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REPUBLIC OF LATVIA

SELECTED ISSUES

September 2024

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Approved By
European Department

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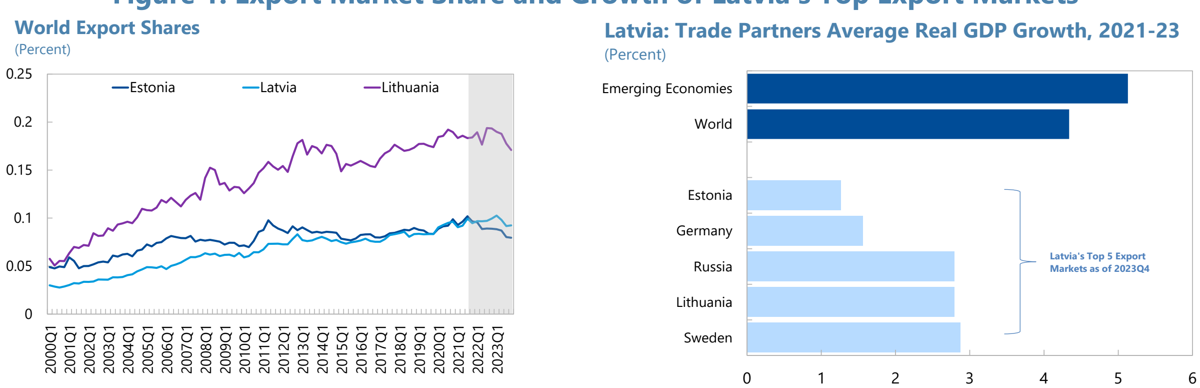
RECENT DEVELOPMENTS IN LATVIA'S COMPETITIVENESS AND PRODUCTIVITY IN THE CONTEXT OF BALTIC ECONOMIES

Latvia's export market share has declined in recent years reflecting weakening external demand and the effects of EU trade sanctions, but only limited loss of competitiveness. While Latvia lags other Baltics in the convergence process and capital deepening, its labor productivity growth was similar to that of other Baltics, powered by relatively strong total factor productivity (TFP) growth. Latvia's strong TFP growth has helped retain its competitive edge, but going forward it is unlikely to be sustained without structural reforms and capital deepening.

A. Introduction

1. **Latvia's export market share increased steadily before the global financial crisis (GFC), but it remained stagnant post-GFC.** Latvia's merchandise exports as a share of global exports have remained stagnant before falling by 6 percent between 2021Q3 and 2023Q4 (Figure 1). The contribution to Latvia's export share decline during 2021Q3 to 2023Q4 by markets such as the UK[1], Germany, Russia, Lithuania and Estonia, was prominent (Figure 2). The immediate cause of this decline was a combination of adverse external shocks. Notably, Russia's war in Ukraine has led to extensive disruptions in supply chains and increased input costs. The underperformance of key external markets has further depressed exports. For Latvia, the export decline was mainly driven by metals, wood, and wood-related sectors.

Figure 1. Export Market Share and Growth of Latvia's Top Export Markets



Sources: Direction of Trade Statistics, IMF; and IMF staff calculations.

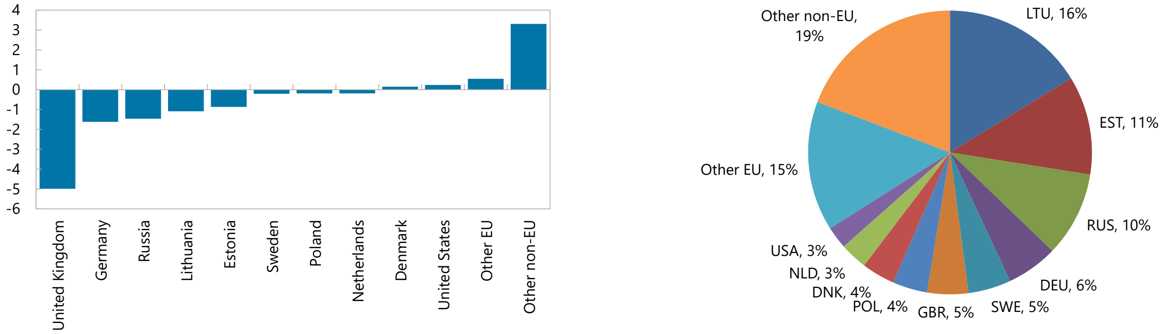
Sources: Direction of Trade Statistics, IMF; World Economic Outlook, IMF; and IMF staff calculations.

[1] The United Kingdom is the eighth largest export destination for Latvia as of 2023. Its negative contribution to Latvia's export share decline during 2021Q3-2023Q4 may be related to the UK's exit from the European Union in 2020.

Figure 2. Country Contribution to Latvia's Export Share Decline and Main Export Destinations

Export Share Decline, 2021Q3-2023Q4
(Percentage points)

Latvia: Export Destinations, 2023Q4
(Percent; share of total exports)



Source: Direction of Trade Statistics, IMF; and IMF staff calculations.

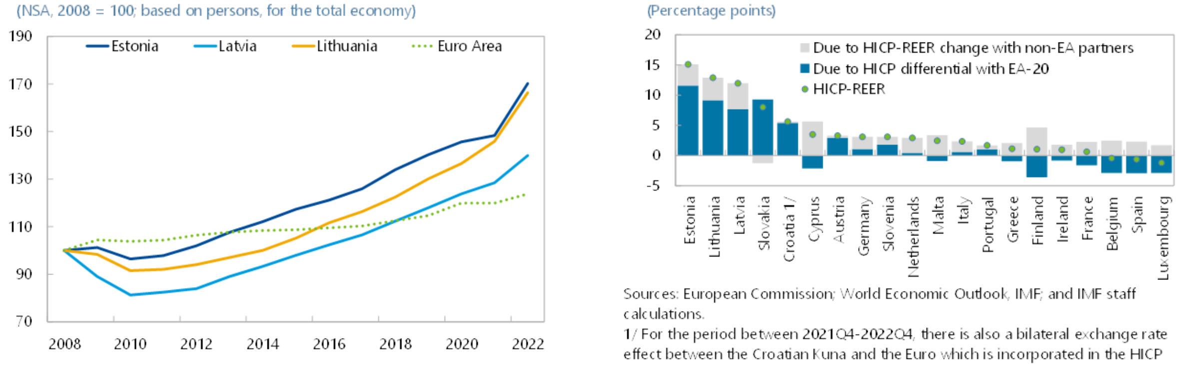
Sources: Direction of Trade Statistics, IMF; and IMF staff calculations.

2. The high inflation differential and labor costs led to an appreciation of Latvia's real effective exchange rate (REER) (Figure 3). Given the large share of energy in the consumer price index basket for the Baltics, the severity of the energy shock resulted in a high inflation rate—twice the euro area average and four times the rate in the lowest-inflation euro area members at one point. At the same time, large nominal wage growth caused unit labor costs to increase. As a result, relative costs in Latvia have increased more than in the euro area, though less than the other Baltic countries (Figure 3). The high inflation rates in the Baltics compared with those in trading partners, combined with large nominal labor costs, undermined the price competitiveness of Latvian exports. Indeed, there was an appreciation of the REER in Latvia and the other Baltics (around 10-15 percent).

Figure 3. ULC and HICP-based Real Effective Exchange Rate

Unit Labor Costs
(NSA, 2008 = 100; based on persons, for the total economy)

Change in HICP-REER, 2021Q4-2023Q4
(Percentage points)



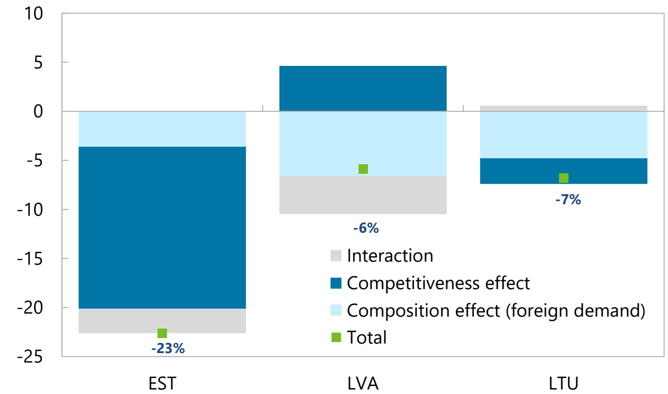
Sources: European Central Bank; and IMF staff calculations.

Sources: European Commission; World Economic Outlook, IMF; and IMF staff calculations.
1/ For the period between 2021Q4-2022Q4, there is also a bilateral exchange rate effect between the Croatian Kuna and the Euro which is incorporated in the HICP differential component.

B. CSA Decomposition: Comparison Across the Baltics

3. A cross-country comparison using a constant share analysis (CSA) shows factors underlying the loss of export shares for Latvia.[2] A CSA decomposition applied to these countries shows that competitiveness issues (the intensive margin) played a much less prominent role overall. In Latvia, both weakening external demand and the effects of EU trade sanctions in response to Russia's war in Ukraine (interaction effect) contributed to the decline in export share during 2021Q3-2023Q4. In Lithuania, the fall in the export share mainly reflected a large contribution from the extensive margin, and hence was mainly associated with shrinking foreign demand. In the case of Estonia, the competitiveness effect played a key role in the decline in export market share decline during the same period. Competitiveness played a less important role in Latvia's decline in export market share despite the appreciation in REER, because the productivity growth in Latvia remained robust until recently.

Baltics: Contribution to Export Share Decline in Goods, 2021Q3-2023Q4 (Percentage points)



Sources: Direction of Trade Statistics, IMF; and IMF staff calculations.

C. An Assessment of the Balassa-Samuelson Hypothesis and Competitiveness in the Baltics

4. An assessment of the Balassa-Samuelson hypothesis shows a cointegration relationship between REER and TFP for Latvia.[3, 4] Johansen cointegration tests indicate a long-run relationship between TFP and REER for all three Baltic countries, which is consistent with the Balassa-Samuelson hypothesis[5]. This cointegration relationship between TFP and the REER can be estimated, and the fitted values can be used to construct a measure of the TFP-based REER as implied by the long-term relationship between the two series. We define the deviation in actual

[2] A constant share analysis (CSA) is used to decompose the export market share change into contribution by the composition effect, i.e. relative size of the export market as measured by the share of total exports to a partner country in the world exports; the contribution by the competitiveness effect, i.e. the export penetration as measured by the share of a given country's exports to a trade partner in the partner's total imports; and the interaction of the composition effect and the competitiveness effect.

[3] We estimate TFP by imposing a standard Cobb-Douglas production function applied to quarterly data of real GDP, labor, and capital inputs over the period from 2002Q1 to 2023Q2. The estimated TFP series is used to assess the Balassa-Samuelson hypothesis in a cointegrating equation with the REER and construct a TFP-consistent REER for the Baltics, which can be used as a benchmark for competitiveness.

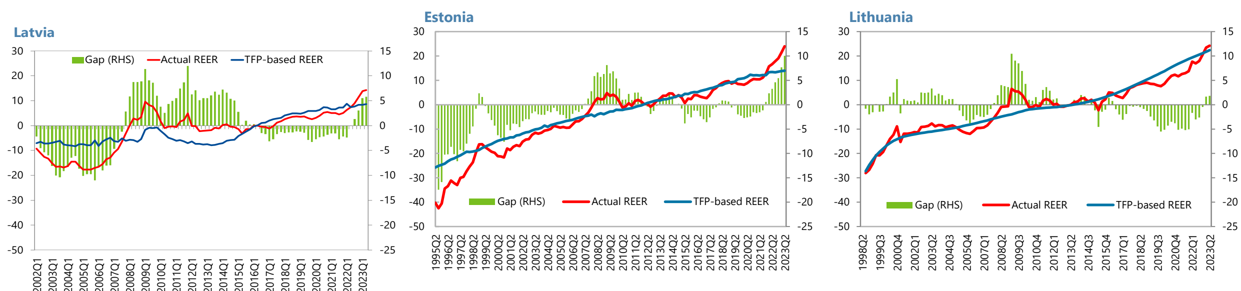
[4] The results show a weak cointegration effect for Latvia, which could be due to measurement problems. However, a cointegration relationship between TFP and trend REER was established for Latvia.

[5] See Balassa (1964) and Samuelson (1964).

REER from the implied TFP-based REER as the REER gap. A negative REER gap indicates price competitiveness advantages.

5. Latvia's competitiveness faded post-GFC. Figure 4 shows actual and estimated TFP-based REER for the Baltics. Prior to the GFC, high TFP relative to REER explained consistently negative REER gaps for the Baltics. In Estonia, negative REER gaps were largely driven by high TFP, whereas in Latvia a depreciating real exchange rate was the main factor. In Lithuania, the gap was negative for a shorter period (between 2004-2007). Post-GFC the competitiveness advantage faded around 2007-2015 for Latvia and 2007-2010 for Estonia. Declining productivity growth in the case of Estonia and real exchange rate appreciation for Latvia drove REER gaps into positive territory after the GFC. Notably, Latvia maintained competitiveness buffer (negative REER gap) during mid-2016 to mid-2022, which helped sustain Latvia's export market share until 2021. The resilience of Latvia during this period was likely a reflection of relatively stronger TFP growth.

Figure 4. Baltics: Actual and TFP-based REER, 1995–2023[1] (Natural logs)

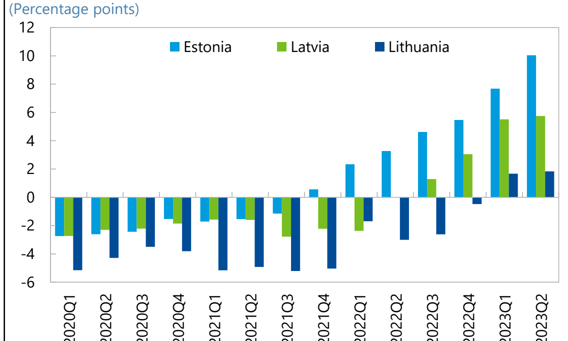


Source: IMF staff estimates

[1] Latvia: 2002Q2-2023Q2; Lithuania: 1998Q3-2023Q2. We use different sample periods for the three Baltic economies to maximize the number of observations. We have conducted a robustness exercise in which we use the same sample period for the three Baltic economies. Results are broadly consistent.

6. Latvia's REER gap became positive in recent years. A decoupling between actual and TFP-based REER in recent years shows that all three Baltic economies had negative REER gaps prior to 2021Q4. However, the negative gaps were much larger in Lithuania and quickly disappeared in both Estonia and Latvia. REER gaps became positive much earlier in Estonia (2021Q4) than in Latvia (2022Q3) and Lithuania (2023Q1) and became wider particularly in Estonia.

Actual and TFP-Based REER Differential
(Percentage points)

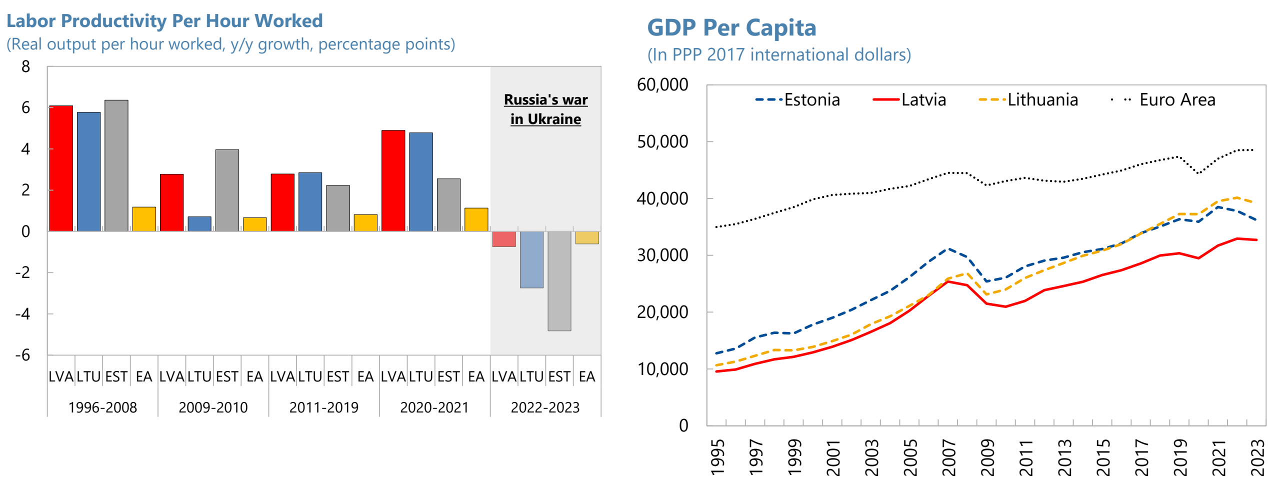


Source: Statistical Authorities; Haver Analytics; and IMF staff calculations.

D. Latvia's Productivity Growth Compared to That of the Other Baltic Economies

7. Latvia's income convergence lags that in the other Baltic economies, while its labor productivity growth declined similarly (Figure 5). The decline in Latvia's productivity growth during 2009-2019 (compared to 1996-2008) partly stemmed from weak investment after the GFC [6]. Compared to that in the other euro area economies, labor productivity in the manufacturing sector of Latvia is relatively low, reflecting inefficient resource allocation, with a prominent share of less productive and less innovative small firms (Yashiro and others, 2019).

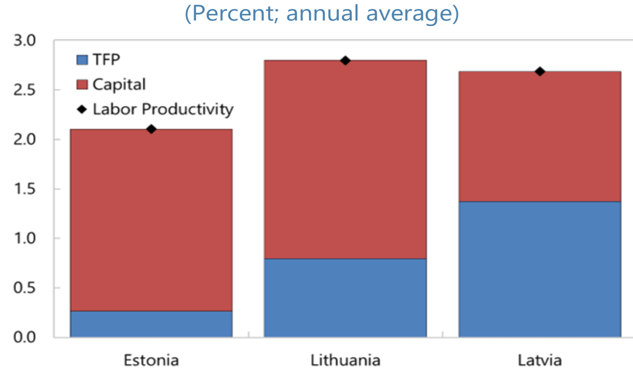
Figure 5. Labor Productivity Growth and Income Convergence



Sources: Haver Analytics; World Economic Outlook, IMF; and IMF staff calculations.

8. Latvia's TFP growth outperformed that of the other Baltic economies, contributing the most to labor productivity growth over the period of 2009-2020. Annual average labor productivity growth was nearly 3 percent in both Latvia and Lithuania, and lower (around 2 percent) in Estonia during this period. The decomposition of labor productivity growth into capital deepening and TFP growth shows that the latter accounted for over half of Latvia's labor

Decomposition of Labor Productivity Growth (2009-2020)
(Percent; annual average)



Sources: EUKLEMS.

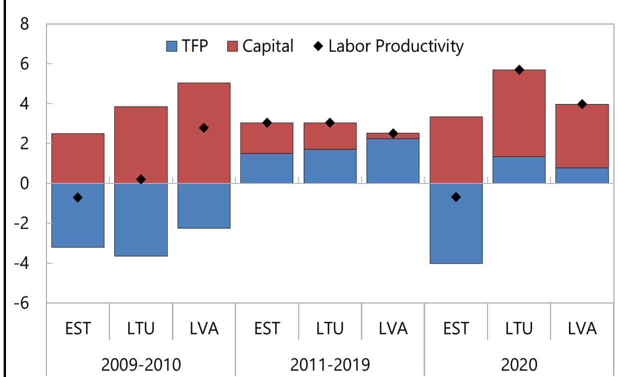
[6] Latvia's decade-long investment weakness stems from pre-GFC excesses (Yashiro and others, 2019, pp. 7).

productivity growth, surpassing Lithuania, and Estonia, where TFP growth accounted for only 20 and 10 percent of labor productivity growth, respectively.

9. The decomposition of labor productivity growth across three distinct episodes reveals that Latvia's stronger TFP-driven growth was limited to the post-GFC recovery period.

- *During the GFC (2009-2010),* Latvia experienced negative TFP growth, like the other Baltic economies, while positive labor productivity growth persisted due to significant capital deepening.
- *During the post-GFC recovery (2011-2019),* labor productivity growth was similar across all Baltic economies, but Latvia's TFP growth surpassed that of other Baltic economies, becoming the primary driver of its labor productivity growth.
- *During COVID-19 pandemic*, TFP growth in Latvia slowed significantly, falling below that for Lithuania.[7]

Decomposition of Labor Productivity Growth (Percent)



Source: EUKLEMS.

Hence, despite Latvia's TFP growth only slightly surpassing that of other Baltic economies during the post-GFC period, it still drove labor productivity growth, compensating for the reduced contribution of capital deepening after the GFC.

10. The relatively rapid TFP growth in Latvia during the post-GFC recovery could be driven by reforms, differences in the economic structure, and measurement errors. Latvia implemented strong reforms during the IMF fund-supported reform program 2009-10 to address the devastating impact of the crisis. These reforms likely contributed significantly to Latvia's post-GFC TFP boost. Differences in economic structure may explain some of Latvia's unique TFP growth pattern (Figure 6). Latvia has lower share of capital-intensive industries (around 20 percent of total value added in 2019), compared to other Baltic economies (close to 30 percent). Less-capital-intensive sectors experienced stronger post-GFC labor productivity growth than capital-intensive sectors in Latvia, likely benefiting from other factors such as technological advancements rather than capital deepening. Furthermore, as TFP is derived as a residual in the production function after considering measured inputs, it is subject to limitations like unobserved factor utilization and potential measurement errors.[8, 9] In addition, the reliance on total investment data suggests that

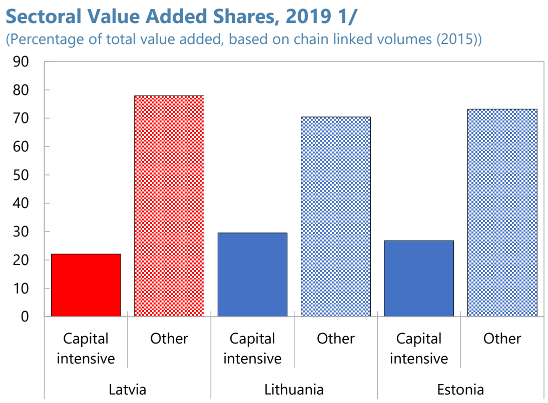
[7] Note that drawing a robust inference about TFP growth is difficult as the EUKLEMS data end at 2020.

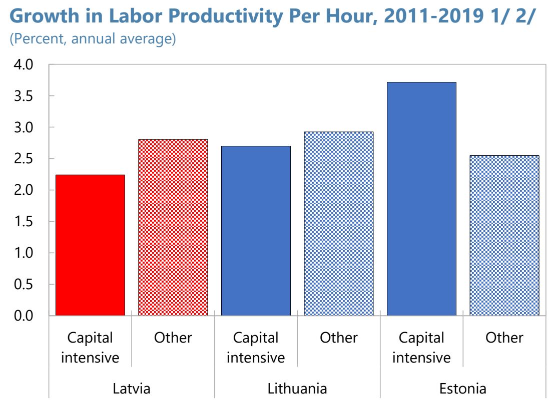
[8] Notably, the large post-GFC drop in gross fixed capital formation and capital stock in Latvia, compared to Lithuania and Estonia, underscores the difficulty in accurately measuring capital inputs.

[9] See Staehr, 2015, highlighting the diverging dynamics in the capital-output ratio of the three Baltic States, with Latvia's capital output ratio declining to 1.1, Lithuania's – constant at 1.9, while that of Estonia – increasing to 2.9.

different developments in residential investment across the Baltics may explain some of the differences in productivity.

Figure 6. Baltics: Sectoral Value Added and Productivity Growth





Source: EUKLEMS and IMF staff calculations.
1/ Capital intensive industries include mining, manufacturing, electricity, water supply, and construction.
2/ Labor productivity calculated as value added (chain linked volumes, 2015) divided by hours worked.

E. Conclusions

11. Latvia faces weakening competitiveness. Latvia's real effective exchange rate (REER) appreciation in recent years has been greater than that implied by its productivity trend, so the economy faces a narrowing competitiveness buffer. Estimates also show that the positive wedge between the actual and TFP-based REER reduced Latvia's external price competitiveness. Reforms in product, capital, and labor markets could also help to retain competitiveness.

12. Latvia's TFP growth boost post-GFC is unlikely to be sustained without structural reforms and efforts to increase capital investment. A decade-long weak investment, large infrastructure gaps, aging and emigration, and insufficient accumulation in skills weigh on Latvia's productivity growth and competitiveness. These also pose risks that Lavia could be caught in a middle-income trap with low growth and slow convergence to euro area income level. Therefore, Latvia requires significantly higher investment for sustained convergence. To preserve Latvia's competitiveness and build more resilience against future shocks, it is key to promote productivity growth via structural reforms and capital investment. Boosting productivity is also needed to meet challenges presented from Russia's war in Ukraine and the ongoing transitions to sustain income convergence.

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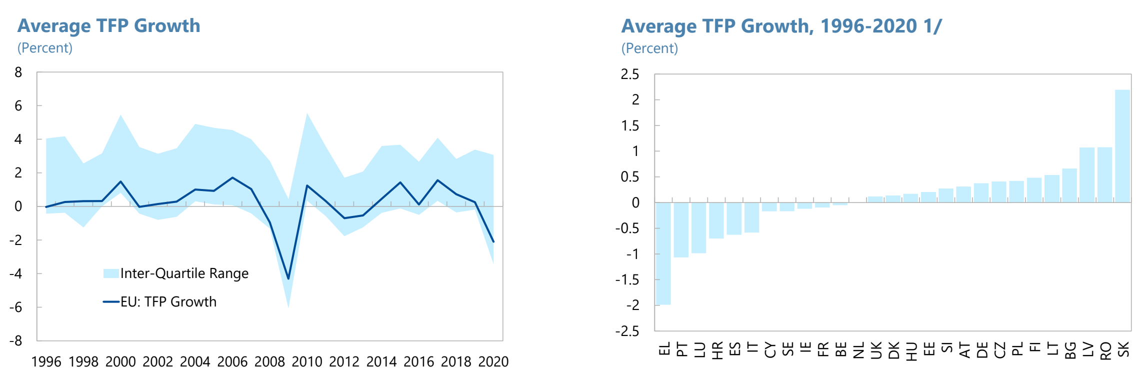
INDUSTRY-LEVEL PRODUCTIVITY DEVELOMENTS[1]

Europe has experienced a barrage of large shocks in recent years that resulted in diverging trends in productivity growth, with significant productivity gaps across industries. Our analysis reveals that TFP growth is driven largely by the extent to which countries are involved in scientific and technological innovation as the leader country or benefiting from knowledge spillovers. The technological gap is a highly significant factor with a substantial economic magnitude in determining TFP growth as countries move towards the technological frontier by adopting new innovations and technologies. Narrowing innovation and technology gaps are key to advancing productivity growth on a sustainable basis. These findings have important policy implications, including policy measures and structural reforms to promote innovation and facilitate the diffusion of new and existing technologies.

A. Introduction

1. Europe has experienced a barrage of large shocks in recent years. These shocks resulted in diverging trends in productivity growth, which is key to raising material living standards, expanding the economy's growth potential, and strengthening international competitiveness. Understanding the determinants of total factor productivity (TFP)—a measure of the efficiency in utilizing factors of production and a crucial contributor to potential growth—is therefore necessary to develop policies that can help strengthen growth prospects.

Figure 1. Total Factor Productivity (TFP) Growth



1/ Time-span covered for each country varies depending on data availability.

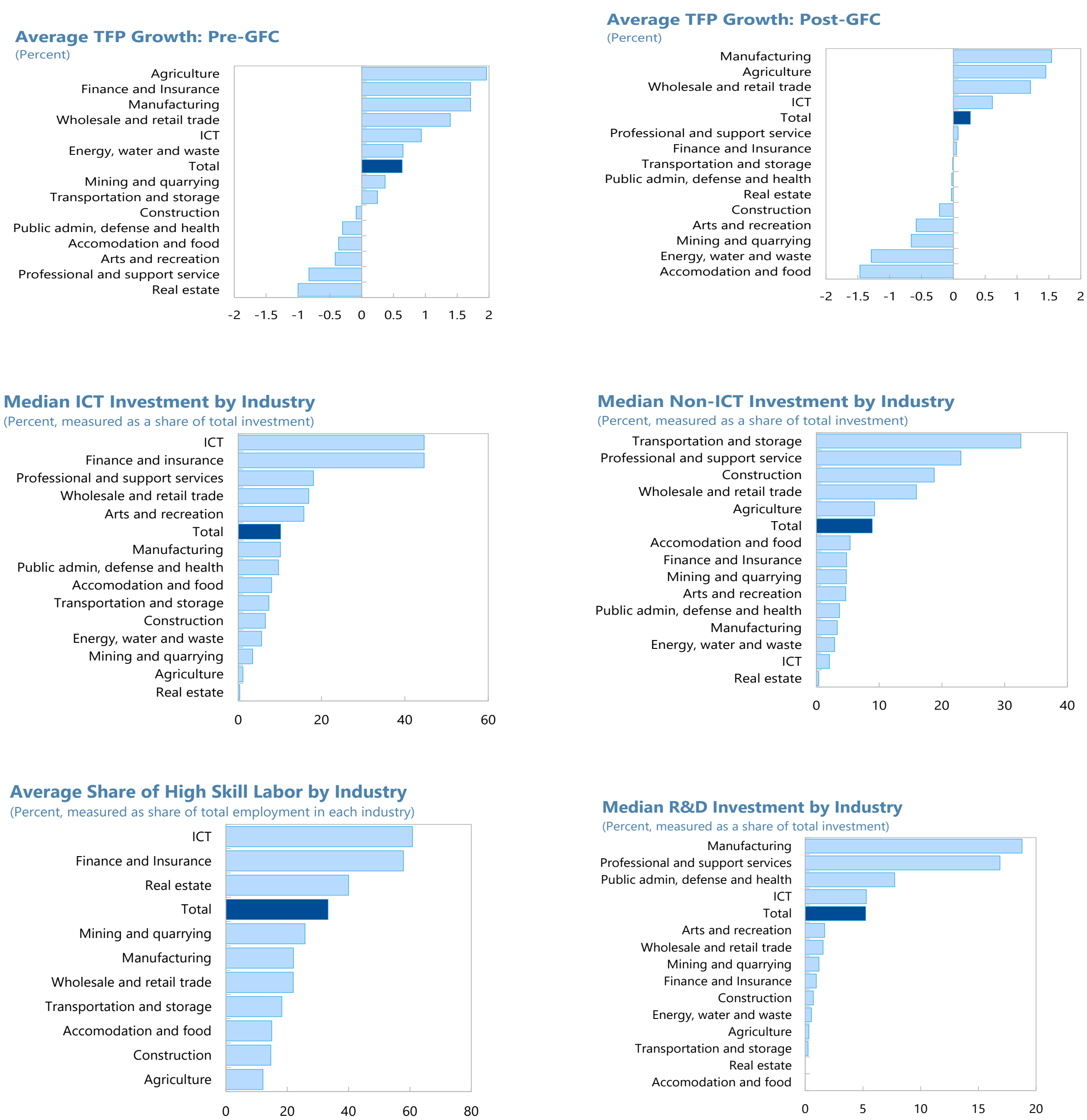
Source: EU KLEMS; authors' calculations.

2. TFP growth has declined in the European Union (EU). An analysis of the data reveals that aggregate TFP growth in the EU declined from an average of 0.7 percent between 1996 and 2007 to 0.1 percent over the period 2009–2019 and -2 percent in 2020 during the COVID-19 pandemic (Figure 1). We also detect significant variation in average TFP growth rates across the EU during the

[1]For more details see forthcoming IMF Working Paper: "Chasing the Dream: Industry-Level Productivity Developments in Europe" by Serhan Cevik, Sadhna Naik, and Keyra Primus.

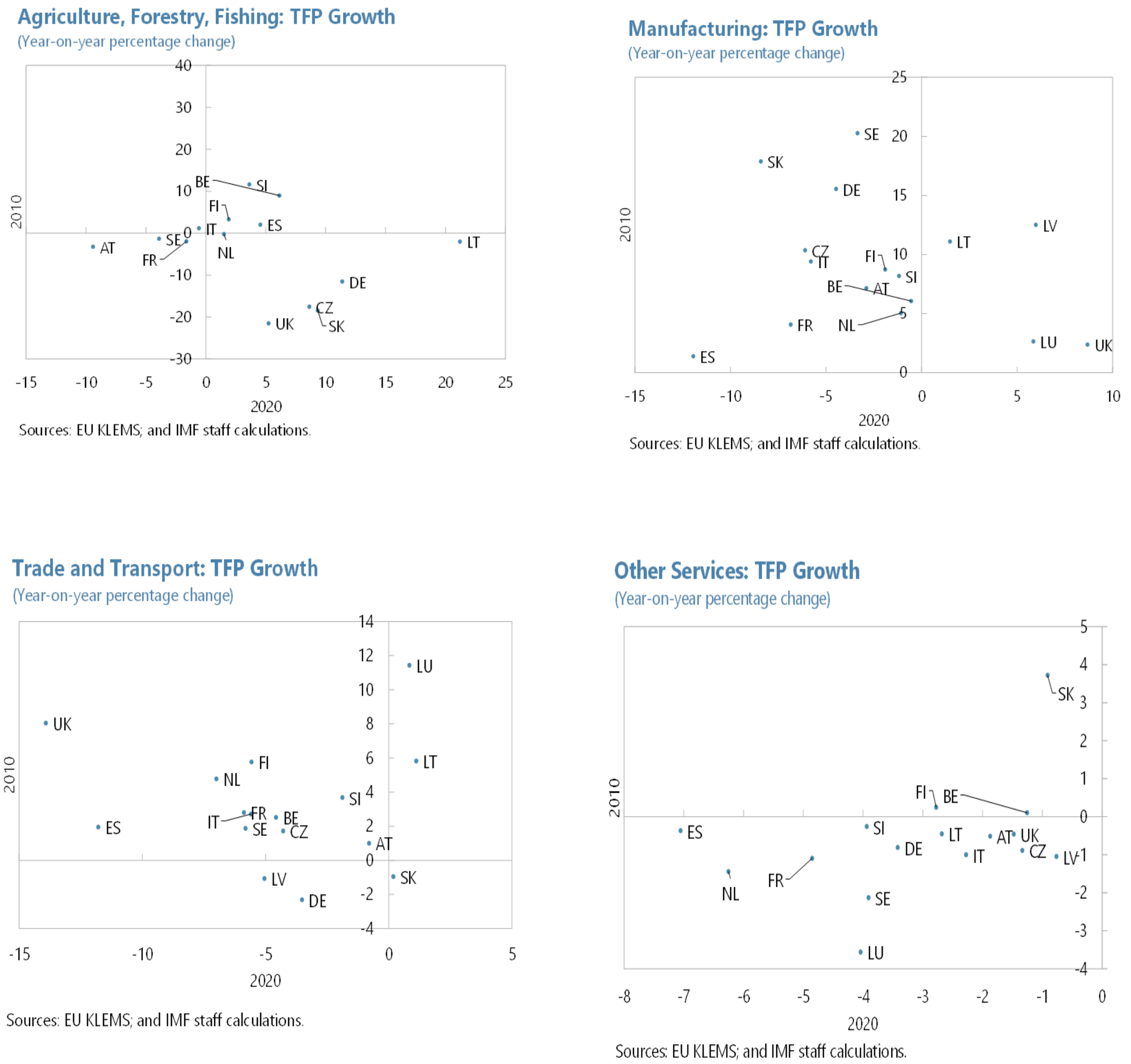
period 1996–2020, with Latvia having the highest TFP growth in the Baltics (around 1 percent on average). These productivity developments at the aggregate level, however, can reflect significant structural differences in human and physical capital accumulation and technological progress at the industry level. We observe similarly substantial variation across sectors and over time (Figure 2). To provide a granular empirical assessment, this paper explores the patterns and sources of TFP growth, focusing on industry-level productivity developments.

Figure 2. Industry-Level Developments



Source: EU KLEMS; and authors' calculations.

Figure 3. TFP Growth in Selected Industries (2010 versus 2020)



B. Methodology

3. We model TFP growth using industry-level data. In this paper, we develop a granular analysis by using comparable industry-level data—drawn from the EU KLEMS dataset—and explore the patterns and sources of TFP growth across the 28 EU countries over the period 1995-2020. Following Scarpetta and Tressel (2002), Nicoletti and Scarpetta (2003), Griffith et al. (2004), Acemoglu et al. (2006), Aghion and Howitt (2006), McMorrow et al. (2010) and Dabla-Norris et al. (2015), we model industry-level TFP growth using the following baseline specification:

$$\Delta y_{ijt} = \beta_0 + \beta_1 \Delta y_{Ljt} + \beta_2 (y_{ijt-1} - y_{Ljt-1}) + \beta_k \sum_k X^k_{ijt-1} + \eta_i + \gamma_j + \mu_t + \varepsilon_{ijt}$$

in which Δy_{ijt} is TFP growth in country i and industry j at time t. Δy_{Ljt} denotes the TFP growth frontier in the EU, which is measured by the highest level of TFP growth in industry j at time t. $(y_{ijt-1} - y_{Ljt-1})$ is the technological gap defined as the TFP difference in country i and industry j at time t with respect to the EU frontier (highest level of TFP) in industry j at time t. X_{ijt-1}^{k} is a vector of industry-level and country-level variables. Industry-level variables include ICT capital spending, non-ICT capital spending, R&D spending, and the share of high-skilled labor, while country-level variables include real GDP per capita, consumer price inflation, trade openness, domestic credit to the private sector, population, and bureaucratic quality. The coefficients η_i, γ_j and μ_t denote the time-invariant industry-specific effects and the time effects controlling for common shocks that may affect TFP growth across all industries at time t, respectively.[1, 2] ε_{ijt} is the idiosyncratic error term. Robust standard errors are clustered at the industry level.

C. Results

4. Our baseline results, presented in Table 1, provide a consistent assessment of industry-level TFP growth in 28 EU countries over the period 1995–2020. We display the specification with country fixed effects in column 1 for the whole sample of industries, in column 2 for tradable sectors, and in column 3 for non-tradable sectors.[3] We replace country fixed effects with a range of country-level control variables and present these estimations in column 4 for the whole sample of industries, in column 5 for tradable sectors, and in column 6 for non-tradable sectors. The findings reveal.[4]

- The TFP growth at the frontier is positive and statistically significant across all specifications of the model, indicating that industry-level TFP growth in all countries is higher when there is stronger TFP growth in the frontier country. This finding indicates that there could be significant cross-border innovation and technology spillovers from the frontier to the rest.[5]

- The technological gap, measured by a country's TFP distance to the frontier, is a significant factor in determining TFP growth as countries move towards the technology frontier by adopting new knowledge and technologies. As such, closing the technological gap would raise TFP growth. The economic contribution of the technological gap is greater than any other factor

[1] Country fixed effects are not included when the model incorporates country-level control variables. The results are not sensitive to replacing country fixed effects with country-level variables, which provide additional information.

[2] The inclusion of fixed effects also helps address endogeneity concerns arising from omitted variable bias.

[3] Tradable sectors include agriculture, forestry, fishing, mining, quarrying, and manufacturing; while non-tradable sectors include construction, wholesale and retail trade, transportation, storage, accommodation, food service, ICT, finance, insurance, real estate, professional services, public sector, education, human health, social work, arts, entertainment, and recreation.

[4] Robustness tests using the system GMM method show similar results to the baseline regressions.

[5] The coefficient on TFP growth at the frontier should be interpreted cautiously because when country i happens to be the leader, the explanatory variable is identical to the dependent variable. Dealing satisfactorily with this issue econometrically is an obvious matter, but the measurement error bias associated with this issue mainly concerns the level of the coefficient, rather than the comparison of this coefficient across alternative specifications, which constitutes part of the focus of this analysis.

in explaining productivity growth dynamics—indicating that most of the cross-country differences in TFP growth can be explained by the technological gap. This is consistent with the view that productivity enhancements are increasingly being driven by innovation, with convergence associated with the adaptation of new and transformative technologies and knowledge spillovers.

- ICT capital spending as a share of gross fixed investment is associated with higher TFP growth and the magnitude and statistical significance of this effect is greater for non-tradables. The positive coefficient on ICT capital spending indicates that an increase in ICT investment generates higher TFP growth in addition to directly raising output. We reason that the ICT effect is not statistically significant for tradables mainly because most manufacturing industries are not ICT- intense in capital spending.

- Non-ICT capital spending (proxied by transportation equipment in this study) as a share of gross fixed investment does not appear to matter for TFP growth across all specifications.

- R&D spending as a share of gross fixed investment appears to have a positive and statistically significant effect on TFP growth across all industries and tradables. This finding, consistent with the impact of ICT capital spending, confirms that an increase in intangible capital is associated with higher TFP growth.

- On the country level variables, real GDP per capita has a positive and statistically significant effect on TFP growth for the full sample of industries, but not in the case of the tradable and non-tradable sectors. Inflation appears to have a negative but insignificant effect on TFP growth across all industries and in the tradable sector, but a positive and insignificant effect on services. Financial development, as measured by domestic credit to the private sector, appears to have a negative effect on TFP growth across all specifications, but it is insignificant. Trade openness has a positive impact on TFP growth across all industries and especially in the case of tradeable industries; but this effect is not significant. We also introduce the institutional dimension with the bureaucratic quality index and find that it has a positive effect on TFP growth, which is statistically significant—at the 5 percent level—for the full sample of industries and non-tradables. Finally, population has a positive coefficient across all specification of the model, but it is insignificant.

Table 1. EU-28: Determinants of Industry-Level TFP Growth: Baseline 1/

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable: TFP growth	All	Tradables	Non-tradables	All	Tradables	Non-tradables
Industry-Level Variables						
TFP growth at frontier	0.174***	0.178***	0.133***	0.158***	0.170***	0.0926**
	(5.783)	(4.659)	(4.071)	(5.225)	(4.581)	(2.395)
Technological gap	-12.45***	-13.68***	-10.43***	-14.34***	-16.19***	-10.88***
	(-9.342)	(-7.910)	(-5.556)	(-8.264)	(-6.974)	(-5.345)
ICT capital	5.536***	3.072	8.657***	5.887**	5.209	7.665**
	(2.837)	(1.140)	(3.634)	(2.627)	(1.522)	(2.494)
Non-ICT capital	-0.933	-8.751	2.533	-1.101	-10.21	3.338
	(-0.319)	(-1.257)	(0.846)	(-0.345)	(-1.544)	(1.118)
R&D spending	7.035**	6.197*	7.990	7.293**	7.729*	5.497
	(2.579)	(1.791)	(1.606)	(2.577)	(1.890)	(1.546)
Country-Level Variables						
Real GDP per capita				3.794*	5.855	1.386
				(1.781)	(1.339)	(0.686)
Inflation				-0.111	-0.252	0.034
				(-1.407)	(-1.554)	(0.525)
Financial development				-0.006	-0.004	-0.010
				(-1.392)	(-0.521)	(-1.478)
Trade openness				0.721	2.708	-0.774
				(0.680)	(1.625)	(-0.460)
Bureaucratic quality				1.425**	1.194	1.892**
				(2.616)	(1.256)	(2.274)
Population				2.969	7.064	7.077
				(0.533)	(0.457)	(1.315)
Number of observations	8,615	4,153	3,644	7,505	3,584	3,200
R2	0.159	0.174	0.144	0.162	0.186	0.138
Country fixed effects	Yes	Yes	Yes	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Robust t-statistics in parentheses; a constant is included in all specifications but not shown.

*** p<0.01, ** p<0.05, * p<0.1

1/ The table is based on EUKLEMS data for 28 EU countries with available data over the period 1995-2020, including Latvia.

5. **Results including data on the share of high-skilled labor show that human capital does not appear to have a significant effect on TFP growth.** Given that data for the share of high-skilled labor are only available from 2008, we present the results separately in Table 2. The findings show that human capital as measured by the intensity of high-skilled labor at the industry level does not appear to have a statistically significant effect on TFP growth at conventional levels, which is

consistent with mixed results in previous studies such as McMorrow et al. (2010).[6] But we obtain some evidence that this effect is stronger the closer a country is to the technological frontier and that human capital matters more in non-tradables than tradable sectors of the economy, after controlling for other factors.

Table 2. EU-28: Determinants of Industry-Level TFP Growth: Baseline with High-Skilled Workers 1/

Dependent Variable: TFP growth	(1) All	(2) Tradables	(3) Non-tradables	(4) All	(5) Tradables	(6) Non-tradables
Industry-Level Variables						
TFP growth at frontier	0.191***	0.181***	0.190***	0.188***	0.180***	0.163***
	(4.415)	(4.028)	(6.454)	(4.393)	(4.033)	(5.368)
Technological gap	-23.68***	-27.85***	-15.19***	-24.13***	-27.93***	-15.44***
	(-7.822)	(-8.359)	(-4.606)	(-7.962)	(-8.137)	(-4.230)
ICT capital	6.908	6.756	10.67*	6.522	7.597	7.162
	(1.571)	(0.933)	(1.955)	(1.557)	(1.071)	(1.646)
Non-ICT capital	-2.773	-22.63*	3.837	-5.377	-23.13*	0.802
	(-0.520)	(-2.006)	(1.067)	(-1.040)	(-2.090)	(0.199)
R&D spending	5.228	7.048	-0.0529	4.530	6.620	-0.684
	(0.887)	(0.875)	(-0.0291)	(0.742)	(0.793)	(-0.363)
Share of high-skilled labor	-0.0240	-0.0678	0.0135	0.001	-0.029	0.0197
	(-0.530)	(-1.624)	(0.269)	(0.0334)	(-0.683)	(0.351)
Country-Level Variables						
Real GDP per capita				9.253***	10.03	6.159
				(2.854)	(1.456)	(1.863)
Inflation				-0.258	-0.573	-0.005
				(-1.308)	(-1.541)	(-0.0331)
Financial development				-0.00129	0.00609	-0.00379
				(-0.193)	(0.503)	(-0.489)
Trade openness				1.583	4.547	-0.586
				(1.003)	(1.664)	(-0.236)
Bureaucratic quality				3.033*	-1.220	5.158**
				(1.771)	(-0.288)	(2.800)
Population				-0.0431	7.464	5.284
				(-0.00436)	(0.273)	(0.523)
Number of observations	4,275	2,196	1,547	4,245	2,194	1,535
R2	0.217	0.233	0.214	0.215	0.235	0.203
Country fixed effects	Yes	Yes	Yes	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Robust t-statistics in parentheses; a constant is included in all specifications but not shown.
*** p<0.01, ** p<0.05, * p<0.1

1/ The table is based on EUKLEMS data for 28 EU countries with available data over the period 1995-2020, including Latvia.

6. An estimation of the pattern and sources of TFP growth in Latvia and Lithuania show similar results to the EU (Table 3)**.** The results, which are subject to greater uncertainty due to the limited number of observations, indicate that industry-level TFP growth is higher when there is stronger TFP growth in the frontier country. The technological gap is a significant factor in determining TFP growth as the Baltics move towards the technology frontier. ICT capital spending as

[6] It should be noted that human capital is key for labor productivity improvements, which are excluded from the TFP measure in the EU KLEMS database.

a share of gross fixed investment is associated with higher TFP growth only when industry-level variables are included in the regression. Similar to the baseline, non-ICT capital spending as a share of gross fixed investment does not appear to matter for TFP growth in the Baltics. However, contrary to the baseline, R&D spending as a share of gross fixed investment has a negative but insignificant effect on TFP growth. On the country level variables, real GDP per capita has a positive and statistically significant effect on TFP growth. Financial development has a negative and statistically significant effect on TFP growth. Both the bureaucratic quality index and population have a positive and significant effect on TFP growth.

Table 3. Latvia and Lithuania: Determinants of Industry-Level TFP Growth

	(1)	(2)
Dependent Variable: TFP growth	All - Industry Level[1]	
	Latvia/Lithuania	
Industry-Level Variables		
TFP growth at frontier	0.293***	0.224***
	(3.102)	(3.125)
Technological gap	-27.77***	-27.83***
	(-4.929)	(-5.138)
ICT capital	18.17*	-0.0142
	(2.046)	(-0.00218)
Non-ICT capital	3.120	-8.486
	(0.362)	(-1.332)
R&D spending	-10.90	-9.883
	(-0.424)	(-0.398)
Country-Level Variables		
Real GDP per capita, log		169.3***
		(3.219)
Inflation		0.824
		(1.072)
Financial development		-0.148**
		(-2.527)
Trade openness		1.323
		(0.233)
Bureaucratic quality		17.77*
		(1.892)
Population, log		173.4**
		(2.684)
Number of observations	315	291
R2	0.367	0.353
Country fixed effects	Yes	No
Industry fixed effects	Yes	Yes
Time fixed effects	Yes	Yes

[1]Industry-level data are available only for Latvia and Lithuania since 2009. Robust t-statistics in parentheses; a constant is included in all specifications but not shown.
*** p<0.01, ** p<0.05, * p<0.1

D. Conclusions

7. Our empirical results, in line with previous studies, highlight four main points. First, TFP growth is driven largely by the extent to which countries are involved in scientific and technological innovation as the leader country or benefiting from knowledge spillovers. Second, the technological gap is a highly significant factor with a substantial economic magnitude in determining TFP growth as countries move towards the technological frontier by adopting new innovations and technologies. Third, increased investment in ICT capital and R&D contributes significantly to higher TFP growth across all EU countries. Fourth, human capital does not appear to have a statistically significant impact on TFP growth, but there is some evidence that this effect is stronger the closer a country is to the technological frontier and human capital matters more in non-tradables than tradable sectors of the economy.

8. The findings presented in this study have important policy implications. Reversing the downward trend in productivity growth is key to raising living standards amid adverse demographic transitions and global economic realignments. First, revamping tangible and intangible capital investment in new technologies can generate higher productivity growth directly and indirectly by closing the technological gap vis-à-vis the frontier. Second, human capital remains critical for rapid progress in science and technology and thereby expanding economic growth potential. Accordingly, policymakers need to give priority to create a conducive environment for higher business investment and better capital allocation by modernizing regulations, lowering trade barriers, increasing public investment in physical infrastructure, strengthening human capital accumulation through education and healthcare, and providing incentives for capital investment and R&D.

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THE ROLE OF ALLOCATIVE EFFICIENCY IN PRODUCTIVITY GROWTH

Resource misallocation has negatively affected total factor productivity growth in all three Baltic economies on average throughout the sample periods of 1997-2020, 2010-2020, and 2000-2020, respectively, for Estonia, Latvia, and Lithuania. In the case of Latvia, allocative efficiency has slightly improved after 2016, but the recovery has been limited. Productivity loss due to resource misallocation is more pronounced for services than for goods sectors. For some Latvian industries such as real estate and transport, allocative inefficiency worsened more significantly during the early period of 2012-2015. Structural reforms in product, capital, and labor markets can help improve allocative efficiency, and therefore promote productivity growth and retain competitiveness for Latvia.

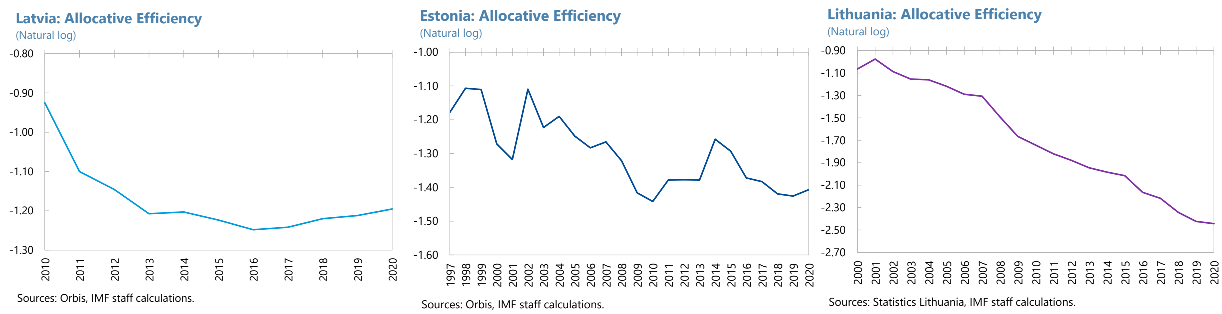
A. Introduction

1. **Allocative efficiency has declined in Latvia and in the Baltic region.** Resource allocation is an important factor underpinning economic growth. In an ideal world, resources flow to where productivity is the highest until the marginal return of an input is equalized across firms and sectors. In this paper, we explore the role of allocative efficiency in promoting total factor productivity growth and supporting competitiveness, using firm-level data for the Baltics[1] and following the methodology of Hsieh and Klenow (2009), Benkovskis (2018) and the IMF World Economic Outlook (April 2024). Intuitively, allocative efficiency is related to the wedge between total factor productivity (TFP) in an ideal case scenario and an alternative scenario with distortions in capital, labor, and output markets. It is reflected in the dispersion of marginal revenue products of capital and labor, which is the marginal revenue generated by one additional unit of these production factors. Our study finds that allocative efficiency has worsened generally in all three Baltic economies, especially for Estonia and Lithuania over the past two decades. In Estonia, there was a limited short-lived recovery after the global financial crisis (GFC). In the case of Latvia, there was a slight recovery after 2016 (Figure 1).[2]

[1] For Estonia and Latvia, we use the Orbis dataset. For Lithuania, we use the administrative data from Statistics Lithuania. Table 1 shows the descriptive statistics on the firms in the sample. Table 2 shows the number of observations by year.

[2] The unit for the vertical axis is the natural log of TFP. Each unit decline in allocative efficiency implies a one unit decline in TFP growth rate.

Figure 1. Allocative Efficiency Has Worsened in the Baltics in General



2. In the cases of Estonia and Lithuania, most of the allocative inefficiency accumulated before the GFC[3]. Representative firm-level data for Latvia is not yet available for years before 2010, so it is not possible to estimate allocative efficiency for the pre-GFC years. In the years leading up to the financial crisis, however, some countries, including the three Baltic economies, experienced real estate bubbles characterized by rapidly rising property prices and speculative investment. Resources were disproportionately allocated to the construction and real estate sectors. This expansion led to excessive borrowing and investment in sectors with lower productivity or unsustainable projects, resulting in misallocation of resources, and thereby worsening allocative efficiency. Government policies, such as subsidies, tax incentives, or regulatory frameworks, may have also adversely influenced the allocation of resources in the economy. We note the difference in estimated allocative efficiency across the three Baltic economies. The difference may be related to the use of administrative data for Lithuania, which has greater coverage of small and micro firms than the Orbis dataset.

B. Methodology: How We Derive Allocative Efficiency

3. We calculate a measure of allocative efficiency using firm-level data. Following Hsieh and Klenow (2009) and IMF (2024), we calculate a measure of allocative efficiency[4] based on the following assumptions. i) Firms' production is characterized by a Cobb-Douglas production function. ii) The aggregation of outputs features constant elasticity of substitution. iii) There are distortions in the capital, labor, and output markets. iv) Firms maximize their profits under monopolistic competition. A given firms' output price is a fixed markup over its marginal cost. The allocation of capital and labor depends not only on firm productivity, but also on the distortions in capital, labor, and output markets. In an ideal world without distortions, TFP at the sector level is an aggregation of the technology component of the firm-level TFP. With distortions in factor and output markets, TFP becomes lower than that in the ideal-case scenario. This wedge is determined by allocative

[3] The Orbis dataset has very limited coverage for Latvian firms for the years before 2010, so we cannot estimate allocative efficiency for the years before the global financial crisis in the case of Latvia.

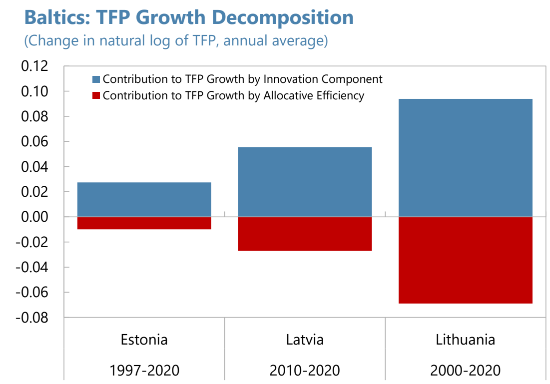
[4] See annex for details on the methodology. For our calculation, we drop sectors such as education, health, and public administration because these sectors are not market oriented.

efficiency. For each unit decline in allocative efficiency, there will be a one unit decline in TFP growth rate (See Annex for more details).

C. Decomposition of TFP Growth

4. Our decomposition exercise shows that allocative inefficiency has negatively contributed to TFP growth. We first aggregate the calculated allocative efficiency up to the sector level, and then decompose country level TFP growth into innovation and allocative efficiency components. The two components are captured by the two terms on the right-hand side of Equation (1). Our results show that allocative inefficiency, or resource misallocation, has negatively affected TFP growth on average in all three Baltics during their respective sample period (Figure 2).

Figure 2. Allocative Inefficiency Has Dragged TFP Growth in the Baltics



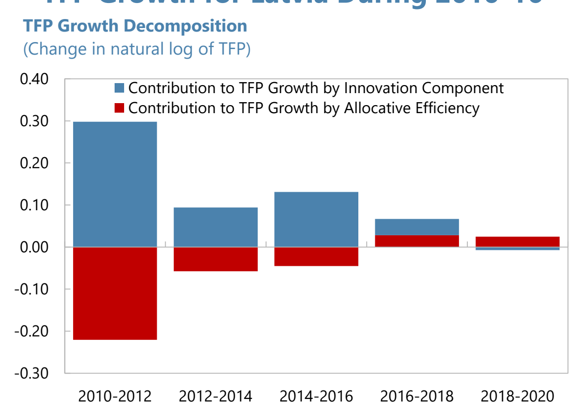
Sources: Orbis, EUKLEMS, Statistics Lithuania, IMF staff calculations.

5. The role of allocative efficiency has varied over time for the Baltic economies, especially before and after the global financial crisis (GFC). Based on equation (1), the contribution of allocative efficiency to

$$\Delta lnTFP_{ct} = \Delta \, ln \, IN_{ct} + \Delta lnAE_{ct} \qquad (1)$$

productivity growth in Estonia was largely negative before the GFC, turned positive during the post-crisis recovery period, but worsened again in recent years. In general, as unviable firms exit the market during economic crises, allocative efficiency tends to improve. In the case of Latvia, improvement in allocative efficiency during 2016-20 may have been driven by a combination of factors, including market corrections in asset prices, reassessment of risks, structural reforms, increased focus on efficiency by businesses, market discipline, and policy interventions that may have facilitated more efficient resource allocation. Our study finds a broadly consistent pattern in the role of allocative efficiency for the Baltic economies, which is in line with previous empirical studies of productivity developments before and after the GFC (for instance see Blanchard et al 2013).

Figure 3. Resource Misallocation Dragged TFP Growth for Latvia During 2010-16



Sources: Orbis, IMF staff calculations.

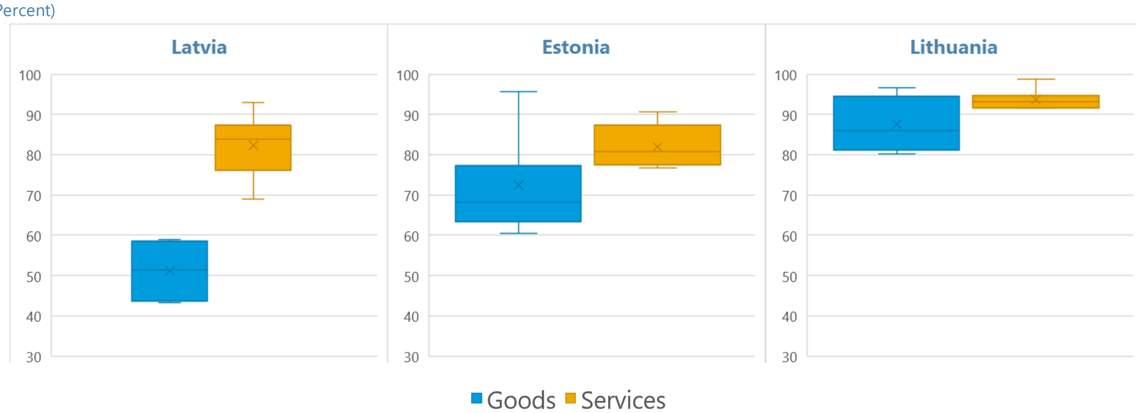
D. Allocative Efficiency in Latvia

6. Productivity loss due to allocative inefficiency has been greater for the service sectors than for the goods sectors. The difference in TFP loss between goods and services sectors is about 30 percentage points for Latvia and 10 percentage points for Estonia, in contrast to a smaller one for Lithuania (about 7 percentage points) (Figure 4[5]). Among the reasons is that the service sectors generally tend to have more market frictions and barriers to competition compared to goods sectors. There may be more product differentiation in services, and firms tend to have greater market power than those in goods sectors. Inefficiencies may also reflect regulatory hurdles, licensing requirements and entry barriers that restrict competition and impede resource reallocation. As a result, inefficient firms in services may persist for longer than in goods sectors. In addition, information and communication technology as well as professional services rely on highly skilled workers. In Latvia, skill shortages in these sectors may have resulted in allocative inefficiency, leading to productivity losses and constraining growth. Certain services in Latvia such as telecommunications, energy and transport may have limited competition, leading to less efficient allocation of resources. The service sectors are typically more labor-intensive than the goods sectors. Labor market frictions in Latvia such as skill mismatches can contribute to allocative inefficiency.

Figure 4. Productivity Loss Due to Allocative Inefficiency Is Worse for Services than Goods

Baltics: TFP Loss Due to Misallocation by Sector Type

(Percent)



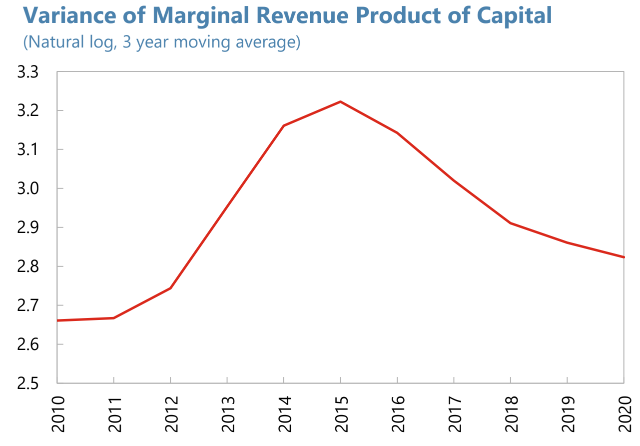
Sources: Orbis, Statistics Lithuania, IMF staff calculations.

Note: The middle lines in the bars represent the median, the x the mean, the bars the interquartile range, and the whiskers the minimum and maximum values across samples in the group. The sample periods for each country are the following: Estonia (1997-2020), Lithuania (2000-2020), and Latvia (2010-2020).

[5] We note that the estimated productivity loss due to allocative inefficiency is greater for Lithuania, which may be due to the fact that the administrative data for Lithuania has more coverage of small and micro enterprises.

7. For Latvia, the allocative efficiency as indicated by marginal revenue product of capital (MRPK) worsened rapidly during 2010-15 but recovered in more recent years (Figure 5). A proxy for allocative inefficiency is the dispersion of marginal revenue product of capital and labor (Hsieh and Klenow 2009). In an ideal world without any distortions, the marginal revenue product of capital and labor is equal to the marginal cost for each respective production factor and equalize across firms. With distortions, there is a dispersion in the marginal revenue products. For instance, we can think of a hypothetical scenario with two otherwise identical firms: one has low productivity but easier subsidized access to credit, while the other has high productivity but must pay a higher premium on access to credit because of distortions in capital markets. If resources were allocated in an optimal manner, more capital would flow to the high-productivity firm, such that the marginal revenue product of capital is equal to the marginal cost of capital. The extent to which the marginal revenue product of capital is dispersed is a measure of the severity of capital misallocation. Figure 5 indicates some improvement in allocative efficiency in terms of capital allocation in Latvia during 2016-20. In contrast, we do not find an increase in the dispersion in marginal revenue product of labor in the case of Latvia, which is consistent with the findings from the literature (for instance, see Benkovskis 2018).

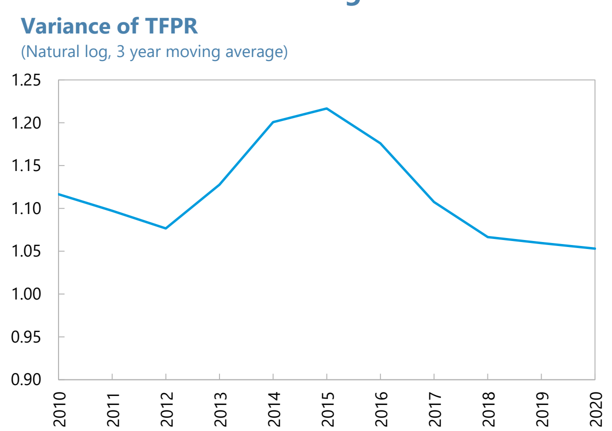
Figure 5. Variance of MRPK Fell in Recent Years but Still Stood Above the Level in 2010



Sources: Orbis, IMF staff calculations.

8. In Latvia, the dispersion in revenue productivity also increased during 2012-15 before a more recent decline (Figure 6). The variance of productivity across firms is also an indicator of allocative inefficiency. Unproductive firms may coexist with productive firms if the economy is not sufficiently dynamic, and resources are not guided by strong market discipline (Decker et al 2017). A wide dispersion in productivity levels among firms or sectors within an economy suggests that capital, labor, and technology are not being allocated in an optimal manner. Some firms may be operating at significantly higher levels of productivity than others, indicating that resources are misallocated towards lower-productivity firms. Such dispersion may be due to market distortions, such as barriers to entry, imperfect competition, information asymmetry, or government intervention. A wide dispersion in firm-level productivity implies a potential for improvement in

Figure 6. Dispersion in Revenue Productivity Increased During 2012-15



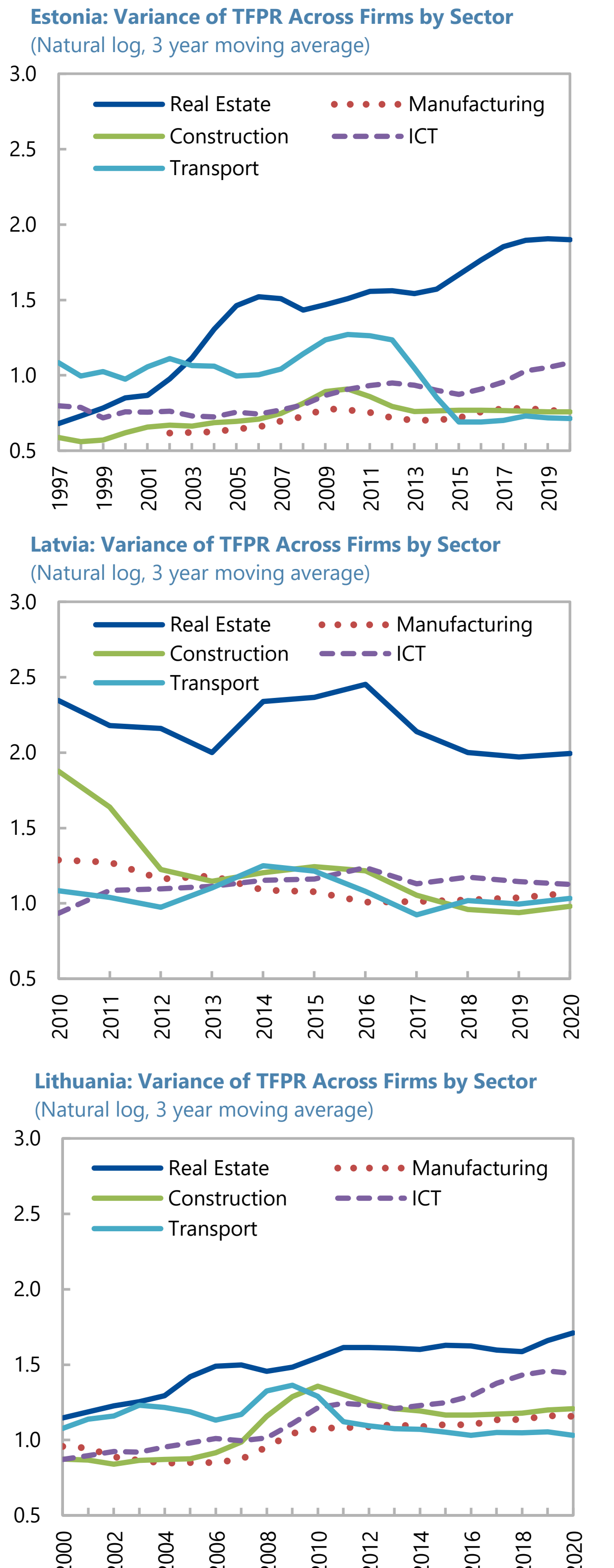
Sources: Orbis, IMF staff calculations.

resource allocation. Figure 6 suggests that allocative efficiency might have improved in terms of the equalization of productivity across firms in the more recent years of 2016-20.

9. The increasing dispersion in productivity in the earlier period of 2012-15 is more prominent for the real estate and transport sectors in Latvia, providing further evidence for allocative inefficiency, despite a slight improvement in 2016-20 (Figure 7). Market structure within these sectors may have contributed to dispersion in productivity. In industries with limited competition and higher barriers to entry, firms may face less pressure to improve productivity or innovate. And with less competition, inefficient firms may survive along with more productive firms, leading to wider dispersion in productivity. Industries such as construction, real estate, and transport tend to involve heterogeneous resources and assets. In the case of real estate, factors such as location, property quality, and market demand can vary significantly and lead to dispersion in productivity among firms. Rapid increases in real estate prices driven by speculation rather than fundamental demand can lead to misallocation of resources. Restrictive zoning laws and regulations may limit firms' ability to respond quickly to changes in demand, causing delays in new construction, which reduces the efficiency of resource allocation. Overall, the increasing dispersion in productivity in 2012-15 suggests that allocative inefficiency worsened, likely undermining productivity growth. Figure 7 shows that allocative efficiency improved slightly for the real estate and construction sectors of Latvia in the recent years of 2016-20, which is consistent with our results at the aggregate level (Figure 6). In the cases of Estonia and Lithuania, there was no such improvement in the measured allocative efficiency in the real estate and construction sectors. However, it is worth noting that allocative efficiency improved in the transport sector in Estonia and Lithuania after the GFC.

10. However, there are some caveats to the abovementioned findings at the sector level, due to measurement problems. Multinational companies play a prominent role in the Latvian economy. The value added of Latvian subsidiaries of global companies may be underestimated if the value added of the parent companies are overreported. Under such circumstances, the measured dispersion of TFP is higher and the calculated potential loss of TFP for Latvian firms due to allocative inefficiency may be overestimated. Another issue is that the investment in research and development by Latvian subsidiaries may be registered within the parent companies overseas. As a result, the total factor productivity of Latvian subsidiaries may be overestimated. This bias would also lead to an overestimation of the potential TFP loss due to allocative inefficiency. Benkovskis (2018) offers a detailed discussion of the potential bias in the estimation of allocative efficiency due to the product fragmentation among firms. The study finds that allocative inefficiency is overestimated for industries where a great proportion of firms are re-exporters.

Figure 7. Allocative Efficiency Varies by Sector

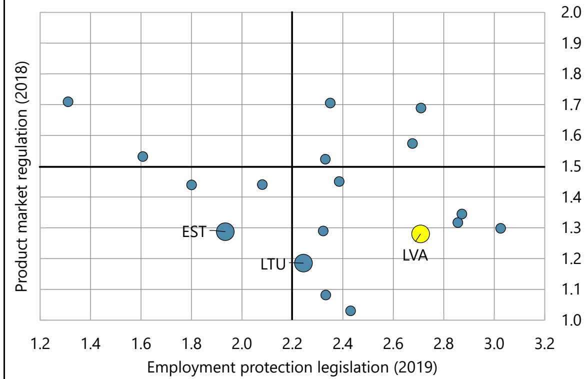


Sources: Orbis, Statistics Lithuania, and IMF staff calculations.

E. Exploring the Relationship Between Allocative Efficiency and Regulation

11. Latvia has relatively flexible product market regulation and stringent labor market regulation, as compared to the rest of the Baltic economies and other advanced economies (Figure 8). The Employment Protection Legislation indicators by the OECD indicates that Latvia has relatively strict employment protection legislation in terms of higher severance pay for low tenure employees, stricter definitions of unfair dismissal including the exclusion of non-performance-related reasons, and generous availability for re-instatement after an employee's dismissal. It is more costly to dismiss an individual worker under a regular contract in Latvia than other OECD economies.

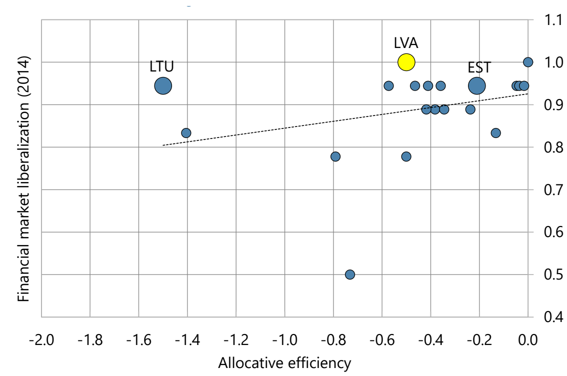
Figure 8. Latvia Has Relatively Stringent Employment Protection Legislation



Source: OECD.

12. Structural reforms may help improve allocative efficiency, support productivity growth, and preserve competitiveness for Latvia. Less regulation in product market and more liberalization in financial and labor markets are generally associated with better allocative efficiency (IMF 2024). Indicators of product market regulation and financial market liberalization place Latvia and the other Baltic economies in a favorable position compared to other advanced and emerging market economies (Figures 9 and 10). However, we find evidence in the dispersion of marginal revenue product of capital among Latvian firms, which indicates the impact of distortions in the capital market. Indeed, one could be concerned over the tight credit conditions and limited access to finance by small firms in Latvia (Benkovskis 2015). When it comes to labor market liberalization, evidence from the IMF structural reforms and OECD employment protection legislation datasets suggests some room for improvement (Figure 11). Labor market measures protecting jobs in economic downturns may come at the cost of labor market flexibility. For instance, recent research suggests that government programs such as job retention schemes in response to the pandemic may have hampered efficient labor allocation and led to productivity losses (Meriküll and Paulus 2024).

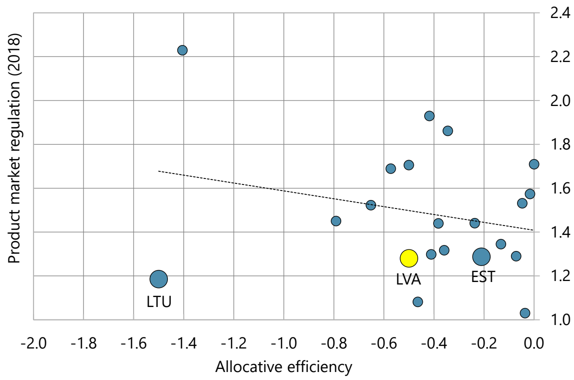
Figure 9. Allocative Efficiency and Financial Market Liberalization



Sources: IMF World Economic Outlook, Chapter 3 (April 2024); IMF structural reforms dataset; Orbis; Statistics Lithuania; IMF staff estimations.

Note: The calculated allocative efficiency values are standardized using the USA as the benchmark.

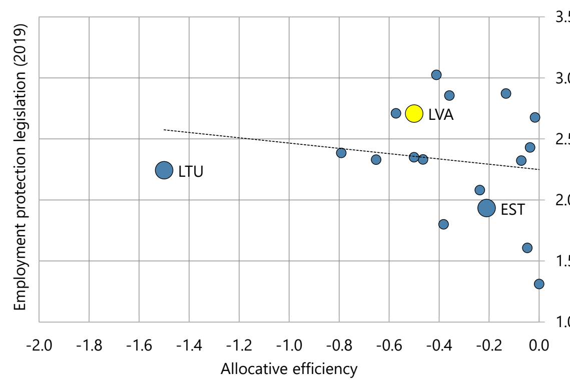
Figure 10. Allocative Efficiency and Product Market Regulation



Sources: IMF World Economic Outlook, Chapter 3 (April 2024); OECD; Orbis; Statistics Lithuania; IMF staff estimations.

Note: The calculated allocative efficiency values are standardized using the USA as the benchmark.

Figure 11. Allocative Efficiency and Employment Protection Legislation



Sources: IMF World Economic Outlook, Chapter 3 (April 2024); OECD; Orbis; Statistics Lithuania; IMF staff estimations.

Note: The calculated allocative efficiency values are standardized using the USA as the benchmark.

Table 1. Estonia, Latvia, and Lithuania: Descriptive Statistics of the Firm-Level Dataset in the Year 2020

	Estonia				Lithuania				Latvia				Total			
	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median
Number of firms	21,417				39,310				2,342				63,069			
Number of employees	1	2,900	8	3	1	12,448	20	6	1	1,936	11	3	1	12,448	16	5
Value added (real)	254	132,026,320	403,983	84,794	375	565,572,864	720,838	143,519	99	327,708,576	740,225	51,865	99	565,572,864	613,960	115,814
Capital (real)	13	1,104,034,176	500,919	24,008	1	1,447,295,360	769,084	25,337	19	2,396,316,416	2,909,459	26,143	1	2,396,316,416	757,501	24,871
Labor costs (real)	26	53,476,432	179,551	31,468	4,376	124,939,888	268,132	47,606	4	63,504,840	192,305	14,922	4	124,939,888	235,236	40,250
Fixed assets (nominal)	29	1,489,453,184	906,524	35,340	1	1,610,169,344	632,402	24,813	17	2,832,126,720	3,344,534	24,873	1	2,832,126,720	826,200	27,989
Sales (nominal)	0	642,218,368	1,442,235	204,388	6	1,689,164,032	2,224,878	254,339	1,517,922	233,755,056	117,625,649	117,603,968	0	1,689,164,032	1,954,623	235,236
Firm age	1	119	13	12	2	32	14	12	1	30	15	14	1	119	14	12

	Estonia															
	Micro (0-9)				Small (10-49)				Medium (50-249)				Large (250+)			
	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median
Number of firms	17,226				2,768				364				1,059			
Number of employees	1	9	3	2	10	49	19	16	50	249	97	81	256	2,900	665	427
Value added (real)	690	10,225,642	120,926	68,509	6,013	20,921,492	842,611	563,400	66,088	98,424,600	4,733,914	3,558,014	254	132,026,320	2,373,500	32,958
Capital (real)	13	10,560,667	89,071	18,293	337	59,193,528	721,221	148,537	1,012	1,004,110,464	6,352,005	1,453,743	63	1,104,034,176	4,613,206	15,753
Labor costs (real)	26	1,046,157	44,229	24,928	2,869	2,626,634	408,670	305,372	19,185	12,112,608	2,370,713	1,932,500	41	53,476,432	1,028,722	4,831
Fixed assets (nominal)	29	53,988,468	172,825	26,288	405	238,168,720	1,114,198	222,688	1,214	1,205,130,496	9,679,733	2,134,857	76	1,489,453,184	9,282,728	26,432
Sales (nominal)	0	29,685,102	376,552	161,514	0	124,736,952	2,888,221	1,415,897	199,780	354,669,728	17,514,255	9,969,563	0	642,218,368	9,484,331	76,251
Firm age	1	88	13	11	1	108	17	17	2	119	22	22	1	114	14	11

	Lithuania															
	Micro (0-9)				Small (10-49)				Medium (50-249)				Large (250+)			
	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median
Number of firms	26,539				10,255				2,122				394			
Number of employees	1	9	4	4	10	49	20	17	50	249	100	82	251	12,448	647	418
Value added (real)	375	12,691,636	143,095	82,749	1,465	27,186,946	732,172	468,166	44,542	147,294,064	3,709,423	2,532,105	934,978	565,572,864	23,245,504	12,774,640
Capital (real)	1	172,109,664	189,669	13,281	1	309,000,032	596,794	78,964	141	547,576,384	3,433,666	772,911	1,679	1,447,295,360	29,930,667	5,644,685
Labor costs (real)	4,376	866,721	39,039	27,653	5,117	4,387,157	254,796	181,048	132,242	9,346,648	1,515,251	1,188,186	739,215	124,939,888	9,329,737	6,257,431
Fixed assets (nominal)	1	195,852,560	159,020	13,286	1	352,456,608	446,453	74,436	2	615,999,808	2,849,067	629,228	911	1,610,169,344	25,419,793	4,026,424
Sales (nominal)	6	75,239,544	415,943	136,432	84	441,529,696	2,204,196	814,597	55,857	479,098,592	11,255,161	5,535,391	1,091,714	1,689,164,032	75,974,045	29,706,402
Firm age	2	32	13	11	3	32	16	15	4	32	15	13	3	30	22	28

	Latvia															
	Micro (0-9)				Small (10-49)				Medium (50-249)				Large (250+)			
	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median	Minimum	Maximum	Mean	Median
Number of firms	1,991				268				33				50			
Number of employees	1	9	3	2	10	49	18	15	50	228	81	75	252	1,936	689	515
Value added (real)	99	3,660,516	91,696	40,305	9,690	13,043,975	677,123	315,358	673,998	45,235,436	5,281,787	2,719,094	2,970	327,708,576	23,905,438	83,884
Capital (real)	19	7,757,013	206,843	19,407	345	84,149,280	1,178,316	139,153	41,775	33,417,588	4,834,881	1,023,621	274	2,396,316,416	118,535,771	288,132
Labor costs (real)	4	470,312	20,814	12,550	6,344	1,539,835	202,044	130,432	479,024	6,702,701	1,569,422	1,092,468	7	63,504,840	6,059,975	1,570
Fixed assets (nominal)	17	7,011,798	190,692	18,312	312	83,820,152	1,180,991	131,048	37,762	30,207,168	5,313,280	1,070,523	248	2,832,126,720	139,227,736	260,451
Sales (nominal)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	117,603,968	233,755,056	175,679,512	175,679,512
Firm age	1	30	15	13	1	30	17	18	5	30	23	27	1	30	22	27

Sources: Statistics Lithuania, Orbis, and IMF staff calculations.

Note: For Estonia and Latvia, the data source is Orbis which reports financial variables in USD. For Lithuania, the data source is Statistics Lithuania which reports financial variables in EUR.

Table 2. Estonia, Latvia, and Lithuania: Number of Observations

	Estonia	Lithuania	Latvia	*Total*
1997	2,088	0	0	*2,088*
1998	3,223	0	0	*3,223*
1999	4,695	0	0	*4,695*
2000	5,394	15,015	0	*20,409*
2001	5,926	12,061	0	*17,987*
2002	8,649	16,530	0	*25,179*
2003	9,421	16,906	0	*26,327*
2004	10,352	18,486	0	*28,838*
2005	11,103	20,605	0	*31,708*
2006	12,401	23,235	0	*35,636*
2007	13,873	26,487	0	*40,360*
2008	14,453	28,135	0	*42,588*
2009	13,876	25,751	0	*39,627*
2010	15,836	25,372	1,438	*42,646*
2011	17,869	27,027	1,567	*46,463*
2012	19,094	28,815	1,689	*49,598*
2013	20,108	30,749	1,796	*52,653*
2014	23,286	32,084	1,831	*57,201*
2015	24,544	33,767	2,370	*60,681*
2016	22,998	35,174	2,467	*60,639*
2017	22,903	36,243	2,406	*61,552*
2018	23,621	37,345	2,381	*63,347*
2019	23,999	39,029	2,373	*65,401*
2020	21,417	39,310	2,342	*63,069*
Total	*351,129*	*568,126*	*22,660*	*941,915*

Sources: Statistics Lithuania, Orbis, and IMF staff calculations.

Annex I. How We Derive Allocative Efficiency

1. **We calculate a measure of allocative efficiency using firm-level data.** Following Hsieh and Klenow (2009) and IMF (2024), we introduce the following assumptions:

- A Cobb-Douglas production function at the firm level, where α_{cs} represents the country-sector specific capital share. Y_{csit}, A_{csit}, K_{csit}, and L_{csit} represent output, technology, capital, and labor at the firm level. The subscripts *c, s, i,* and *t* represent country, sector, firm, and year, respectively.

$$Y_{csit} = A_{csit} K_{csit}^{\alpha_{cs}} L_{csit}^{1-\alpha_{cs}} \tag{1}$$

- Aggregation with constant elasticity of substitution, where σ_c represents the elasticity of

$$Y_{cst} = \left(\sum_{i=1}^{I_{cst}} Y_{csit}^{\frac{\sigma_c - 1}{\sigma_c}} \right)^{\frac{\sigma_c}{\sigma_c - 1}} \tag{2}$$

  substitution. Lower case i indicates sector i.

- Distortions in output, capital, and labor markets. The distortions on capital and labor markets increase the effective cost of capital and labor by τ_K and τ_L, respectively. τ_Y represents a tax on output. τ_{csit} is defined as a function of the distortions on capital, labor, and output markets.

- Firms maximize profits under monopolistic competition, by choosing the optimal amount of capital (*K*) and labor (*L*) such that the marginal revenue product of each input factor is equal to

$$\tau_{csit} \equiv (1 + \tau_{Kcsit})^{\alpha_{cs}} (1 + \tau_{Lcsit})^{1-\alpha_{cs}} / (1 - \tau_{Ycsit}) \tag{3}$$

  its marginal cost, as described by Equations (4) and (5). r_{cst} and w_{cst} are the cost of capital and

$$K_{cst} = \frac{\alpha_{cs}}{r_{cst}} \frac{\sigma_c - 1}{\sigma_c} \sum_{i=1}^{I_{cst}} \frac{(1 - \tau_{Ycsit}) P_{csit} Y_{csit}}{1 + \tau_{Kcsit}}, \tag{4}$$

$$L_{cst} = \frac{1 - \alpha_{cs}}{w_{cst}} \frac{\sigma_c - 1}{\sigma_c} \sum_{i=1}^{I_{cst}} \frac{(1 - \tau_{Ycsit}) P_{csit} Y_{csit}}{1 + \tau_{Lcsit}}, \tag{5}$$

  labor, respectively, at the sector level. Profit maximization is such that the firm's output price is a fixed markup over its marginal cost.

- Equation (6) gives the output in the equilibrium. As illustrated by equation (7), the marginal revenue product of capital and labor, will not be equalized due to the distortions.

$$Y_{cst} = \frac{\left(\frac{A_{csit}}{\tau_{csit}}\right)^{\sigma_c} K_{cst}^{\alpha_{cs}} L_{cst}^{1-\alpha_{cs}}}{\left[\sum_{i=1}^{I_{cst}} \left(\frac{A_{csit}}{\tau_{csit}}\right)^{\sigma_c - 1} \frac{1-\tau_{Ycsit}}{1+\tau_{Kcsit}}\right]^{\alpha_{cs}} \left[\sum_{i=1}^{I_{cst}} \left(\frac{A_{csit}}{\tau_{csit}}\right)^{\sigma_c - 1} \frac{1-\tau_{Ycsit}}{1+\tau_{Lcsit}}\right]^{1-\alpha_{cs}}} \quad (6)$$

$$\frac{MRPK_{csit}}{r_{cst}} = \frac{1+\tau_{Kcsit}}{1-\tau_{Ycsit}}, \qquad \frac{MRPL_{csit}}{w_{cst}} = \frac{1+\tau_{Lcsit}}{1-\tau_{Ycsit}} \quad (7)$$

- Equations (8) and (9) illustrate the fact that in an ideal world without distortions, total factor productivity at the sector level is an aggregation of the technology component of the firm-level productivity *A*, since the distortion parameters τ_{csit} and τ_{cst} both equal 1 in that case. With distortions on factor and output markets, total factor productivity becomes lower than that in the ideal-case scenario. This wedge is represented by the term AE in Equation (10). For each unit decline in allocative efficiency, there will be a one-percentage point decline in TFP growth.

$$TFP_{cst} \equiv \left[\sum_{i=1}^{I_{cst}} A_{csit}^{\sigma_c - 1} \left(\frac{\tau_{csit}}{\tau_{cst}}\right)^{1-\sigma_c}\right]^{\frac{1}{\sigma_c - 1}} \quad (8)$$

$$Y_{cst} = TFP_{cst} K_{cst}^{\alpha_s} L_{cst}^{1-\alpha_s} \quad (9)$$

$$\ln TFP_{ct} = \sum_{s=1}^{S} \theta_{cst} \ln \left[k_{cst}^{\alpha_{cs}} l_{cst}^{1-\alpha_{cs}} \underbrace{\left(\sum_{i=1}^{I_{cst}} A_{csit}^{\sigma_c - 1}\right)^{\frac{1}{\sigma_c - 1}}}_{\equiv A_{cst}^{*}} \right] + \sum_{s=1}^{S} \theta_{cst} \ln \underbrace{\left[\sum_{i=1}^{I_{cst}} \frac{A_{csit}^{\sigma_c - 1}}{\sum_{i=1}^{I_{cst}} A_{csit}^{\sigma_c - 1}} \left(\frac{\tau_{csit}}{\tau_{cst}}\right)^{1-\sigma_c}\right]^{\frac{1}{\sigma_c - 1}}}_{AE_{cst}} \quad (10)$$

We first aggregate the calculated allocative efficiency up to the sector level, and then decompose country level TFP growth into innovation and allocative efficiency component of total factor productivity growth. The two components are captured by the two terms on the right-hand side of Equation (11).

$$\Delta lnTFP_{ct} = \Delta\, ln\, IN_{ct} + \Delta lnAE_{ct} \quad (11)$$

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