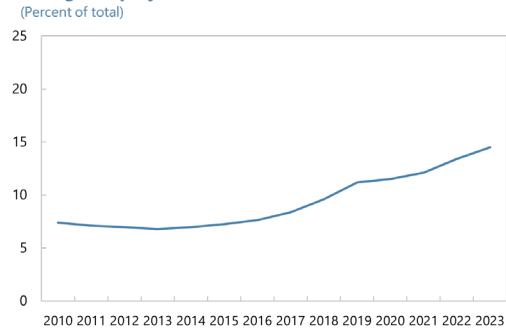
Sources: SURS and IMF staff calculations.

Figure 4. Slovenia: Productivity Trends

TFP growth has slowed in recent years, similar to EU peers...

...and labor productivity has also fallen.
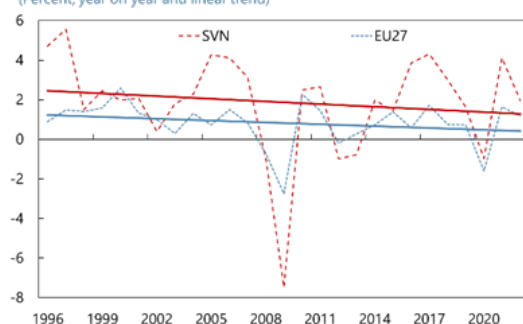
Sources: EC AMECO and IMF staff calculations.
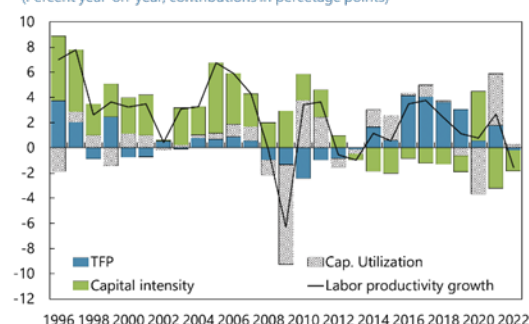
Sources: Haver Analytics, AMECO and IMF staff calculations.

C. Looking Ahead: Challenges and Opportunities

4.   Productivity is determined by the interaction of firm-specific and external factors. Dieppe (2021) examines a range of variables associated with long-term productivity growth and finds that key drivers include investment in physical capital and innovation, education and labor force quality, a supportive environment (institutions, infrastructure, polices), and firm-specific characteristics, including investment in new technologies and R&D, training of staff, improved business processes and management practices. ECB (2021) analyzes the TFP dynamics of EU countries and concludes that labor regulations, ICT patenting, financial openness and the tax structure help explain cross-country differences in productivity. Some of the key determinants of productivity identified in the literature and Slovenia's performance are discussed below and grouped into four categories: (i) firm-specific characteristics related to a company's ability to innovate and grow; (ii) innovation and physical capital; (iii) labor force quality; and (iv) supportive environment. IMAD (2023) provides granular analysis on Slovenia's strengths and weaknesses in key areas related to productivity, as well as policy recommendations to address remaining deficiencies.

C.1. Evidence from Firm-level Data: What Features Matter for Productivity?

5.   Staff uses firm-level analysis below to investigate firm characteristics that impact productivity. The analysis employs data for a selection of European countries from Eurostat's structural business statistics, the EBRD/World Bank Business Environment and Enterprise Performance Survey (BEEPS), and the Orbis Bureau Van Dijk (BvD) database.[2] The Orbis BvD database encompasses a large number of enterprises that are registered with the business registry

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[2] Orbis Bureau Van Dijk data have been processed by the International Monetary Fund's Research Department, as documented by Díez et al. (2021). In particular, the production function is estimated at the industry-level across countries (mainly OECD) in line with Ackerberg, Caves, and Frazer (2015) method. As noted in De Loecker and Collard-Wexler (2016), measurement error in inputs may lead to an overestimation of TFP. The database's limitations, including the dependence on revenue data and the inadequate representation of smaller firms in the sample, require caution in interpreting the findings. This issue is particularly pronounced for firms engaged in services activities.

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and thus provides a comprehensive representation of the dynamics within the business sector, as supported by the findings of Gopinath et al. (2017).

Firms Size

6. **Slovenian firms tend to be smaller than in EU peer countries.** The prevalence of small and micro firms is high in Slovenia compared to other European countries which reflects Slovenia's small size and likely also reflects a culture of family-owned.

Figure 5. Slovenia: Employment and Firm Size

Sources: Eurostat's Structural Business Statistics and IMF staff calculations.
Notes: Large enterprises correspond to firms with mroe than 250 employees.
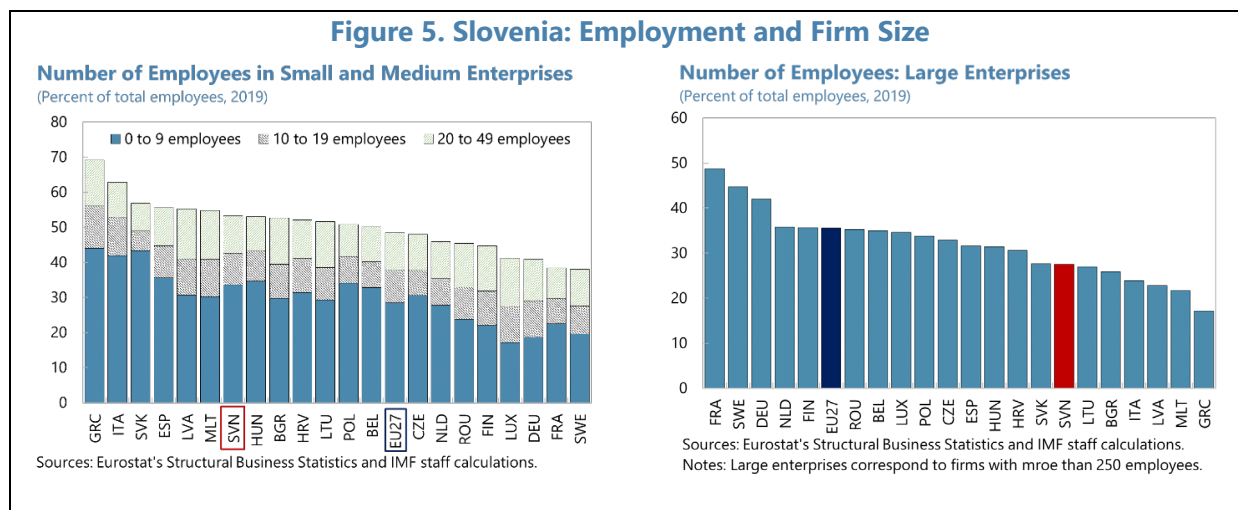
7. **Smaller firms tend to be less productive.** Generally, firms with more employees are closer to the TFP frontier, as they benefit from economies of scale and a richer set of available resources, knowledge and experience, and invest more in information technology and R&D. This in turn can raise TFP through improvements in product quality and production processes within firms (Goldberg et al. 2010), in particular for firms engaged in the production of goods. World Bank (2021) estimates that the productivity of a firm in the highest quartile of the size distribution is about 12 percent and 22 percent closer to the output and value added TFP frontiers, respectively relative to a firm in the lowest quartile of the distribution.

Labor Productivity per Firm Size
(Value added per employees)

Sources: Eurostat and IMF staff calculations.

8   INTERNATIONAL MONETARY FUND
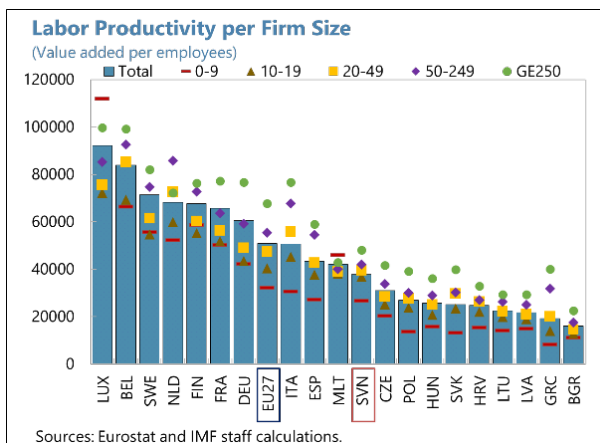
Figure 6. Slovenia: TFP, Investment and Firms Size

Selected Countries: TFP Path per Firm Size
(Mean across firm, 2006=100)

Sources: Chen and Le, 2023. "Small and Vulnerable: Small Firm Productivity in the Great Productivity Slowdown." Notes: This figure plots the average firm-level TFP for SMEs and large firms calculated from the Orbis database. The TFP level in 2006 is normalized to 100. The vertical axis represents the TFP level relative to the base year (%).

TFP Path per Firm Size
(Mean across firm, 2006=100)

Sources: Orbis and IMF staff calculations.

Slovenia: Intangible ratio, per firm size
(Mean across firm, Percent)

Sources: ORBIS

Business R&D Expenditure by Firm Size
(Share of total Business R&D)

Sources: OECD and IMF staff calculations.

8. **Firm size is shaped by a variety of factors including market size, institutional frameworks, tax regimes, and labor market regulations.** Typically, larger markets facilitate bigger firms. Rajan and Zingales (2001) and La Porta et al. (1998) emphasize the importance of robust legal institutions in safeguarding entrepreneurs and investors, which results in deeper capital markets and firm expansion. Moreover, stringent labor market regulations may hinder productivity by limiting labor market flexibility and the effective allocation and utilization of labor resources.

Biggest Obstacle Affecting The Establishment Operation
(Percent)

Source: BEEPS survey.

Access to Finance

9. **A survey of Slovenian firms does not appear to indicate major issues with access to financial institutions.** Access to finance, particularly for small and medium enterprises (SMEs) and startups, is crucial for productivity and growth as it allows firms to invest in new technologies and expand operations. Beck, Demirgüç-Kunt, and Maksimovic (2005) found that financial access

Reasons for Not Applying for New Loans: Small Firms
(Percent)

Sources: BEEPS and IMF staff calculations.
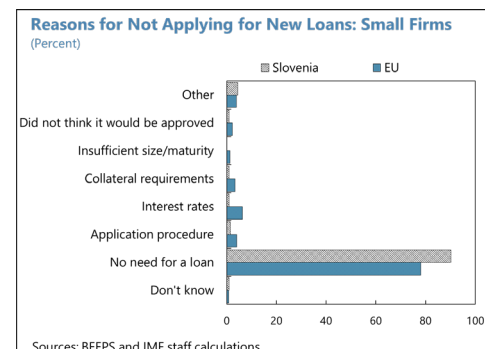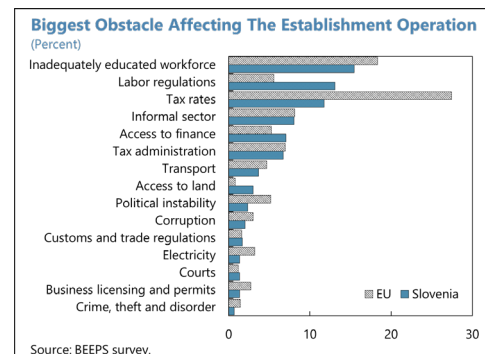
limitations hinder firm growth. Based on the BEEPS results, Slovenian firms are more likely to secure a credit line or loan from financial institutions than EU peers and a larger share of financing in Slovenia comes from state-owned banks or government agencies. This is likely helped by the pivotal role of SID Bank (a state-owned development bank) and the Slovene Enterprise Fund (Public Fund of the Republic of Slovenia for Entrepreneurship in facilitating SMEs access to funding in Slovenia. As of end-2022, SID Bank's loans to non-bank customers amounted to €1.4 billion, representing around 13 percent of all bank loans to non-financial corporations (NFCs), mostly to SMEs.

10.   Slovenian firms tend to rely more on funding from suppliers compared with peers, in particular small firms. Survey responses indicate that Slovenian companies use significantly more supplier credit and advances for working capital than EU peers. Smaller firms are more inclined to use supplier funding over bank credit, whereas younger companies depend heavily on internal funds.
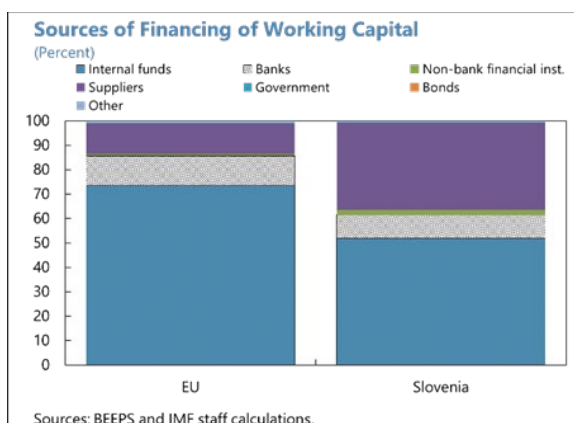
11.   A firm-level econometric analysis of Slovenian firms tentatively suggests that entities with higher leverage levels tend to experience higher productivity growth. Following the methodology in Coricelli et al. (2012), a threshold model has been estimated

Sources of Financing of Working Capital
(Percent)
Internal funds | Banks | Non-bank financial inst. | Suppliers | Government | Bonds | Other

Sources: BEEPS and IMF staff calculations.

that allows for a differentiated impact of leverage on productivity growth depending on the level (Appendix II). Results for Slovenia suggest that it is difficult to distinguish between the effects of the different degrees of leverage based on the thresholds. In most cases, the point estimates of the coefficients are very similar, and where differences are larger, they generally point to a positive impact of higher leverage on TFP growth. Given the low indebtedness of Slovenian firms, it appears that there is room to increase leverage without this impacting negatively productivity.

Entry of High-productivity and Exit of Low-productivity Firms

12.   Productivity levels are highly differentiated across firms in Slovenia. Based on Orbis BvD data, the top 10 percent most productive manufacturing firms are six times more productive than the bottom 10 percent after controlling for input size, a differential that is much higher than in the US (of 2:1, see Syverson 2004, 2011) and higher than the 5:1 in China and India (Hsieh and Klenow 2009). The distribution of firm-level TFP is also highly skewed, with a greater number of firms falling below the average. Such dispersion is important for policies as interventions may impact firms differently based on their position in the productivity distribution (di Giovanni, Levchenko, and Mejean 2018).

Density of Firm TFP
(Kernel density)

Kernel density
Normal density

Source: IMF staff calculation based on Orbis data.
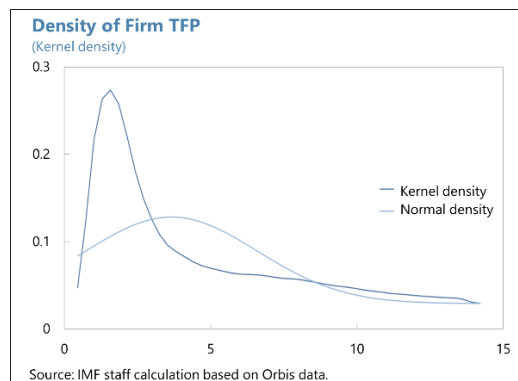
13. **Declining firm entry and exit rates are likely hampering TFP growth in Slovenia.** The entry of high-productivity firms and exit of low-productivity ones should lead to aggregate TFP gains over time. Slovenia previously exhibited higher firm entry rates compared to EU peer countries, but this has reversed in recent years, possibly indicating that Slovenian firms encountered increasing entry barriers. The post-entry survival rate is also decreasing, highlighting the challenges businesses face in sustaining their operations. However, Slovenian firms seem to face significant challenges only in the first two years—conditional on surviving past 2 years, the likelihood of surviving between 3 to 5 years is higher in Slovenia than in a median EU country. Similarly, the exit rate, previously aligned with EU countries, has been declining.

Figure 7. Slovenia: Entry, Exit and Firms' Survival Rates

New Entrants
(Percent of active enterprises)

Sources: Eurostat Business Demography Database and IMF staff calculations.

Survival Rates Within the First Two Years
(Percent of total entrants within the past 2 years)

Sources: Eurostat Business Demography Database and IMF staff calculations.

Conditional Survival Rate: 3 to 5 Years After Birth
(Percent of the number of enterprises survived after 2 years)

Sources: Eurostat Business Demography Database and IMF staff calculations.
Note: The conditional survival rate is computed as the ratio of the probability of surviving in 3-5 years over the probability of surviving after two years.

Exit Rate
(Percent of active enterprises)

Sources: Eurostat Business Demography Database and IMF staff calculations.

C.2. Innovation and Physical Capital: Constraints and Areas for Improvement

Physical Capital

14, **Low investment activity by non-financial corporations (NFCs) has hampered productivity and growth since the GFC.** Financial sector stress and strong deleveraging by NFCs contributed to a sharp decline in private investment in Slovenia, and, despite some improvement in recent years, business investment is still below the EU average, from being well above prior to the

GFC. Consequently, fixed assets of NFCs are relatively low in per capita terms, especially compared to more advanced EU members. The composition of the capital stock matters as well, with, for example, investment in machinery and IT assets having been found to be strongly associated with productivity growth (DeLong, 1992; Jorgenson and Stiroh, 2000). Slovenian firms are close to the average in terms of share of machinery in total fixed assets but have a lower share of intellectual property products, largely reflecting the low share of computer software and databases.

Figure 8. Slovenia: Business Investment and Capital Stock

Source: Eurostat.

Sources: Eurostat and IMF staff calculations.
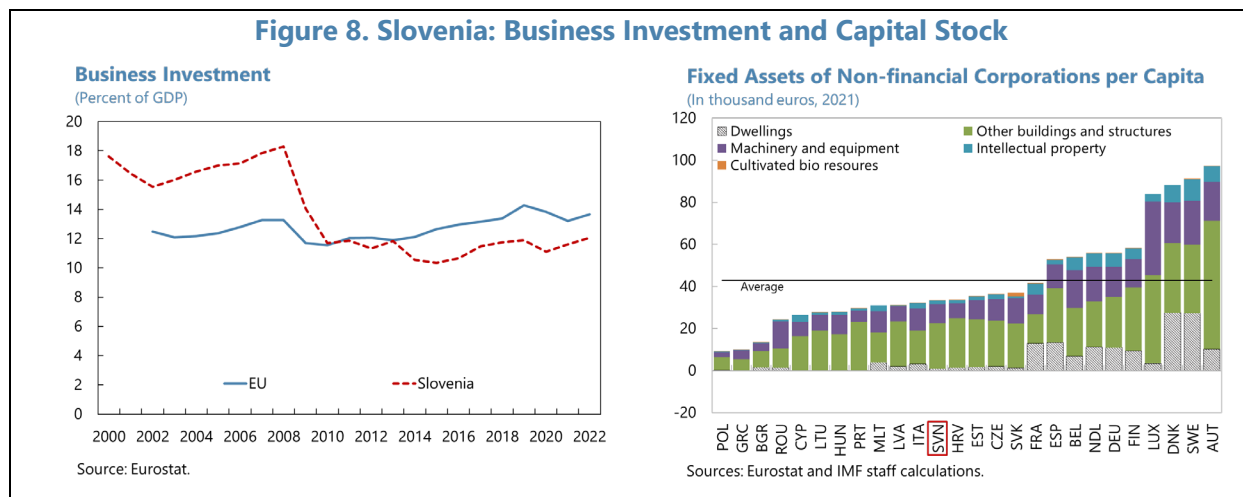
15. **Besides the stresses that arose from the GFC, deeper issues such as the lack of suitable qualified staff, uncertainty, regulations, and e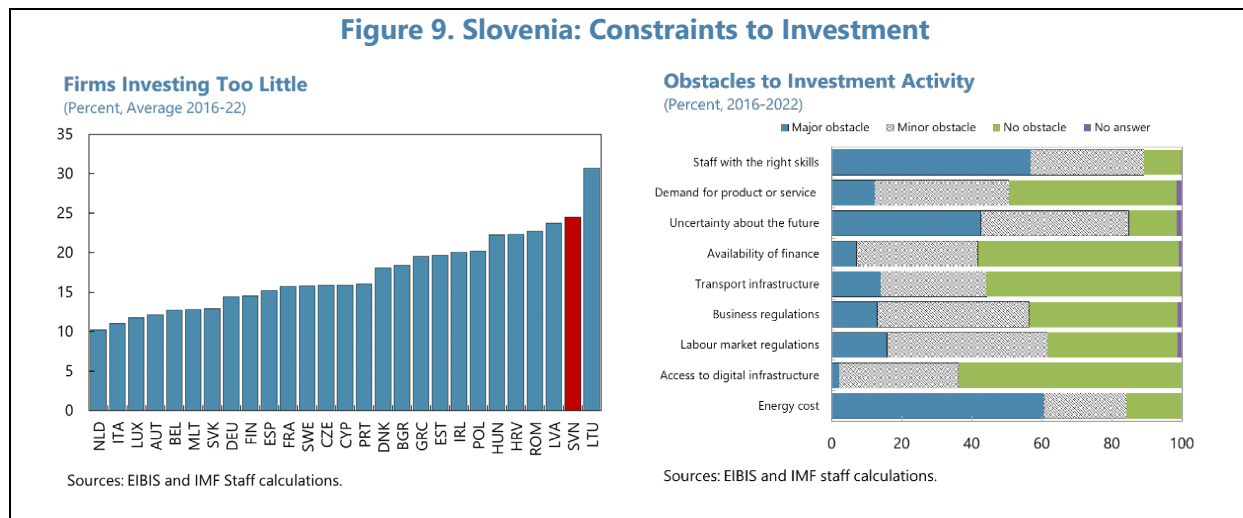nergy costs are cited in surveys as the main reasons for investment underperformance.** Survey data confirm that companies in Slovenia do not invest enough. Over a fifth of the respondents to the European Investment Bank (EIB) investment survey reported that they invested too little in the period 2016–22. Managers point out as key obstacles the lack of staff with the right skills, uncertainty about the future, labor and business regulations, and high energy costs.

Figure 9. Slovenia: Constraints to Investment

Sources: EIBIS and IMF Staff calculations.

Sources: EIBIS and IMF staff calculations.

16. **Infrastructure in Slovenia appears adequate.** Investment in public capital, in particular infrastructure, can increase an economy's growth potential by raising the productivity of private capital, but it needs to be done efficiently (IMF, 2015; Schwartz et al., 2020) Public investment in Slovenia has been relatively high, albeit volatile; it declined sharply after the banking crisis because of fiscal consolidation and picked up markedly in recent years, including because of major infrastructure projects (e.g., the Divača–Koper railway and Karavanke tunnel). Although the public capital stock per capita is below the EU average, quantitative indicators of infrastructure do not reveal any significant gaps. Indicators of infrastructure quantity such as motorway and

Logistic Performance Index Infrastructure Score and GDP per Capita

Sources: World Bank, Eurostat and IMF staff calculations.

railway density show Slovenia is in a favorable position (except for double and more tracks railways) and high-speed internet coverage is above the average for the EU. Slovenia also does not seem to face significant challenges in terms of infrastructural quality. Less than 10 percent of firms participating in the World Bank enterprise survey[3] identified transportation infrastructure as a major constraint, and the score on infrastructure in the latest Logistics Performance Index (2023), which is positively associated with GDP per capita, has improved.

Figure 10. Slovenia: Public Investment and Capital Stock

Government Investment
(Percent of GDP)

Source: Eurostat.

Public Capital Stock per Capita
(In thousand euros)

Sources: Eurostat and IMF staff calculations.

[3] 2019 data, https://www.enterprisesurveys.org/en/data/exploretopics/infrastructure
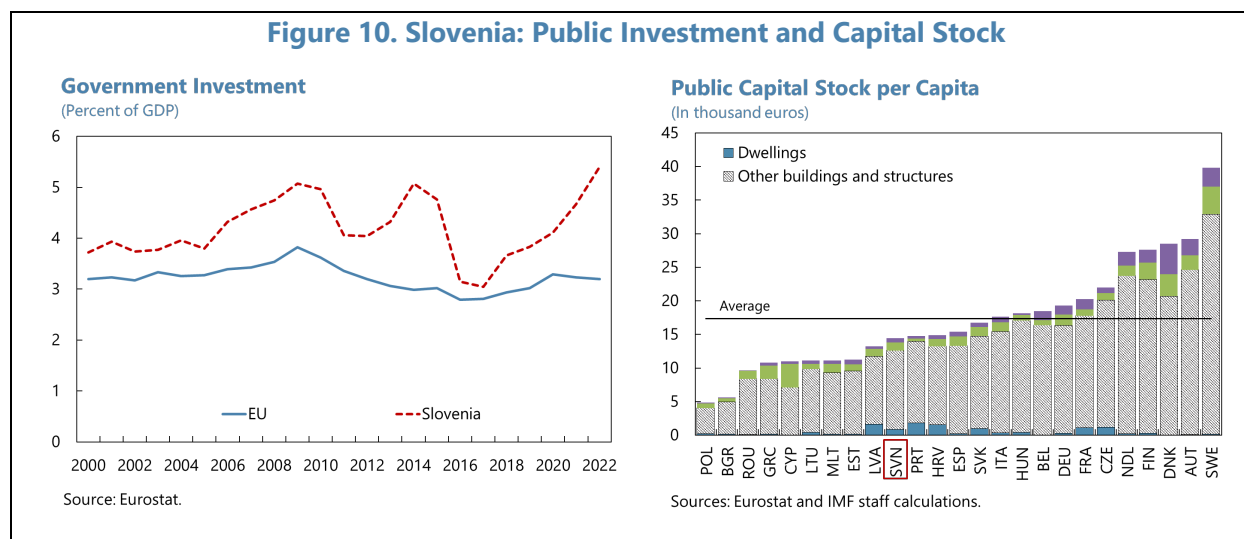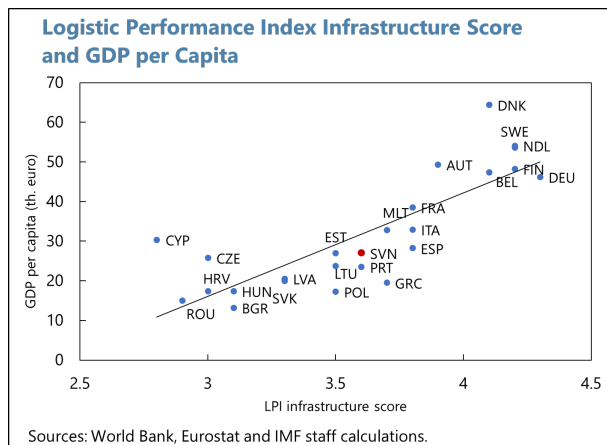
Innovation

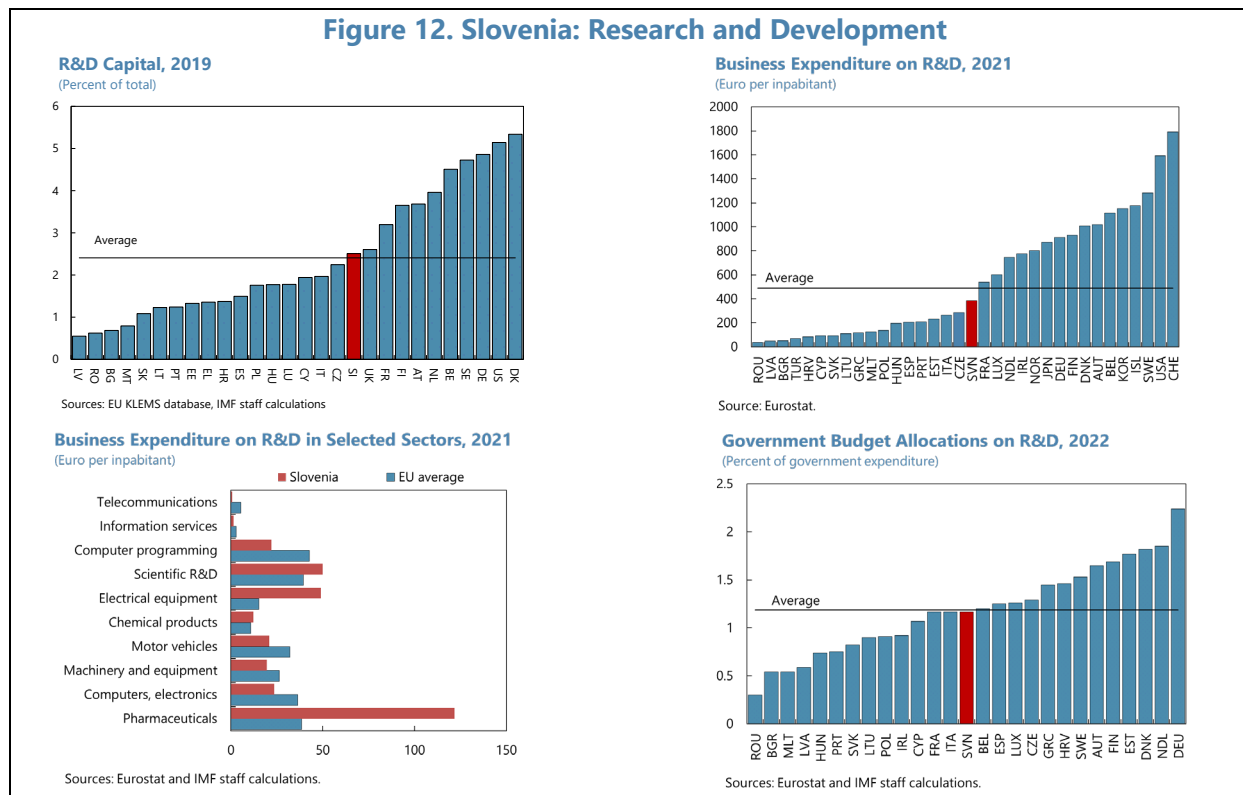**17.   Slovenian firms tend to be innovative and cooperation with stakeholders is good.**
Innovation is defined as development of new or improved products or processes[4] and productivity
and growth in the long run depend crucially on innovation activities (Jorgenson, 2011). Slovenia has
a higher share of innovative firms than the OECD average, with over 70 percent of workers
employed by such firms. Innovators are concentrated in large companies but a significant share of
innovation activities is undertaken also by SMEs. Slovenia is relatively well positioned in the
development of new products, with more than a third of firms reporting such innovations and more
than a fifth of firms developed products that are new to the market, Income from such products,
however, is below the average for the countries in the sample and innovation activity yet needs to
translate into higher productivity. Cooperation with other private companies, universities, public
research institutes and international collaboration is generally above average.

Figure 11. Slovenia: Innovation Indicators
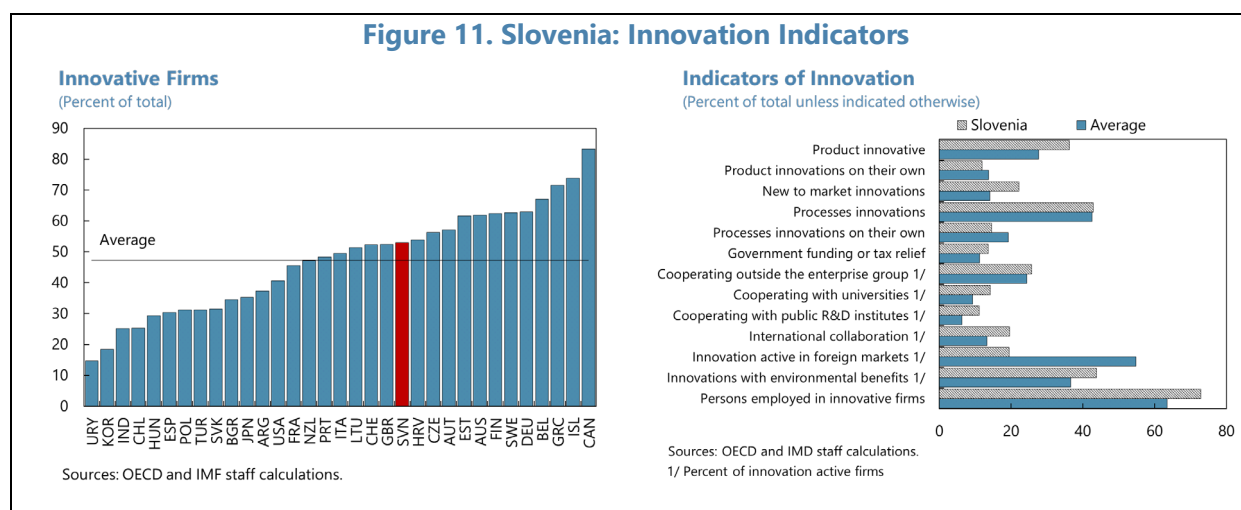
18.   The gap in R&D relative to economies at the frontier is, however, substantial. R&D is
closely linked to innovation, but the relationship is complex and non-linear (Guellec and van
Pottelsberghe de la Potterie, 2001). Studies generally find that the R&D capital stock is positively
associated with productivity growth (McMorrow and Roger, 2009). Slovenia's R&D capital stock,
while close to the average as percent of total, is well below the technological leaders. This largely
reflects relatively low business expenditures on R&D overall. There is, however, wide variation across
sectors, with pharmaceuticals and electrical equipment significantly overperforming peers, and
computer programming and ICT services lagging behind. Public R&D spending is important as well,
not only due to the direct effect on the capital stock but also because of complementarities and
catalyzing effects. Slovenia's budget allocates at the EU average for R&D and legislation provides for
a 100 percent tax allowance for investments in R&D.

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[4] See OECD, 2018 for precise definition.

Figure 12. Slovenia: Research and Development

R&D Capital, 2019
(Percent of total)

Sources: EU KLEMS database, IMF staff calculations

Business Expenditure on R&D, 2021
(Euro per inpabitant)

Source: Eurostat.

Business Expenditure on R&D in Selected Sectors, 2021
(Euro per inpabitant)

■ Slovenia   ■ EU average

- Telecommunications
- Information services
- Computer programming
- Scientific R&D
- Electrical equipment
- Chemical products
- Motor vehicles
- Machinery and equipment
- Computers, electronics
- Pharmaceuticals

Sources: Eurostat and IMF staff calculations.

Government Budget Allocations on R&D, 2022
(Percent of government expenditure)

Sources: Eurostat and IMF staff calculations.

Export Complexity

19.   Slovenia has a diverse export base with high economic complexity. Firms that engage in international markets typically encounter heightened competition, which fosters innovation, efficiency improvements, and enhanced product quality to maintain competitiveness. Export-focused firms also benefit from access to broader and more diverse markets, potentially helping to increase economies of scale and streamline production processes. Exposure to international best practices and technologies and the need to adhere to international standards and regulations often results in improved management and more efficient resource utilization. Slovenia is a highly open economy with a diverse export base. One measure that captures both the diversity and ubiquity of exports is the economic complexity index (Hidalgo and Hausmann, 2009), which is found to be positively correlated with productivity and growth. Slovenia is well positioned based on this metric (12th out of 131 countries), highlighting the country's ability to integrate complex and knowledge-intensive products into its export portfolio. These conclusions, however, pertain largely to firms engaged in the production of goods where labor productivity tends to be higher than in non-tradable services.

Economic Complexity of Exports, 2021
(Index)

Source: OEC.
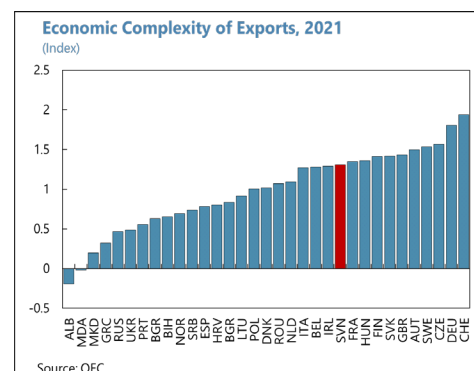
C.3. Human Capital as a Key Factor of Productivity

20.   Slovenia has a well-educated labor force. Endogenous growth theory attaches high importance to human capital and knowledge for productivity and growth (e.g., Romer, 1990) and many studies have confirmed this relationship empirically (Barro, 1991; Mankiw, Romer and Weil, 1992). A skilled and educated labor force helps set the stage for greater innovation and creativity and better adaptation to technological changes. Slovenia has an above-average share of the population with at least upper secondary education and of young people (25–34) with tertiary education. In terms of graduates in STEM, it is on par with EU peers. Also, relatively more vocational education and training graduates in Slovenia benefit from exposure to work-based learning. The quality of education is also strong based on the recent PISA scores where Slovenia performs very well, and above the OECD average, in math and science. And a new human capital measure, which takes into account both the quantity and quality of education, and is strongly linked to productivity, places Slovenia in the upper third of the distribution (Égert et al., 2022).

21.   Yet, shortages of staff with specific skills are a growing concern. High educational attainment and quality of education do not automatically translate into a sufficient supply of qualified labor tailored for labor market needs. While vertical skills mismatch does not seem to be a major issue (over- and underqualification rates in Slovenia are about 12 percent), horizontal skills mismatches, which measure the discrepancy between the field of education and occupation are among the highest in the EU in the age group 25–34. This discrepancy is often addressed by internal training—about half of Slovenian companies provide training programs for full-time employees (vs. 36 percent on average in the other EU countries).[5] Programs in Slovenia tend to focus more on language, communication and managerial skills compared to EU peers.


Figure 13. Slovenia: Education and Skills

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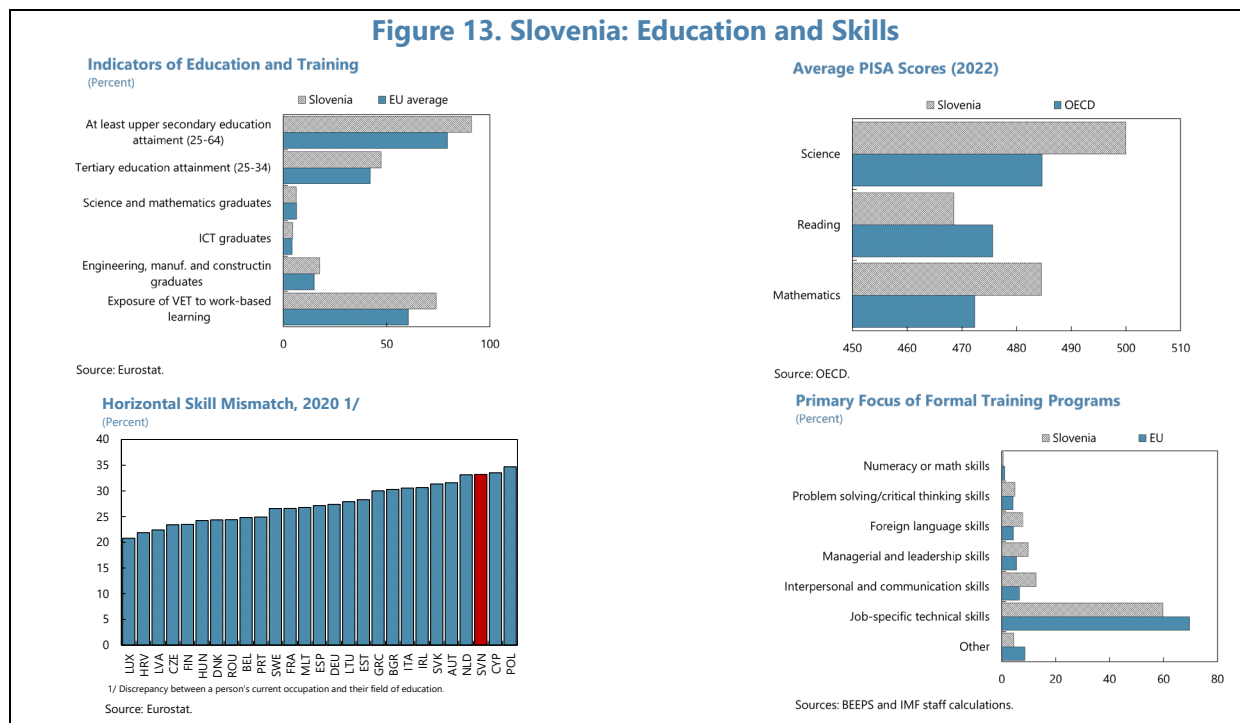
[5] Based on the EBRD/WB BEEPS responses.

C.4. Supportive Environment: Significant Room for Developing Financial Markets

Institutions

22.   Slovenia benefits from high government effectiveness and political stability but regulatory quality is not as strong. Private
investment and innovation require a growth-friendly
environment and supportive institutions and policies
(Dieppe, 2021). Slovenia's scores in the Worldwide
Governance Indicators (WGI) suggest strong
performance in political stability and government
effectiveness but there remains much room for
improvement of regulatory quality. This indicator is
key to productivity as it aims to measure the ability of
the government to formulate and implement policies
and regulations that promote private sector development. It captures among other things unfair
competitive practices, administrative burdens, and the ease of starting a business. Survey-based
evidence (BEEPS, EIBIS) suggests that labor market and business regulations are major obstacles to
firms' performance and investment. Unfair practices of competitors in the informal sector are also
pointed out by many firms as a hindrance.
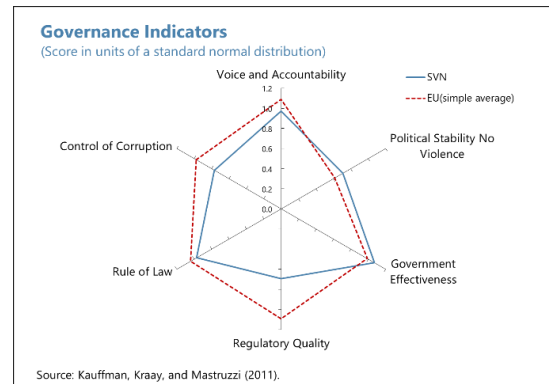
Equality

23.   Slovenia has one of the lowest inequality rates in Europe and low gender gaps. Most
empirical evidence indicates that income inequality adversely affects economic growth, primarily
through limiting educational opportunities and fostering political and social instability (Perotti,
1996). Reducing inequality after taxes and transfers is associated with faster and more enduring
growth, with redistribution only impeding growth at extreme levels (Berg et al. 2018). Slovenia is
notable for its low levels of income inequality, ranking as the second lowest in the euro area.
Similarly, gender disparities in access to education, healthcare, and employment can affect adversely
productivity. Slovenia performs well regarding gender equality, ranking among the bottom
20 percent in Europe in terms of gender gap in labor force participation.

Figure 14. Slovenia: Inequality Indicators
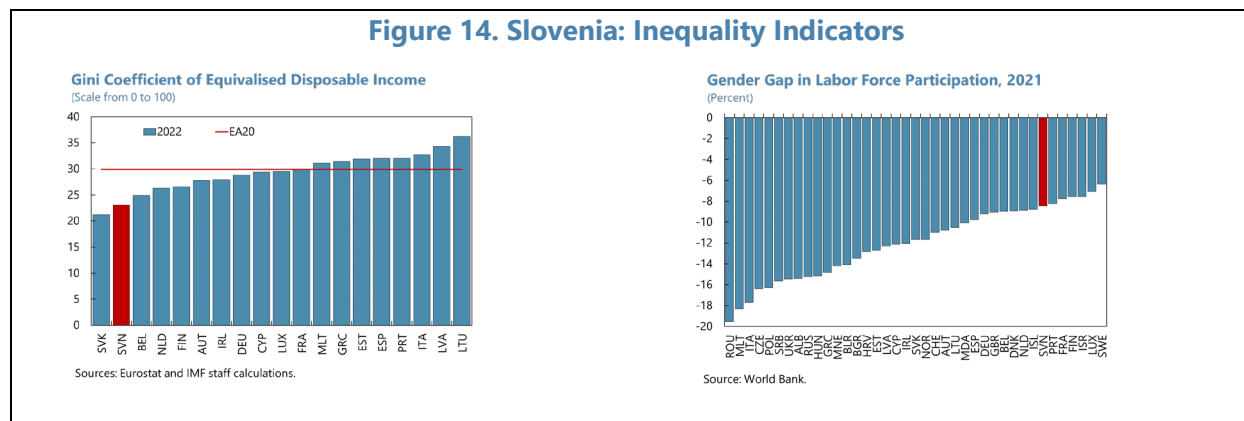
Role of Access to Finance and Financial Development

24. Strong deleveraging over the last decade has increased reliance of the corporate sector in Slovenia on internal financing and trade credits. Loans reached nearly 50 percent of NFC liabilities in the run-up to the GFC but have declined since then to less than 30 percent. Firm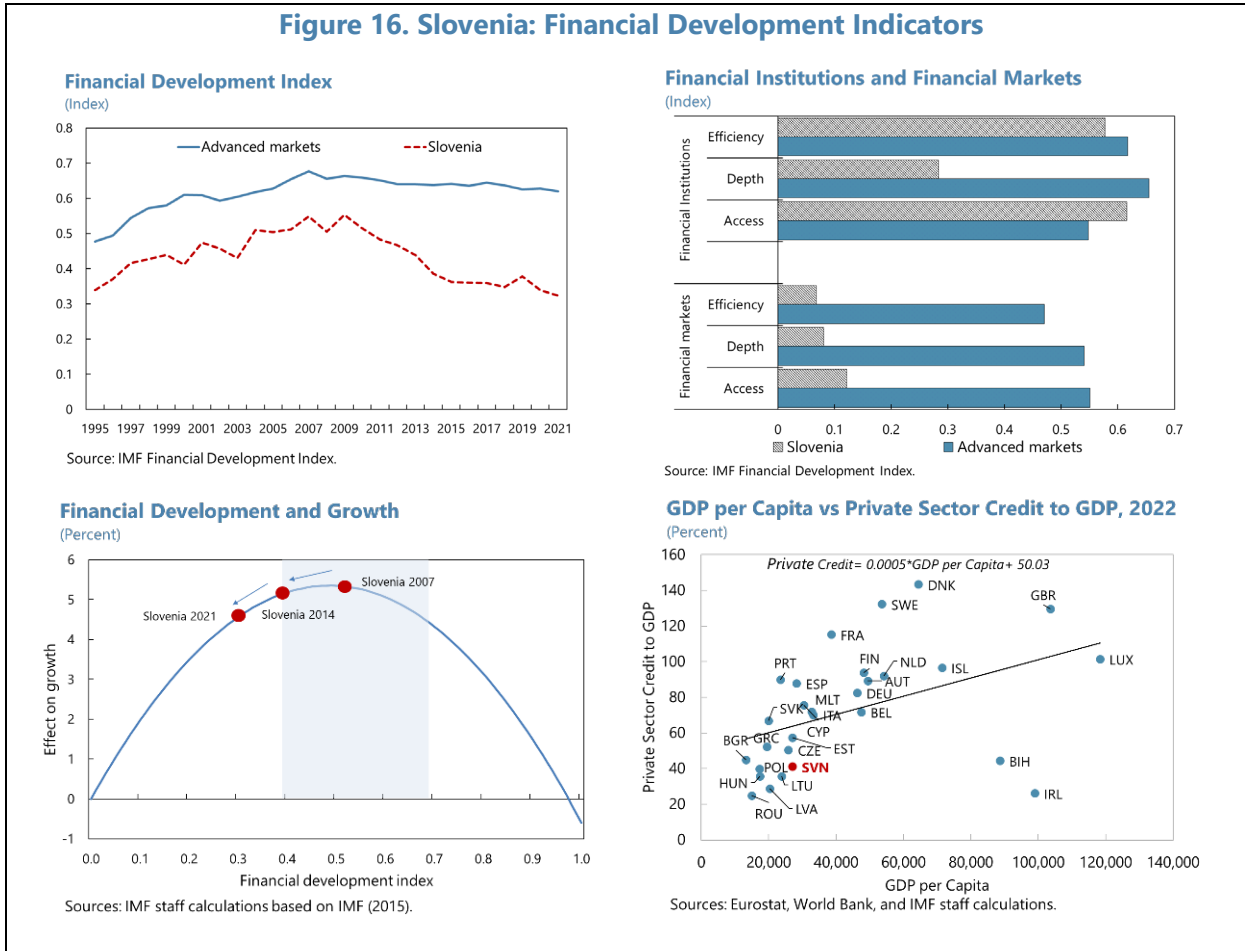s have instead relied increasingly on own funds and trade credits to finance investments and operations. In particular, the share of trade credits in liabilities in Slovenia is more than twice as high as the average for the euro area. This could be related to the growing role of FDI and stronger integration of Slovenian companies into European supply chains, but could also signal untapped financing potential within Slovenian financial system.

Figure 15. Slovenia: NFC Liabilities
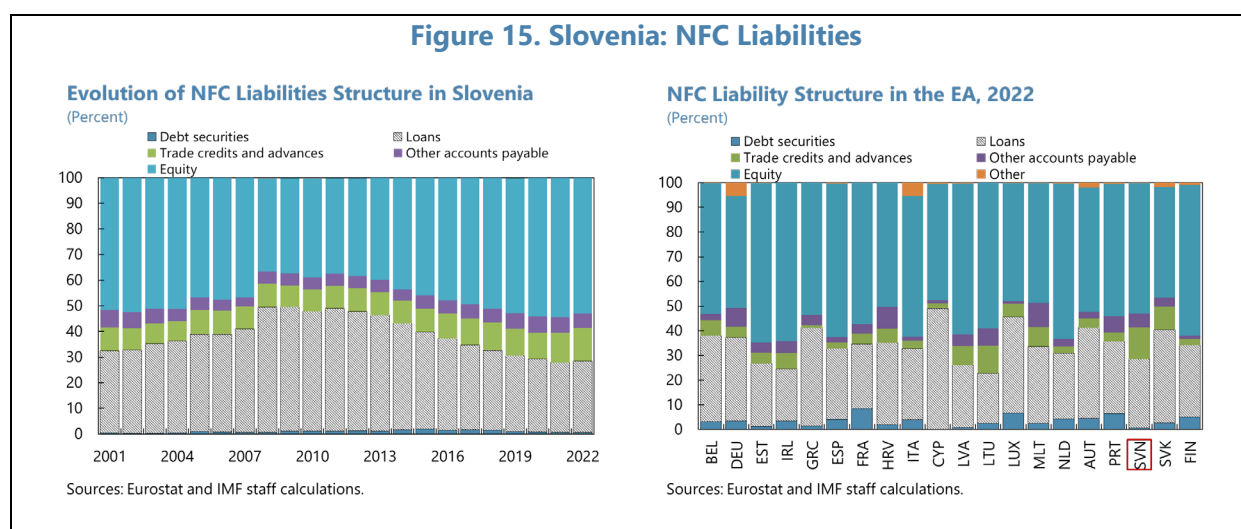
25. Financial development is recognized as a key driver of productivity and economic growth. Well-developed financial systems provide a variety of instruments to encourage savings, diversify and manage risks, and support entrepreneurship and innovation by funding new business ventures. Slovenia's overall financial development, measured by the IMF's Financial Development Index (FDI), lags behind the average for advanced economies and the gap has widened since the GFC. While indicators for financial institutions access and efficiency are broadly in line with peers, financial institution depth and financial market indicators are significantly weaker. This reflects a low private credit to GDP ratio, a small number of private debt issuers, and low stock market capitalization and turnover, among others.

26. But the relationship between financial development and growth is not linear. Empirical evidence suggests a bell-shaped relationship between financial development and growth (IMF 2015). Analysis shows that FDI values between 0.4 and 0.7 have the greatest positive impact on growth. Slovenia's latest FDI value of 0.3 puts it below the optimal range which implies gains in terms of growth from moving up the curve.

Figure 16. Slovenia: Financial Development Indicators

Financial Development Index
(Index)

Source: IMF Financial Development Index.

Financial Institutions and Financial Markets
(Index)

Source: IMF Financial Development Index.

Financial Development and Growth
(Percent)

Sources: IMF staff calculations based on IMF (2015).

GDP per Capita vs Private Sector Credit to GDP, 2022
(Percent)

$Private\ Credit = 0.0005 * GDP\ per\ Capita + 50.03$

Sources: Eurostat, World Bank, and IMF staff calculations.

27.   Equity and bond markets are at an early stage of development in Slovenia, which potentially hinders investment and company growth. Access to capital market is constrained by its small size and underdevelopment. The market capitalization of the Ljubljana Stock Exchange is low and continues to decline. The AFME indicator which assesses capital market competitiveness through a composite index, considering capital availability, sustainability and digitalization, access to finance, and market liquidity, places Slovenia second to last in Europe, with only marginal improvement since 2018.

Capital Market Competitiveness Indicator
(Index)

Sources: AFME Report, 2022.
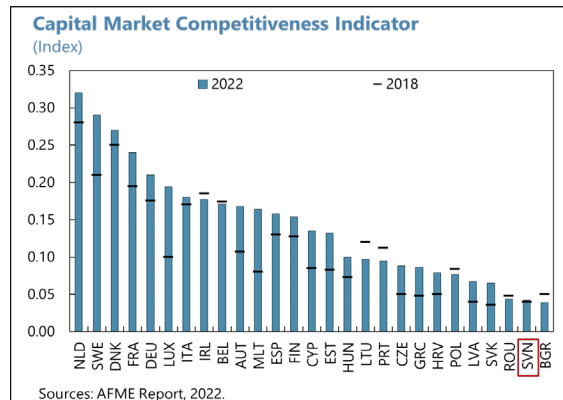
C.5. The Production Frontier Analysis: Quantifying the Constraints

28.   Improving efficiency is key for enhancing productivity growth. In standard growth accounting, TFP growth is the residual increase in output that cannot be explained with increases in inputs such as labor and capital and reflects how efficiently factor inputs are used. It can be seen as a proxy for technological change and the efficiency of use of available resources (Fare et al., 1994).[6]

29.   The production frontier analysis is a useful tool to measure inefficiencies. In practice, producers often operate below the efficiency frontier and the distance between feasible and actual output can result from technical inefficiency. Formally, a stochastic frontier model can be represented by the following set of equations (see Kumbhakar et al., 2015):

$$\ln y_i = f(x_i; \beta) + \epsilon_i$$

$$\epsilon_i = v_i - u_{i,}$$

where y_i denotes the observed output of unit i, x_i is a vector of inputs, β is a vector of parameters, and the error term ϵ_i is decomposed into a technical inefficiency component $u_i \geq 0$ and a random error v_i. Here, u_i measures the difference between the maximum attainable and actual output. Stochastic frontier models have been widely used in the literature to assess inefficiencies both at the firm level and at the aggregate level. For example, IMF (2019) uses macro data for a set of countries to estimate the potential impact of structural reforms on Türkiye's productivity growth.

30.   Model specification and estimation entail choices about functional forms, data, and techniques. The Cobb-Douglas production function seems a natural choice for most applications and is widely used in stochastic frontier analysis. Both cross-sectional and panel data can be employed and with panel data, technical inefficiency can be modeled as constant or time-varying. For practical purposes, it is important to model inefficiency explicitly as a function of exogenous variables; such variables can determine the inefficiency location or variance, or both. As in IMF (2019), the analysis in this note follows the approach proposed by Battese and Coelli (1995) in a panel data setup where the mean inefficiency effect is a linear function of a set of explanatory variables. Specifically, the following model is considered:

$$\ln y_{i,t} = \beta_0 + \beta_1 \ln k_{i,t} + \beta_2 \ln l_{i,t} + v_{i,t} - u_{i,t}$$

$$u_{i,t} = z_{i,t}\delta + w_{i,t,}$$

---

[6] Some authors, e.g., Kumbhakar et al. (2015), refer to both as technical change, distinguishing the change in production technology that results from improved methods of using existing factors (disembodied) and from changes in input quality (embodied). TFP also captures measurement problems and the degree of utilization of inputs.
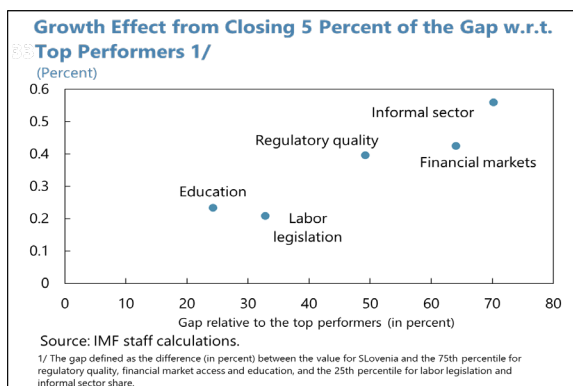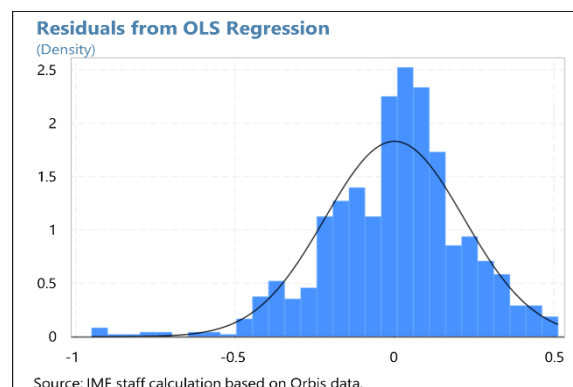
where $k_{i,t}$ denotes capital of country i at time t, $l_{i,t}$ stands for labor, $z_{i,t}$ is a vector of exogenous regressors that explain technical inefficiency and $w_{i,t}$ is a random variable coming from a truncated normal distribution. Estimation of the parameters (β, δ) is done jointly by maximum likelihood.

31.   The stochastic frontier model is estimated using a panel of advanced countries. Data on GDP, labor and capital are obtained from the Penn World Tables (PWT). The choice of explanatory variables for the technical inefficiency is less straightforward, with multiple potential candidates for such variables.

32.   Regressors are chosen with a focus on structural reforms that could enhance productivity growth. The responses of Slovenian firms to the EIBIS and EBRD/World Bank BEEPS suggest that the main challenges companies face relate to the quality of the labor force, labor and business regulations, taxation, and competition from the informal sector. Access to finance also appears to be important as well, especially for small firms. Consequently, mean inefficiency is modeled as a function of the following indicators: regulatory quality, an employee protection index, financial market access, the share of income taxes in total tax revenue, the informal sector share, and three different measures of education—the share of labor force with advanced education, the PWT human capital index, and the share of adult population with tertiary education. To control for the business cycle, an estimate of the output gap is included in the regressions as well. Data descriptions and sources are given in Appendix III.

33.   Estimates suggest a significant impact of structural variables on technical inefficiency. Residuals from a simple OLS regression of output on capital and labor display a distribution skewed to the left, which is confirmed by a formal test. This is an indication of the presence of inefficiencies and justifies the use of the stochastic frontier approach. Table 1 presents the estimation results for different model specifications. In most specifications, the structural variables entering the technical inefficiency equation are statistically significant and have the expected signs.[7] Thus, lower values of the employee protection index, informal sector share and income taxes would contribute to reducing the technical inefficiency. Similarly, better financial markets access and higher percentage of labor force with tertiary education would act in the same direction. A simple simulation using point estimates shows that closing 5 percent of the gap in the indicator levels between Slovenia and the

Residuals from OLS Regression
(Density)

Source: IMF staff calculation based on Orbis data.

Growth Effect from Closing 5 Percent of the Gap w.r.t. Top Performers 1/
(Percent)

Source: IMF staff calculations.
1/ The gap defined as the difference (in percent) between the value for SLovenia and the 75th percentile for regulatory quality, financial market access and education, and the 25th percentile for labor legislation and informal sector share.

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[7] Estimation is undertaken using the Stata module for panel data SFA developed by Belotti et al. (2013).

OECD top performers[8] could be associated with substantial productivity gains. This is particularly the case with improving regulatory quality and financial market access. By contrast, the high growth impact from reducing informality could largely reflect the statistical effect of recording activity that previously was not captured in the official accounts. All the above estimates should, however, be interpreted with caution due to uncertainties associated with the model specification and estimation.

Table 1. Slovenia: Stochastic Frontier Estimation Results

| | Dependent variable: log of GDP | | | | |
	(1)	(2)	(3)	(4)	(5)
Frontier					
Log of Capital Stock	0.580	0.581	0.458	0.471	0.446
	(0.013)***	(0.012)***	(0.015)***	(0.014)***	(0.016)***
Log of Number of Employed	0.436	0.420	0.539	0.528	0.552
	(0.014)***	(0.013)***	(0.015)***	(0.014)***	(0.015)***
Trend	0.012	0.01	0.009	0.008	0.007
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Constant	3.616	3.799	5.662	5.265	5.614
	(0.167)***	(0.153)***	(0.513)***	(0.181)***	(0.201)***
Mean Inefficiency					
Output gap			-0.008	-0.008	-0.009
			(0.002)***	(0.002)***	(0.002)***
Regulatory quality			-0.158	-0.12	-0.099
			(0.019)***	(0.021)***	(0.023)***
Employee protection index			0.081	0.108	0.081
			(0.008)***	(0.009)***	(0.009)***
Financial markets access			-0.175	-0.2	-0.191
			(0.023)***	(0.029)***	(0.032)***
Informal sector share			0.005	0.01	0.011
			(0.001)***	(0.001)***	(0.001)***
Income tax share			0.002	0.003	0.003
			(0.001)***	(0.001)***	(0.001)***
Advanced education			0.001		
			(0.001)		
Human capital index				-0.042	
				(0.015)***	
Tertiary education					-0.004
					(0.001)***
Constant		-20.473	0.236		
		(41.502)	(0.461)		
Number of observations	950	950	646	646	581
Number of countries	38	38	32	32	32
Period	1995–2019	1995–2019	1995–2019	1995–2019	1995–2019
R^2	0.980				
Log likelihood	99.63	134.3	398.6	398.7	382.4

Notes: Standard errors are reported in parentheses and stars indicate p-values (* $p<0.1$; ** $p<0.05$; *** $p<0.01$). Model (1) is the OLS regression, model (2) estimates the stochastic frontier without explanatory variables and models (3)–(5) include different proxies for the labor force education, namely the share of labor force with advanced education, the PWT human capital index and percent of population with tertiary education.

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[8] Top performers are defined as the 75th percentile for the variables which contribute positively to improving efficiency (regulatory quality, financial market access and education) and the 25th percentile for the others.

D. Conclusions

34.   Slovenia has achieved impressive economic results since independence. It has high per capita income, strong human development indicators, effective institutions and one of the lowest inequality rates in the world. Strong private investment activity prior to the GFC spurred productivity growth, increased economic complexity, diversified the export base, and boosted integration into European value chains. This, combined with good infrastructure and the implementation of sound economic policies has helped Slovenia develop a comparative advantage in key determinants of productivity growth such as innovation, human capital and equality.

35.   At the same time, the analysis has identified several broad areas where improvements should be made. Addressing factors that deter private investment and capital deepening could speed up significantly growth and income convergence, while broadening and deepening of the digital and green transitions should continue to be promoted as a matter of priority. Policies that could help achieve this goal include:

- *Innovation*. Innovation and technological development should be bolstered further, including by promoting investment in ICT and automation, encouraging patents and trademarks, and supporting innovative startups to bridge the gap with the EU leaders.

- *Regulatory quality.* A regulatory framework that is more growth-friendly could further encourage investment and productivity. Easing the administrative burden, streamlining procedures in areas such as building permits and further digitalization of public services could help private investment and productivity.[9] Reducing market distortions and removing barriers to entry and exit would increase business dynamism and growth-enhancing reallocation.

- *Labor regulations.* Slovenia made significant progress in relaxing labor regulations with the 2013 Employment Relations Act. It scores close to the average on OECD's overall employment protection regulations but with relatively wide variation across individual indicators. Further progress, including, for example, on severance costs and broader employer burdens could also help the economy grow and remain competitive.

- *Taxation.* Slovenia's high labor tax wedge is seen as an issue by many employers, including foreign investors who have difficulties attracting highly skilled employees and managers from abroad. Lowering the tax wedge on labor could increase labor supply and help growth.[10] It would also contribute to reducing informality by lowering the incentive to underreport labor income. A shift in revenue composition away from income and towards indirect and property taxes, along with reducing tax expenditures to ensure at least revenue neutrality would improve Slovenia's growth prospects.

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[9] Policies aimed at reducing the administrative burden are summarized in Slovenia's National Reform Program.

[10] IMF (2015) estimates that a revenue-neutral reform involving reduction of the tax wedge by 5 percent leads to high long-run growth by 0.2–0.3 percent.

- **_Education and skills mismatch._** Slovenia has strong education results but there seems to be a gap between the knowledge and skills offered and market demand. This calls for measures to increase the flexibility of the education system to respond to the evolving market needs. This should be undertaken in consultation with relevant stakeholders, including employers. The authorities' initiative to launch a labor market platform that assesses the gaps in competences and predicts the labor market needs is welcome, especially if results are used as feedback to education policies.

- **_Capital market._** The government's capital market development strategy through 2030 defines a set of measures that would provide companies with access to debt and equity financing, help innovative SMEs develop and grow, and expand investment opportunities for professionals and the general public. Although there are no quick fixes, deepening capital markets over time would help support private investment and growth.

References

Ackerberg, D. A., K. Caves, and G. Frazer (2015). "Identification properties of recent production function estimators," *Econometrica*, 83(6), 2411–2451.

Barro, R. (1991), "Economic Growth in a Cross Section of Countries", *Quarterly Journal of Economics*, Vol. 106 (2), pp. 407–443.

Battese, G. and Coelli, T. (1995), "A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data," *Empirical Economics*, Vol. 20 (2), pp. 325–332.

Beck, T., Demirgüç-Kunt, A. and Maksimovic, V. (2005), "Financial and Legal Constraints to Growth: Does Firm Size Matter?", *The Journal of Finance*, 60 (1), pp.137–177.

Berg, A., Ostry, J., Tsangarides, C. and Yakhshilikov, Y. (2018), "Redistribution, Inequality, and Growth: New Evidence," *Journal of Economic Growth*, Vol. 23 (3), pp. 259–30.

Chen, S. and Lee, D. (2023), "Small and Vulnerable: SME Productivity in the Great Productivity Slowdown," *Journal of Financial Economics*, vol. 147 (1), pp. 49–74.

Coricelli, F., Driffield, N., Pal, S. and Roland, I. (2012), "When Does Leverage Hurt Productivity Growth? A Firm-level Analysis," *Journal of International Money and Finance*, Vol. 31 (6), pp. 1674–1694.

De Loecker, J., and A. Collard-Wexler, (2016), "Production Function Estimation with Measurement Error in Inputs," *C.E.P.R. Discussion Papers*, CEPR Discussion Papers 11399.

DeLong, J.B. (1992), "Productivity Growth, Convergence, and Welfare: Comment", *American Economic Review*, 82 (5), pp.1138–1154.

Dieppe, A., ed. (2021), "Global Productivity: Trends, Drivers, and Policies", Washington, DC: World Bank.

Díez, F.J., Fan, J. and Villegas-Sánchez, C. (2021), "Global Declining Competition?", *Journal of International Economics*, Vol. 132, 103492.

di Giovanni, J., Levchenko, A. and Mejean, I. (2018), "The Micro Origins of International Business-Cycle Comovement", American Economic Review, 108 (1), pp. 82–108.

European Central Bank (2021), "Key Factors Behind Productivity Trends in EU Countries". *ECB Occasional Paper Series 268,* European Central Bank.

Égert, B, de la Maisonneuve, C, and Turner, D. (2022), "A New Macroeconomic Measure of Human Capital Exploiting PISA and PIAAC: Linking Education Policies to Productivity", *OECD Economics Department Working Papers No. 1709*, OECD, Paris.

Elgin, C., M. A. Kose, F. Ohnsorge, and S. Yu. 2021. "Understanding Informality", *CERP Discussion Paper 16497*, Centre for Economic Policy Research, London.

Fare, R., Grosskopf, S., Norris, M. and Zhang, Z. (1994), "Productivity Growth, Technical Progress and Efficiency Change in Industrialized Countries", *American Economic Review*, vol. 84 (1), pp. 66–83.

Goldberg, P.K., Khandelwal, A.K., Pavcnik, N. and Topalova, P. (2010), "Imported Intermediate Inputs and Domestic Product Growth: Evidence from India", *The Quarterly Journal of Economics*, *125* (4), pp.1727–1767.

Gopinath, G., Kalemli-Özcan, Ş., Karabarbounis, L. and Villegas-Sanchez, C. (2017), "Capital Allocation and Productivity in South Europe", *The Quarterly Journal of Economics*, *132* (4), pp.1915–1967.

Guellec, D. and Van Pottelsberghe de la Potterie, B. (2001), "R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries", *OECD Economic Studie*s 2001/3, OECD, Paris.

Hansen, B. (2000), "Sample Splitting and Threshold Estimation," *Econometrica*, vol. 68 (3), pp. 575–604.

Hidalgo, C. and Hausmann, R. (2009), "The Building Blocks of Economic Complexity," *CID Working Papers 186*, Center for International Development at Harvard University.

Hsieh, C.T. and Klenow, P.J. (2009), "Misallocation and Manufacturing TFP in China and India", *Quarterly Journal of Economics*, 124 (4), pp.1403–1448.

Institute for Macroeconomic Analysis and Development (2023), "Productivity Report 2023", Institute for Macroeconomic Analysis and Development, Ljubljana.

Institute for Macroeconomic Analysis and Development (2022), "Productivity Report 2022", Institute for Macroeconomic Analysis and Development, Ljubljana.

International Monetary Fund (2015), "Fiscal Policy and Long-Term Growth", International Monetary Fund, Washington, DC.

International Monetary Fund (2019), "Turkey: Selected Issues", *IMF Country Report No. 19/396*, International Monetary Fund, Washington, DC.

Jorgenson, D. (2011), "Innovation and Productivity Growth: T.W. Schultz Lecture", *American Journal of Agricultural Economics*, Vol. 93 (2), pp. 276–296.

Jorgenson, D.W. and Stiroh, K. (2000), "Raising the Speed Limit: U.S. Economic Growth in the Information Age", *Brookings Papers on Economic Activity*, 2000 (1), pp.125–211.

Kaufmann, D., Kraay, A. and M. Mastruzzi (2010). "The Worldwide Governance Indicators: Methodology and Analytical Issues". *World Bank Policy Research Working Paper No. 5430*, World Bank, Washington, DC.

Kumbhakar, S., Wang, H-J. and Horncastle, A. (2015), "A Practitioner's Guide to Stochastic Frontier Analysis Using Stata," Cambridge University Press.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A. and Vishny, R. (1998), "Law and Finance", *Journal of Political Economy*, 106 (6), pp.1113–1155.

Mankiw, G., Romer, D. and Weil, D. (1992), "A Contribution to the Empirics of Economic Growth", *Quarterly Journal of Economics*, Vol. 107 (2), pp. 407–437.

Mc Morrow, K. and Röger, W. (2009), "R&D Capital and Economic Growth: The Empirical Evidence," *EIB Papers 4/2009*, European Investment Bank.

Perotti, R. (1996), "Growth, Income Distribution, and Democracy: What the Data Say," *Journal of Economic Growth*, Springer, vol. 1(2), pp. 149–187.

Rajan, R.G. and Zingales, L., (2001), "The Firm as a Dedicated Hierarchy: A Theory of the Origin and Growth of Firms", *Quarterly Journal of Economics*, 116 (3), pp. 805–851.

Romer, P. (1990), "Endogenous Technological Change", *Journal of Political Economy*, Vol. 98 (5), pp. S71–S102.

Schwartz, G., Fouad, M., Hansen, T. and Verdier, G. (eds.), (2020), "Well Spent: How Strong Infrastructure Governance Can End Waste in Public Investment", Washington, DC: International Monetary Fund.

Syverson, C. (2004), "Market Structure and Productivity: A Concrete Example", *Journal of Political Economy*, 112(6), pp.1181–1222.

Syverson, C. (2011), "What Determines Productivity?", *Journal of Economic Literature*, 49 (2), pp. 326–365.

World Bank (2021), "Listing State-Owned Enterprises in Emerging and Developing Economies: Lessons Learned from 30 Years of Success and Failure", World Bank, Washington, DC.

Appendix I. Shift Share Methodology

Methodology: Given that aggregate labor productivity can be represented as a weighted average of individual sectors with weights determined by labor shares, productivity growth can be decomposed into the following components:

(i)   *Intra-industry productivity growth effect.* This component is equal to the sum of productivity growth rates of individual sectors in the absence of changes in employment shares.

(ii)   *Structural shift effect (changes in labor shares).* This effect quantifies the contribution to overall productivity growth of a shift of labor resources across sectors. When labor moves from low- to high-productivity growth sectors, this shift contributes positively to aggregate productivity growth and vice versa.

(iii)   *Interaction effect.* The third component is estimated as a residual term. It captures, among other effects, the impact of TFP changes on labor productivity not directly measured in the first two components.

Formally, labor productivity (LP) of the overall economy is defined as the output (Y, measured by gross value added) divided by labor input (L, measured as hours worked). Since total output and labor are obtained by aggregation of individual sectors, LP can also be defined as:

$$LP_t = \left.\sum_i Y_{i,t} \middle/ \sum_i L_{i,t}\right. .$$

Alternatively, labor productivity can be written as a weighted sum of the intra-industry productivity rates:

$$LP_t = \sum_i LP_{i,t} \frac{L_{i,t}}{L_t}$$

This gives, in the first difference:

$$\Delta LP_t = \sum_i \Delta(LP_{i,t}) \frac{L_{i,t-1}}{L_{t-1}} + \sum_i LP_{i,t-1} \Delta\left(\frac{L_{i,t}}{L_t}\right) + \sum_i \Delta(LP_{i,t}) \Delta\left(\frac{L_{i,t}}{L_t}\right)$$

To calculate the growth rate, this expression is divided by labor productivity (LP_{t-1}) which, after some rearrangements, yields:
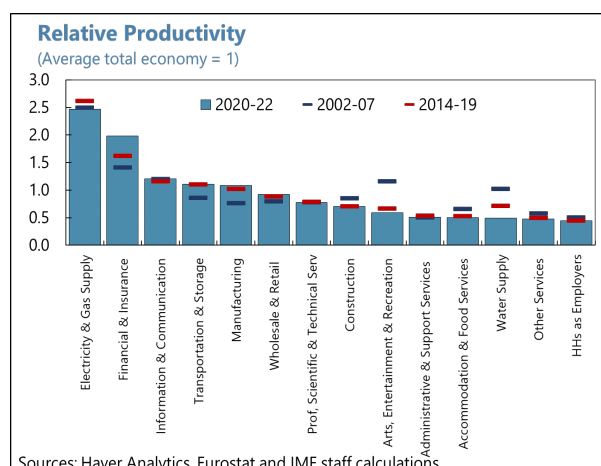
$$\frac{\Delta LP_t}{LP_{t-1}} = \sum_i \frac{\Delta LP_i}{LP_{i,t-1}} \frac{Y_{i,t-1}}{Y_{t-1}} +$$

$$\sum_i \frac{LP_{i,t-1}}{LP_{t-1}} \left(\frac{L_{i,t}}{L_t} - \frac{L_{i,t-1}}{L_{t-1}}\right) +$$

$$\sum_i \frac{\Delta LP_{i,t}}{LP_{t-1}} \left(\frac{L_{i,t}}{L_t} - \frac{L_{i,t-1}}{L_{t-1}}\right)$$

The first component is the intra-industry effect, calculated as the sum of individual sectors' productivity growth rates weighted by the output share in the initial period, i.e., assuming there is no change in the economic structure.

The second component is the shift effect, which captures the change in the labor shares of each industry weighted by relative productivity, i.e., the ratio of the industry productivity to average productivity.

The third term is the interaction component that measures the correlation between productivity and employment changes, as well as additional productivity gains associated with qualitative factors affecting TFP. As noted above, it is positive when the intra-industry effect and the structural shift are complementary, and negative when an increase in productivity is related to a decrease in labor use.

Results: Labor productivity in Slovenia varies widely at the sectoral level. Over the past two decades, the dispersion of labor productivity among different sectors of the economy has narrowed, but significant differences remain. The intra-industry effect clearly dominates in the overall labor productivity dynamics, while the reallocation of labor between sectors has contributed negatively to productivity growth in Slovenia since 2014, although this effect is very small.

Relative Productivity
(Average total economy = 1)

Sources: Haver Analytics, Eurostat and IMF staff calculations.

In Slovenia, as in other European countries, the declining share of employment in manufacturing, which has generally tended to be more productive, has had a negative impact on aggregate productivity growth. A major exception is the pharmaceutical sector where high productivity levels have been accompanied by an increasing share in employment. In services, after a strong positive contribution for years, the shift effect turned negative after the GFC. The change was driven by *Professional, Scientific & Technical Services* and *Finance & Insurance* which recorded higher relative productivity growth but a decreasing share in labor.
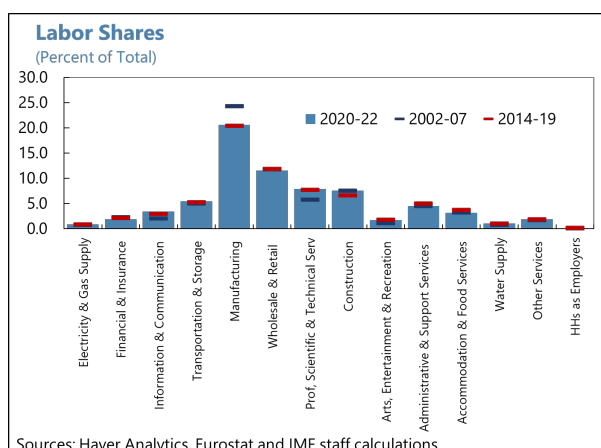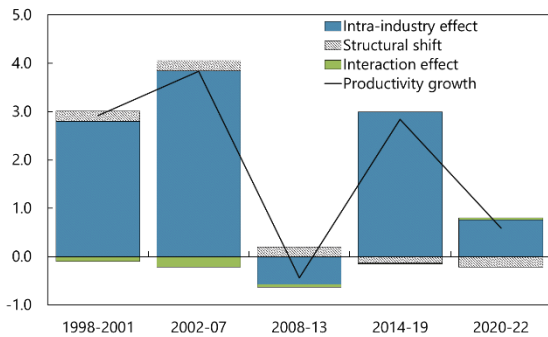

Labor Shares
(Percent of Total)

Sources: Haver Analytics, Eurostat and IMF staff calculations.

Figure A I.1. Slovenia: Shift Share Decomposition
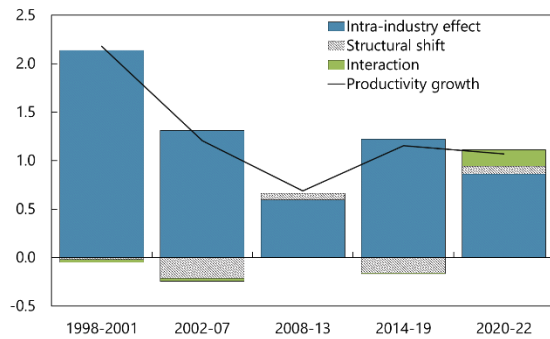
SVN: Labor Productivity Growth
(Percent change and percentage points. Period average)

Sources: Haver Analytics, Eurostat and IMF staff calculations.
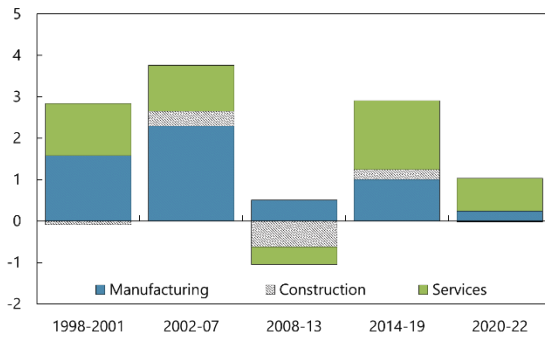
EU: Labor Productivity Growth
(Percent change and percentage points. Period average)

Sources: Haver Analytics, Eurostat and IMF staff calculations.

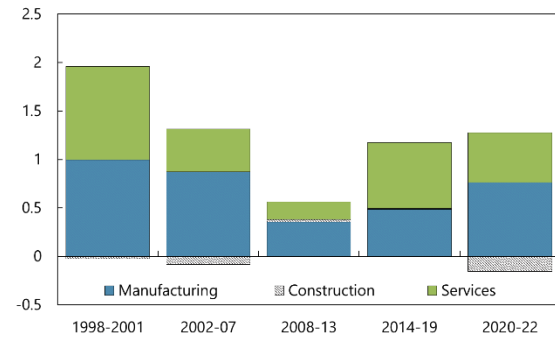## SVN: Intra-industry Contribution to Productivity Growth
(Percentage points)

Sources: Haver Analytics, Eurostat and IMF staff calculations.

EU: Intra-industry Contribution to Productivity Growth
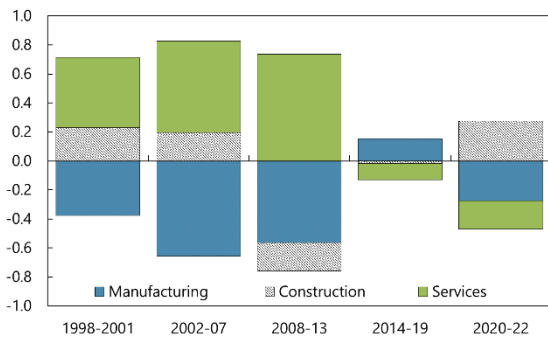(Percentage points)

Sources: Haver Analytics, Eurostat and IMF staff calculations.

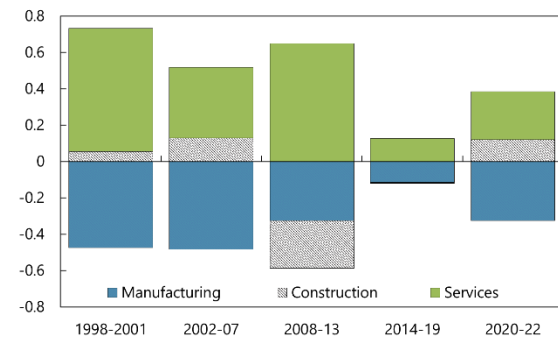## SVN: Structural Shift Contribution to Productivity Growth
(Percentage points)

Sources: Haver Analytics, Eurostat and IMF staff calculations.

EU: Structural Shift Contribution to Productivity Growth
(Percentage points)

Sources: Haver Analytics, Eurostat and IMF staff calculations.

Appendix II. Firm Leverage and Productivity Growth

Motivation: Leverage provides firms with external resources that enable them to invest in new technologies, expand operations and enter new markets. Access to capital can be crucial for growth, especially for companies with high potential and limited internal funds. Since total factor productivity is considered to be the main driver of growth in the long run, it is closely related to firm value. The trade-off theory of optimal capital structure posits that firms choose their mix of debt and equity financing to balance the benefits and cost of debt. This theory predicts that when indebtedness is low, the benefits of debt financing increase as the firm uses the borrowed funds to finance productive investment. After a certain point, however, leverage becomes a drag on growth because of the debt overhang problem and the need to divert attention from productivity improvement to generating cash to service debt (Coricelli et al., 2012).

Methodology: The analysis below follows Coricelli et al. (2012) which considers a non-monotonic (hump-shaped) relationship between leverage and TFP growth. Thus, initially, leverage has a positive impact on TFP growth but beyond a certain threshold, it begins to hurt productivity. To find this turning point, the authors use the framework developed by Hansen (2000), which determines endogenously the existence of a threshold value that splits a sample into two subsamples (or regimes). Specifically, let $y_{i,t+1}$ be firm i's TFP growth between times t and $t+1$, and let $L_{i,t}$ denote the leverage of that firm at time t. Then, the threshold regression model can be written formally as follows:

$$y_{i,t+1} = \alpha_1 L_{i,t} + \beta' X_{i,t} + \epsilon_{i,t} \ if \ L_{i,t} \leq \gamma \qquad (1)$$

$$y_{i,t+1} = \alpha_2 L_{i,t} + \beta' X_{i,t} + \epsilon_{i,t} \ if \ L_{i,t} > \gamma, \qquad (2)$$

where $X_{i,t}$ is a set of other explanatory variables, β is a vector of coefficients, $\epsilon_{i,t}$ are the regression errors, and γ is the threshold value. Hansen (2000) proposes a method to construct asymptotic confidence intervals for the threshold estimates which Coricelli et al. (2012) use to identify three leverage regions—(i) low, when the leverage ratio is below the lower bound of the confidence interval γ_1, (ii) intermediate, when the ratio falls within the confidence interval, and (iii) excessive, when leverage is above the upper bound γ_2:

$$y_{i,t+1} = \alpha_1 L_{i,t} I(L_{i,t} \leq \gamma_1) + \alpha_2 L_{i,t} I(\gamma_1 < L_{i,t} \leq \gamma_2) + \alpha_3 L_{i,t} I(L_{i,t} > \gamma_2) + \beta' X_{i,t} + \epsilon_{i,t}, \qquad (2)$$

where $I(\cdot)$ is the indicator function. The usual distribution theory can be used to test the null hypothesis that $\alpha_1 = \alpha_2 = \alpha_3 = 0$; its rejection would imply the existence of a significant threshold effect.

Data: Firm level data are sourced from the Orbis Bureau van Dijk database, compiled by the IMF's Research Department (Díez et al., 2021). The database includes balance sheet, income statement and

employment data for about 100 thousand firms on average since 2010.[1] In 2020, these companies accounted for about 60 percent of registered employment. Not all companies, however, reported relevant variables, and the quality of reported information varies, with data for small firms generally being less accurate. For the estimation of the leverage threshold model, only companies employing more than one person are included in the sample. Three different measures of leverage are used: (i) the ratio of debt (sum of loans and long-term debt) to total assets; (ii) the ratio of total liabilities to total assets; and (iii) the ratio of debt to equity. Explanatory variables are intangible fixed assets to total assets and two dummy variables—one for small firms (employment less than 50) and one for young firms (five years of age or less).

Descriptive statistics: After truncating, the sample contains about 396 thousand observations; many firms did not, however, report data on long-term debt and loans, with the proportion of missing observations for these two variables being 42 percent and 38 percent, respectively. Thus, for the leverage variable, defined as the ratio of total debt to total assets, there are about 163 thousand observations, representing 45 percent of total. The average leverage value is about 26 percent and it varies very little by firm size, with larger firms reporting slightly lower leverage on average. When firms with zero leverage are excluded, the mean is only slightly higher. Overall, there is no correlation between the leverage ratio and firm size measured by the number of employees, or firm characteristics such as profitability (the ratio of EBIT to total assets) and the share of intangible assets in total assets. There is relatively little variation in the leverage levels by economic sectors, with accommodation and transport having higher debt to asset ratios on average and utilities lower. These results broadly hold when alternative measures of leverage are employed, except that the ratios tend to be lower for larger firms and higher for small and young firms. This is especially the case when the debt-to-equity definition is used. For small and young firms, the ratio is

Correlations

	Leverage	Number of employees	Intangible to total assets	EBIT to total assets
Leverage	1.00			
Number of employees	0.00	1.00		
Intangible to total assets	0.04	0.02	1.00	
EBIT to total assets	-0.01	0.00	-0.01	1.00

Average Leverage Level by Economic Sector
(Ratio of debt to total assets)
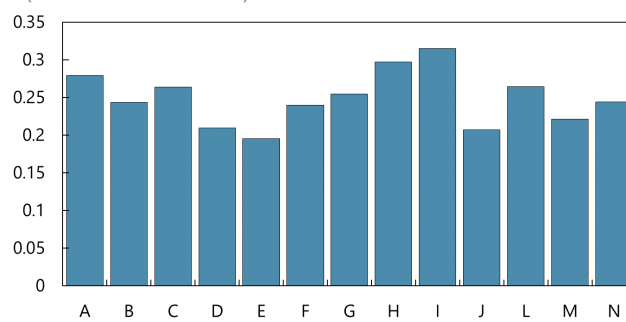
Legend: A: Agriculture, forestry, Fishing; B: Mining and querring; C: Manufacture; D: Electricity, gas, steam; E: Water and sewage; F: Construction; G: Wholesale and retail trade; H: Transport and storage; I: Accomodationa nd food service; J: Information and communication; L: Real estate; M: Professional,

Sources: Orbis Bureau van Dijk database and IMF staff calculations.

significantly higher which reflects the relatively low value of equity relative to assets. While about 10 percent of the young firms and 6 percent of the small firms in the sample have negative equity, for large firms this share is only 0.9 percent.

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[1] While the panel contains data since 1997, the coverage prior to 2010 is significantly smaller (about 13 thousand firms on average).

Table A II.1. Slovenia: Leverage (Debt/Total Assets): Descriptive Statistics

	All	Small (<50 empl.)	Medium (50-249 empl.)	Large (250+ empl.)	Young (< 5 years)
Firms with zero or positive leverage					
Percent of total	44.54	40.89	2.98	0.67	7.81
Mean	0.26	0.26	0.23	0.24	0.27
St. dev.	0.20	0.20	0.19	0.18	0.21
Min	0.00	0.00	0.00	0.00	0.00
p25	0.08	0.09	0.06	0.09	0.08
p50	0.23	0.23	0.21	0.22	0.24
p75	0.40	0.41	0.37	0.37	0.44
Max	0.76	0.76	0.76	0.76	0.76
Firms with positive leverage					
Percent of total	40.7	37.4	2.7	0.6	7.0
Mean	0.28	0.28	0.26	0.26	0.30
St. dev.	0.19	0.19	0.18	0.17	0.20
Min	0.00	0.00	0.00	0.00	0.00
p25	0.12	0.12	0.11	0.12	0.13
p50	0.26	0.26	0.24	0.25	0.28
p75	0.42	0.42	0.39	0.38	0.46
Max	0.76	0.76	0.76	0.76	0.76

Results: The first column of Table A II. 2. shows the estimates from a simple OLS regression which includes leverage as an independent variable, along with initial TFP to test convergence, the share of intangible assets in total and dummy variables for small and young firms. The estimation results suggest a positive contribution of leverage to TFP growth in Slovenia. They also show significant convergence and size effects, with small firms more likely to record lower productivity growth. Columns (2) to (5) present the results from the threshold model of Coricelli et al. (2012) which allows the estimation of a differentiated impact of leverage based on its level. Overall, regardless of the definition of leverage used, it is difficult to distinguish between the impact of different degrees of leverage on TFP growth. In most cases, the point estimates of the coefficients are very close and the hypothesis that they are equal cannot be rejected at the 5 percent level; exceptions are model (4) which uses the ratio of total liabilities to total assets, where the coefficient on high leverage is significantly larger than those of low and medium leverage, and model (5) where low debt to equity ratios are associated with weaker productivity growth. The results are robust to alternative splits of the leverage bands. For example, replacing the relatively wide and asymmetric confidence interval around the threshold in model (2) with a symmetric one at 25 percent below and above the threshold estimate (i.e., [0.14, 0.24]) also yields similar estimates.[2] This is in contrast to Coricelli et al.

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[2] Adding sector dummy variables does not change qualitatively the result.

(2012) who estimate a negative effect of excessive leverage on TFP growth, albeit beyond a higher threshold (0.39) for the debt ratio. Overall, because of the low indebtedness of the Slovenian firms, it appears that there is room to increase leverage without this impacting negatively productivity.

	(1) TFP growth	(2) TFP growth	(3) TFP growth	(4) TFP growth	(5) TFP growth
Table A II.2. Slovenia: Regression Results					
Initial TFP	-0.00279*** (-7.18)	-0.00280*** (-7.21)	-0.00380*** (-10.84)	-0.00405*** (-13.30)	-0.00269*** (-6.76)
Intangible assets ratio	-0.00729 (-1.17)	-0.00735 (-1.18)	-0.00484 (-0.92)	-0.00293 (-0.65)	-0.00507 (-0.79)
Young (dummy)	0.000961 (1.15)	0.000930 (1.12)	-0.0000580 (-0.08)	-0.00212*** (-3.66)	0.0000576 (0.07)
Small (dummy)	-0.00227** (-3.04)	-0.00233** (-3.11)	-0.00212** (-2.93)	-0.00233*** (-3.69)	-0.00219** (-2.89)
Leverage (overall)	0.0164*** (11.29)				
Leverage (low)		0.0358* (2.19)	0.0272** (3.22)	0.00521** (2.98)	-0.00593 (-1.44)
Leverage (medium)		0.0158*** (8.52)	0.0197*** (3.43)	0.00698*** (5.76)	0.00303* (2.44)
Leverage (high)		0.0192*** (9.75)	0.0192*** (13.92)	0.0124*** (12.44)	0.00301*** (11.20)
Constant	-0.0000462 (-0.05)	-0.0000810 (-0.08)	0.000678 (0.72)	0.00144 (1.39)	0.00149 (1.53)
Threshold estimate Confidence interval		0.19127 [0.09040, 0.60726]	0.160472 [0.13190, 0.18509]	0.74934 [0.65288, 0.81394]	0.30789 [0.26572, 0.86484]
N	107718	107718	147474	206537	100014
adj. R-sq	0.002	0.002	0.003	0.003	0.002

t statistics in parentheses: * p<0.05   ** p<0.01   *** p<0.001"

Legend: Model (1) is a simple OLS model with overall leverage defined as the ratio of dent to total assets. Model (2) estimates the threshold model of Coriccelli et al. (2012). Model (3) assumes that long-term debt of firms that do not report it is equal to zero. Model (4) defines leverage as total liabilities to total assets. In Model (5), leverage is defined as the ratio of debt to equity.

Another approach to gauging the TFP growth effect of different leverage levels would be to use a decision tree regression to generate thresholds. Such a model with maximum depth 2 for the debt ratio is shown in the text chart. The first split occurs at a leverage ratio of 0.38 and the next one at leverage ratios of 0.168 and 0.604. The decision tree model estimates that TFP growth increases from -0.6 percent for leverage less than 0.168 to -0.2 percent for leverage in the interval [0.168, 0.38], 0.1 percent for the interval [0.38, 0.604] and 0.6 percent for leverage greater than 0.604. Overall, productivity growth improves with leverage; this does not, however, take into account other explanatory variables.
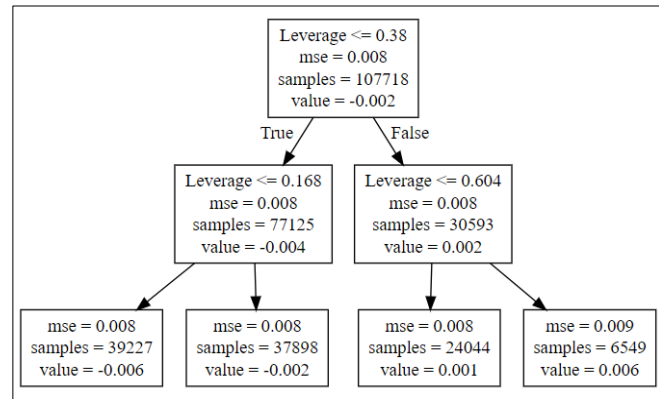
Appendix III. Data and Sources for the Stochastic Frontier Analysis

Variable	Description	Source
Output	Expenditure-side real GDP at chained PPPs (in million 2017 US$)	Penn World Tables 10.1
Labor	Number of persons engaged (millions)	Penn World Tables 10.1
Capital	Capital stock in constant 2017 national prices (in million 2017 US$)	Penn World Tables 10.1
Output gap	Percent deviation of actual GDP from potential	World Economic Outlook database
Regulatory quality	Regulatory quality score	Kaufmann, D., Kraay, A. and M. Mastruzzi (2010)
Employee protection index	Strictness of employment protection – individual and collective dismissals (regular contracts).	OECD
Financial market access	Financial markets access index	Financial Development Index, IMF
Income tax share	Share of individual and corporate income taxes in total tax revenue.	OECD
Informal sector share	Share of informal sector as percent of official GDP (MIMIC method)	Elgin et al. (2021)
Advanced education	Labor force with advanced education (% of total working-age population with advanced education)	World Development Indicators
Human capital index	Human capital index	Penn World Tables 10.1
Tertiary education	Percent of adult population with tertiary education	OECD