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Czech Republic: Selected Issues

INTERNATIONAL MONETARY FUND

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CZECH REPUBLIC

SELECTED ISSUES

June 2018

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CZECH REPUBLIC

SELECTED ISSUES

June 7, 2018

Approved By
European Department

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CONTENTS

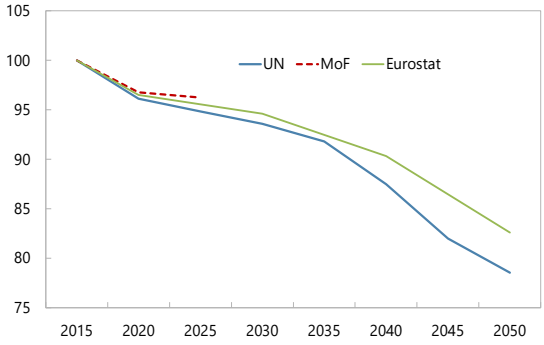
LABOR SUPPLY IN THE CZECH REPUBLIC: STOCKTAKING AND POLICIES

The Czech working age population is projected to decline. This has important implications for labor supply and long-term growth. Our paper analyzes recent developments in labor force participation, and assesses perspectives for labor supply and policies that could affect it. The first part of the paper provides a baseline projection for labor supply in the medium and long term under existing policies. It proceeds to answer the question to what extent policies could help raise the effective labor supply. We find that policies aimed at increasing the participation of young women and older workers are important and could help mitigate the decline in the labor force, but are unlikely to stop it. The second part of the paper focuses on female labor force participation and its determinants. We examine the scope for raising female labor force participation by reducing the relative tax rate on the second earner. We find that removing the non-working spouse tax credit could boost female labor force participation by 6 percentage points.

A. Motivation

1. The demographic outlook is poor. Although the Czech population is younger than that of western Europe, it is expected to shrink in the coming years. Moreover, the working-age (15–64) population is projected to decrease more quickly than the total population. According to the United Nations medium fertility scenario, the working age population in the Czech Republic is projected to decline by 6 percent by 2030 and 21 percent by 2050.[1] Eurostat projections are more optimistic, but the differences are not large with 5 and 17 percent declines, correspondingly. At the same time, the share of population aged 65+ is projected to double and the dependency ratio will increase from 28 percent currently to 40 percent by 2030 (and nearly 60 percent in 2050).

Working age (16-64) population
(Index, 2015=100)

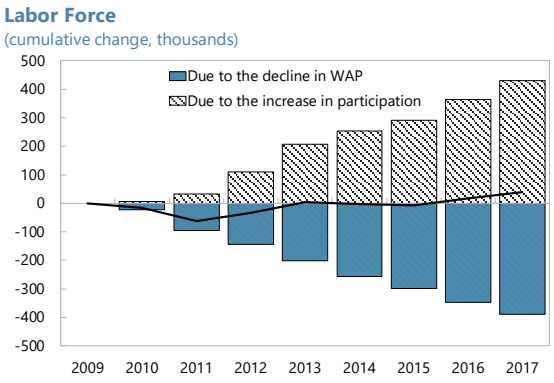


Sources: UN population projections, MoF

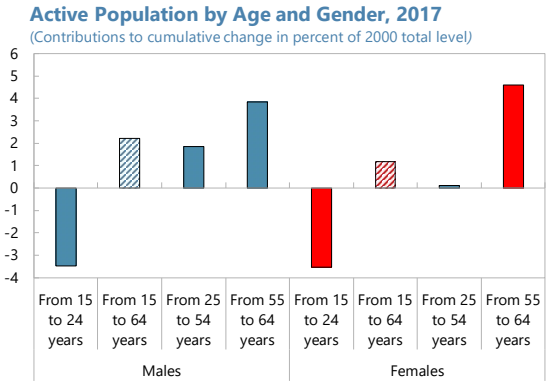
2. Increases in participation rates have offset the decline in the working age population so far. The Czech working age population (15–64) has been declining since 2009, with a cumulative decline of 7 percent from 2009 to 2017; however, the labor force has stayed largely unchanged, as significant increases in participation rates, from 70 to 76 percent, have compensated for the decline in population. In line with statutory retirement age increases, older workers have contributed the most to the labor force growth, with the participation of workers 55–64 years old increasing from 50 to 64 percent. (Similar trends are common in many advanced economies (IMF 2018). A surprising

[1] This assumes a positive contribution from net inward migration.

development in the Czech Republic is that while contribution of prime-age men has increased, that of women in the same age category (25-54 years old) has not changed.



Sources: Eurostat

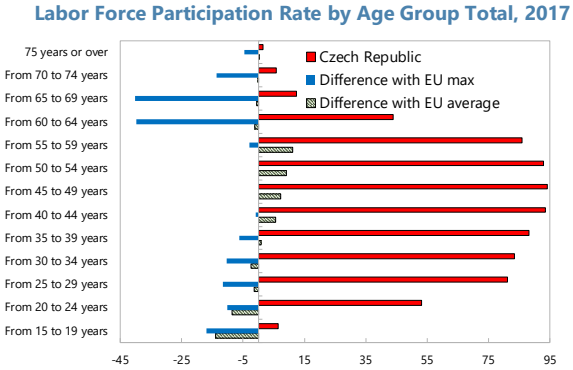


Source: Eurostat.

3. Participation rates have reached the EU maximum levels in many age cohorts, except for those of young women and older workers:

- Participation rates of men aged 25–55 are now at the EU maximum of 96 percent, while for young women (25–45 years old) there is still a gap with the best performers. (The current participation rate is 78 percent versus the EU maximum of 91 percent.)

- Notwithstanding the recent progress in the participation of older workers, further improvements could be made to reach the level of best EU performers. Namely, the participation of men aged 55–64 is at 73 percent versus the EU maximum of 83 percent, and the participation of women is at 55 percent versus the EU maximum of 78 percent.



Source: Eurostat.

4. The paper aims to assess labor force prospects and policies. The paper is structured as follows. The first section assesses long-term prospects for labor supply under current policies and analyzes what improvements in effective labor supply could be gained from plausible increases in female labor force participation, participation of older workers, and increases in retirement age. The second section focuses on the factors and policy distortions affecting female labor participation, using a heterogeneous agent model to assess how removing the non-working spouse tax credit (STC) could affect female labor force participation.

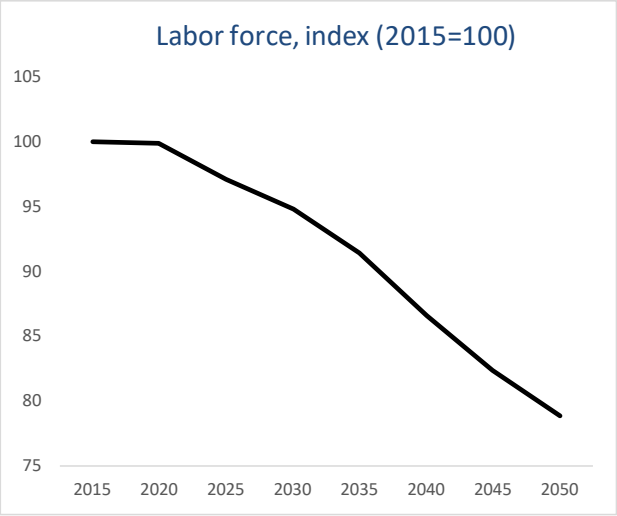
B. Labor Supply Prospects: Baseline and Policy Scenarios

5. Labor force developments are projected by 5-year age and gender cohorts. For the purpose of our analysis, we use the following labor force decomposition:

$$Labor\ force = \sum_j Population_j * Participation\ rate_j$$

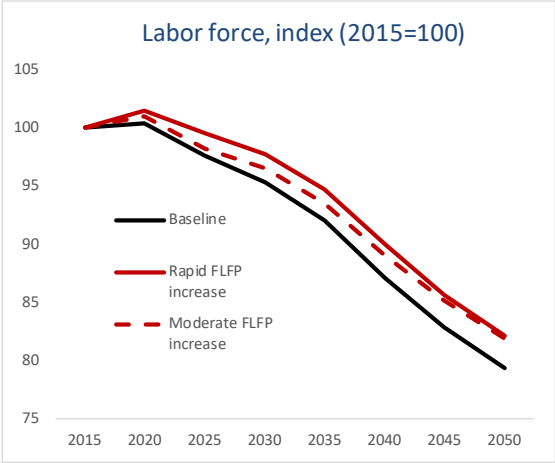
where *j* is a 5-year cohort of men or women from 16 to 80 years old. We use the United Nations population projections (2017 vintage, medium fertility scenario) and historical labor force participation rates from Eurostat. To assess the labor force prospects overall, we calibrate the assumptions for the participation rates of certain groups, e.g. older workers or women, depending on various policy scenarios. Population projections remain the same in all scenarios.

6. Under current policies the labor force is projected to decline by 5 percent by 2030 (21 percent by 2050).[2] The baseline scenario under unchanged policies assumes unchanged age and gender-specific participation rates for all cohorts, except seniors. The participation rates for senior cohorts reflect the envisaged gradual increase in the statutory retirement age in the Czech Republic. To calibrate the increase in participation rates of older workers, we assume that they will increase to the average level of participation rates in countries with a similar statutory retirement age. Namely, the participation rate for men (for those 55–69 years old) is projected to increase from 55 to 59 percent, and for women (those 55–69 years old) from 39 to 45 percent. Under the baseline scenario, the share of older workers will increase from the current 16 percent to 22 percent in 2030.

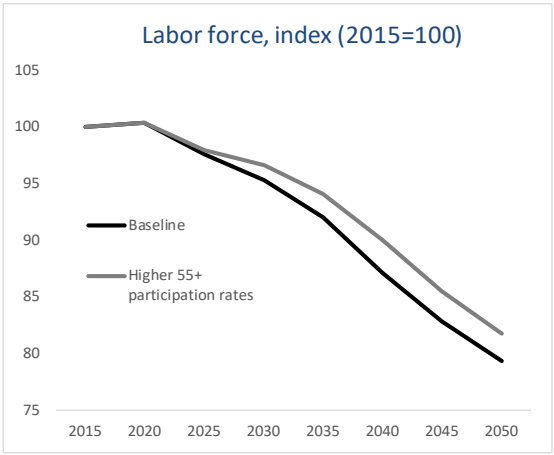


[2] We use the UN population projections. The UN data are at five-year frequency, with some interpolated to annual frequency. The latest historical observations are at 2015. The participation rate in the Czech Republic has increased since 2015, driven by the increased participation of older workers. The simulation takes into account the increase in participation rates from 2016 to 2017 by assuming that participation in 2020 is at the level observed in 2017.

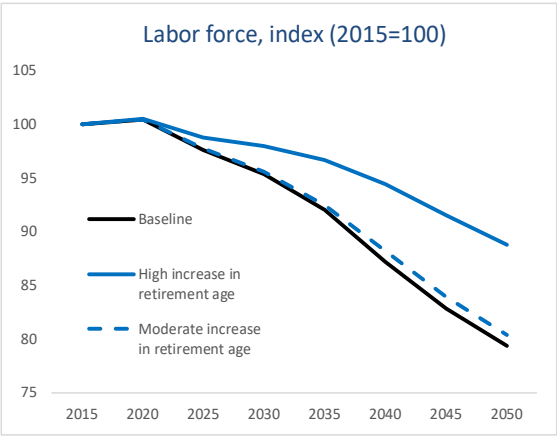
7. Increasing participation of young women (25–45) could reduce the labor force shortfall by up to 2 percentage points. This policy scenario assumes female labor force participation is increased to the EU maximum levels of the corresponding age-gender cohort. The rate of increase is assumed to be constant across years and countries, but different across age-gender cohorts and calibrated based on historical data. A rapid female labor force participation (FLFP) increase scenario assumes an average annual increase in the FLFP of 1.3 percentage points (calibrated based on the data for 1995–2016 for the best performer in the EU, Spain). A moderate FLFP increase scenario assumes an average annual increase in the FLFP of 0.5 percentage points, corresponding to the average annual increase in the EU-15 countries over the last 20 years.



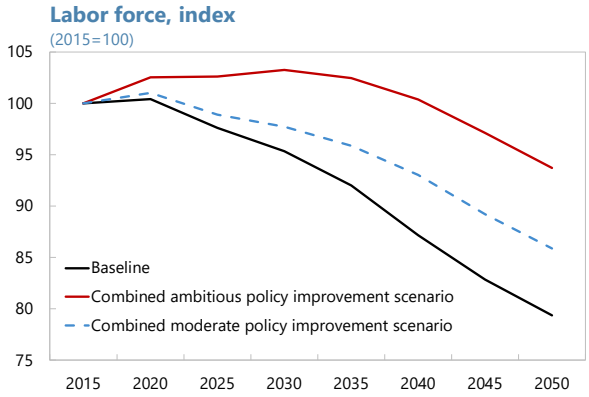
8. Increasing the participation of *older* (55+) workers *without* changing the retirement age could contribute another 2 percentage points. This scenario assumes increases in participation rates of older men and women to the EU maximum of countries with a similar retirement age. Changes in participation rates start from the first projection period, and the target participation rate changes with the projected increases in retirement age. The average participation rate for men aged 55–69 increases to 63 percent by 2030, and to 48 percent for women.



9. Raising the statutory retirement age would have the biggest impact on the labor force. An ambitious scenario that assumes the retirement age increases to 67 for both men and women by 2030 (baseline scenario for advanced Europe) and links the increase in retirement age to increases in life expectancy in the subsequent period (2030–50) would have the largest impact, of 3 percentage points. A more moderate increase in retirement age—linking the increase in the statutory retirement age to changes in life expectancy till reaching the ceiling of 67 for both men and women—would increase the labor force by 1 percentage point. Both scenarios assume participation rates at the average of the EU countries with a similar statutory retirement age.



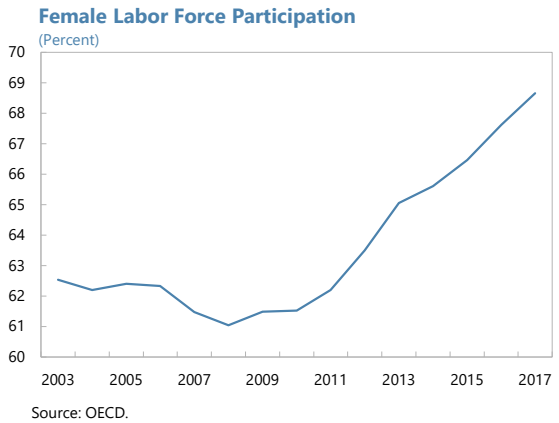
10. Reforms could mitigate the fall in labor force, but are unlikely to completely offset it. Under a combined moderate policy improvement scenario (a moderate rate of increase in female labor force participation, retirement age increases in line with life expectancy, but not higher than 67, and participation rates for older workers at EU maximum level), the labor force decline is estimated at 2 percent in 2030 and 14 percent in 2050. Under the very optimistic (hence less likely) scenario (a rapid increase in female labor force participation, retirement age increases to 67 by 2030, and participation rates for older workers at EU maximum level), the labor force would increase by 3 percentage points by 2030, but then start to decline later with a gap of 6 percent in 2050.



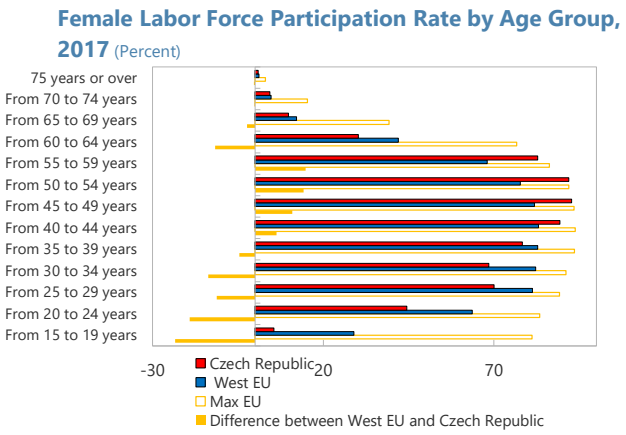
Sources: Czech Statistical Office and IMF staff calculations.

C. An Analysis of Distortions Affecting Female Labor Force Participation

11. Labor force participation of young women in the Czech Republic remains relatively low. Female labor force participation has increased from 62 percent in 2009 to 69 percent in 2017 and is now around the EU average, though the developments differ significantly across age cohorts. The increase was driven primarily by higher participation of women aged 45+. A comparison with European peers shows that the participation rates of these cohorts is at the EU maximum level. On the other hand, the participation rates of younger women remain below the EU average.



Source: OECD.

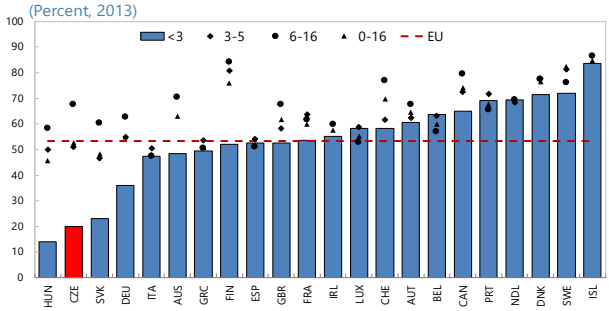


Sources: Eurostat

12. Several factors can affect female labor force participation. A large literature provides cross-country evidence that better access to childcare and greater flexibility in work arrangements are associated with higher attachment of women to the labor market.[3] Additionally, EC (2017, 2018) documents the link between the gender employment gap in the Czech Republic and low availability of affordable childcare, low use of flexible work arrangements, and a lack of long-term care facilities.

13. There are signs of insufficient supply of public childcare. Despite the increased provision of child care facilities financed by the EU structural funds, there is evidence of large unmet demand. The Ministry of Labor and Social Affairs estimates that there were 32,000 rejected applications for publicly provided childcare places due to lack of space.[4] Furthermore, according to the Czech Ministry of Labor and Social Affairs, there are currently approximately 300,000 beneficiaries of the Czech Republic's relatively long parental leave allowance. This suggests that the latent demand for public childcare facilities could be even higher.

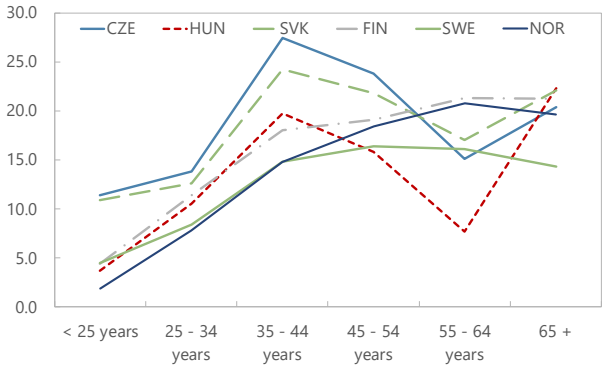
Maternal Employment Rates by Age of Youngest Child
(Percent, 2013)



Source: OECD.

14. The gender pay gap is second highest in the EU and could negatively affect female labor force participation. The observed pay gap is higher in the private sector, and highest in financial services and in managerial and professional occupations. While the age profile of the pay gap in the Czech Republic is similar to that of other European countries—the gap is most pronounced for women between the ages of 35 and 44 years, which in turn could reflect lower participation of women the earnings pay gap in the Czech Republic is also higher for women below the age of 25.[5]

Gender pay gap by age cohort
(Percent)



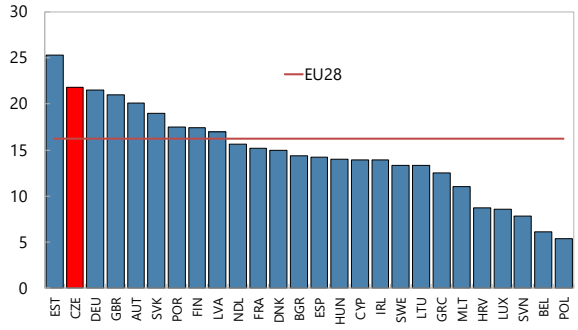
Source: Eurostat

[3] See WEO (2018), Olivetti and Petronglo (2017), Jaumotte (2003), Genre et al. (2010), Blau and Kahn (2013), Cipollone et al. (2013), Thévenon (2013), Dao et al. (2014), Christiansen et al. (2016b), and WEO (2016).

[4] Some of these rejected applicants may be subsequently placed in private childcare facilities albeit at higher cost.

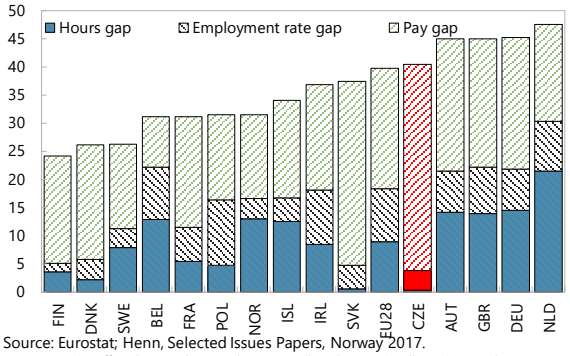
[5] Research shows that women leaving labor force early to raise children typically do not recover earnings when they return.

Gender pay gap, unadjusted 1/
(percent, 2016)



Sources: Eurostat
1/ Difference between average gross hourly earnings of male and female employees as percent of male gross earnings

Gap in Female versus Male Earnings by Components, 2014
(Percent of male earnings)



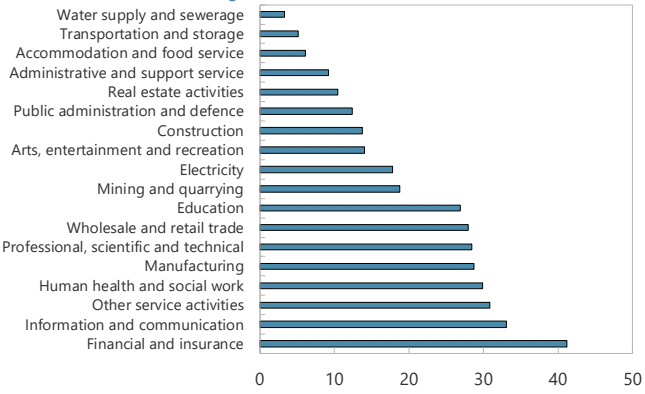
Source: Eurostat; Henn, Selected Issues Papers, Norway 2017.
Note: Interaction effects between hours and pay are attributed proportionally. Positive employment rate

15. Analysis suggests that the earnings gap is driven mostly by differences in hourly pay. Although males do have higher employment rates and work more hours on average, these differences are relatively small compared with those in regional peers and other European countries.

- The contribution of the hours gap is negligible. This accords with the observed low share of part-time workers for both men and women in the Czech Republic.

The sectoral composition of employment does not explain the gender pay gap. The pay gap would be 4.5 percent *larger* were women equally represented across industries (NACE 2-digit industry level). The pay gap is computed as the ratio of weighted average of female annual earnings to the weighted average of male annual earnings,[6] where weights represent the industry-gender share. In the counterfactual scenario, the share of women in each industry is the same and equal to the share of women in the labor force.

Czech Republic: Gender pay gap by industry
(Percent, mean annual earnings)



Source: Eurostat

[6] We obtain qualitatively similar results when hourly pay is used instead of annual earnings pay. This is consistent with evidence provided above that differences in hours worked contribute little to the overall gap in earnings.

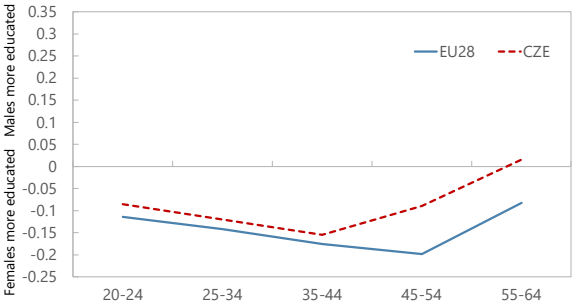
- The share of women in different occupations explains some portion of the gender pay gap. Specifically, the pay gap would be 2.1 percent *smaller* were women equally represented across occupations. In the counterfactual scenario, the share of women in each occupation is the same and equal to the share of women in the labor force. The difference in the pay gaps indicates that the current occupational allocation increases the gender pay gap.

Czech Republic: Gender pay gap by occupation
(Percent, mean annual earnings)

Source: Eurostat

- Women in the Czech Republic have higher educational attainment than men. The age profile shows a V-shape, with women having higher educational attainment through the cohort aged 35–44. For the cohort aged 55–64, males have higher educational attainment. The educational attainment age profile of the EU differs slightly in that females in the EU have higher educational attainment than males at all ages.

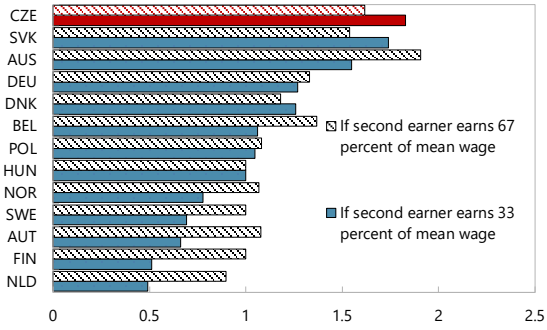
Gender Gap in Educational Attainment by Age, 2017
(Index)



Sources: Eurostat and Fund Staff calculations
Note: Difference between male and female indices, each of which can range from 1-3 and is a weighted average of attainment, with weight 1 for primary, 2 for secondary, 3 for tertiary.

16. The Czech Republic has a high relative tax rate on second earner income that is likely to discourage women's participation in the labor force. Christiansen et al. (2016) provide a cross-country comparison of relative tax rates, defined as the tax rate of the second earner divided by tax rate of the first earner in a childless household. This relative tax rate is high in the Czech Republic when compared with neighbors and other advanced economy peers. Furthermore, this relative tax rate is higher if the second earner earns 33 percent of the mean wage than if the second earner earns 67 percent of the mean wage.

Relative Tax Rate by Second Earner Income, 2014
(Fraction of First Earner's Tax Rate)



Source: Christiansen et al (2016), based on OECD data.
Note: Tax rate of second earner divided by tax rate of first earner in a childless household.

17. The non-working spouse tax credit (STC) contributes significantly to the relative tax rate on the second earner. The non-working spouse tax credit acts as a participation tax for second-earners who are primarily women. We investigate how removing this distortion could affect female participation. Box 1 provides a numerical example of the implied participation tax that results from the provision of this tax credit.[7]

Box 1: An Illustration of the Effect of the Non-Working Spouse Credit on Participation Incentives

This box aims to illustrate the way by which the non-working spouse credit can affect incentives for second earners to participate. To keep the analysis as simple as possible, not all taxes, credits and government assistance are considered—the analysis should be regarded as an illustration of the direction of effects, and not a comprehensive numerical evaluation.

For an indicative example, consider Jakub and Tereza, a married couple, and their young son Pavel. Suppose Jakub earns CZK 360,000 per year and Tereza does not work. Jakub's "super-gross wage" is defined as his gross wage plus 25 percent from his employer's social security contribution and 9 percent health insurance—that is, 1.34 × 360,000 = CZK 482,400.

Jakub pays 15 percent income tax. He receives a basic income tax credit, roughly CZK 25,000, and the non-working spouse credit, also roughly CZK 25,000, which the family receives because Teresa is not working. We assume also that Pavel is enrolled in preschool childcare and hence the family receives a preschool childcare tax credit (CZK 11,000). This yields a tax burden of 11,360 CZK and implies a household budget constraint of CZK 348,640.

Now suppose Tereza works and earns about 22.8 percent less than Jakub (per the average pay gap faced by women in the Czech private sector). This would imply annual earnings of CZK 277,920 for Tereza. In this scenario, the net income tax due for Jakub becomes 0.15 × (482,400) – 25,000 - 11,000 = CZK 36,360, and the net income tax due for Tereza is 0.15 × (372,413) – 25,000 = CZK 30,862, because there is individual taxation and both spouses work. Now the household budget constraint becomes 360,000 + 277,920 – 36360 – 30,862 = CZK 570,698.

With these assumptions, Tereza's marginal income is the difference in total household income between the scenarios, 570,698 – 348,640= CZK 222,058, and Tereza's participation tax is the difference in total household tax, 36,360+ 30,862 – 11,360 = CZK 55,861. Thus, Tereza's decision to work is taxed at 25.2 percent.

[7] We abstract from parental benefits, such as parental allowance received, as income that would apply regardless of the household's work decision for the second-earner. Including these in our numerical example would not change the qualitative results.

Box 1: An Illustration of the Effect of the Non-Working Spouse Credit on Participation Incentives (concluded)

The participation tax rate would be somewhat higher were Tereza working part-time and earning less. Suppose Tereza earns 33 percent of average annual earnings (CZK 120,000). In this scenario, the tax on her income is below the value of the basic income tax credit so her individual tax obligation would be zero. The household budget constraint becomes 360,000 + 120,000 – 36,360 = CZK 443,640. With these assumptions, Tereza's marginal income is 443,640 – 348,640 = CZK 95,000 and Tereza's participation tax is 36,360 – 11,360 = CZK 25,000. Thus, Tereza's decision to work would be taxed at 26.3 percent.

Marginal Tax Rates for Average Earners			
	Marginal Income	Participation Tax	Participation Tax Rate
Jakub	CZK 348,640	CZK 11,360	3.3percent
Tereza	CZK 222,058	CZK 55,861	25.2 percent

Participation Tax Rates for Low-Income Second Earner			
Tereza	CZK 95,000	CZK 25,000	26.3 percent

There are other family benefits not considered in the example above, such as child tax credits, a tax base deduction, and parental benefits. Including these would alter the numerical results, but the main conclusion—that Tereza faces a non-zero participation tax rate—would remain the same. For example, taking into account the first-child tax credit (worth CZK 13,404) shows that while Tereza's participation tax rate would be slightly lower, at 24 percent, the difference with Jakub's tax rate would be even higher, as his participation tax rate goes to zero under this example.

18. To study the effect of STC on female participation we build a heterogenous agent model calibrated to match key characteristics of the Czech economy (Annex 1). Households in the model are comprised of male and female workers who jointly decide on consumption, savings, and labor supply. Male workers are assumed to supply labor inelastically, but each household decides whether the female will work or not. Hours supplied, conditional on working, are fixed. There is a representative competitive firm that employs workers and operates the economy's capital and is owned by households. The government taxes labor income and redistributes all proceeds as a lump-sum transfer to households. Lump-sum transfers could be viewed as a proxy for government's provision of goods and services such as public childcare facilities. Households optimize by choosing consumption and leisure, taking wages and interest rates as given. The combination of preference, technology, and asset market specifications implies that accumulated household wealth will also influence households' female worker labor supply decision.

19. Eliminating the non-working spouse tax credit could increase female labor force participation by 6 percentage points and the freed-up resources, and extra tax revenue, could be used to increase the supply of childcare facilities. We simulate removing the non-working spouse tax credit. A comparison of the steady states between the baseline and policy scenarios

shows that more women choose to work responding to the increased the incentives for the second-earner. This raises household earnings, particularly for lower-income workers. The government budget gets higher tax revenue from eliminating the tax credit and taxing income of additional women employed. This implies higher lump-sum transfers to households which could proxy for an increased supply of public childcare facilities. Overall welfare is higher under the policy scenario.

20. Robustness exercises confirm the main simulation results. An exercise in which lumpsum transfers are held fixed and the increased proceeds from taxes are spent on non-productive government consumption displays only marginally different results. Consumption and wealth are slightly lower but female labor force participation is fractionally higher in this exercise.

Table 1. Czech Republic: Results from Policy Experiment

Variable	Model		
	Baseline	Remove Non-Working Spouse Credit	Change
Female Participation Rate	66.4	72.6	+6.2pp
Saving Rate	0.10	0.11	+1.0pp
Consumption	1.49	1.52	+2.0%
Assets	5.09	5.28	+3.7%
Labor Supply	0.53	0.55	+2.4%
Output	1.65	1.70	+3.1%
Female Earnings	0.52	0.56	+6.4%
Welfare*	-8.31	-8.01	+3.6%
Transfers	0.10	0.12	+12.5%

*Welfare is calculated as the average present-discounted value of lifetime utility.

D. Conclusions

21. Policies to increase participation rates and retirement age are important and can mitigate the decline in labor force, but are unlikely to offset it. Under a combined moderate policy improvement scenario, the labor force is expected to decline by 3 percent in 2030 and 15 percent in 2050. Under the very optimistic (hence less likely) scenario the labor force would increase by 3 percentage points by 2030, but then start to decline later with a gap of 8 percent by 2050.

22. Reducing the relative tax facing the second earner could boost female labor force participation. Our results indicate that removing the non-working spouse tax credit would increase female labor force participation by up to 6 percentage points.

Annex I. Model Specifications

The model features heterogenous agents with incomplete asset markets and indivisible labor and all households are comprised of male and female workers that face idiosyncratic earnings risk. Preferences are additively log-separable in household consumption and male and female labor, with separate disutility of labor parameters for men and women, and a common Frisch elasticity. There is a representative competitive firm that employs workers and operates economy's capital while the government taxes labor income and redistributes as lump-sum transfer. The basic tax credit and non-working spouse credit are explicitly included in the model.[1] It is assumed that the government cannot transfer resources across periods i.e., the government budget has an overall balance of zero every period.

At the start of a model period, uncertainty is realized—earnings for female and male workers become known—and households begin with some wealth. During the model period, the male worker supplies labor inelastically, earning income for the household subject to taxes and tax credits. The household decides if the female worker will work. If the woman works, she also earns income for the household subject to taxes and tax credits. If the woman does not work, she derives some utility from staying at home. This preference for non-market activity could represent a comparative advantage in home production. There is complete risk-sharing within the household and the household decides how much to save and how much to consume.

The female worker participation decision will depend on the tradeoff between potential market earnings[2] and non-participation. It will also depend on household wealth through its effect on the consumption-leisure tradeoff. In equilibrium, the combination of earnings uncertainty and incomplete asset markets results in an ergodic distribution of wealth.

A recursive formulation of the household optimization problem is as follows. Let V, V^E, and V^N denote the value functions for a household, a household with an employed female, and a household with an unemployed female. Then a household solves:

$$V(x_m, x_f, a; \mu) = \max_{h \in \{0, \bar{h}\}} \{V^E(x_m, x_f, a; \mu), V^N(x_m, x_f, a; \mu)\}$$

Where x_m is male productivity, x_f is female productivity, a is beginning of period family wealth, μ is the distribution of households over wealth and productivity, h is the choice of hours worked and $\bar{h}$ represents full-time hours, V, V^E, and V^N denote the value functions for a household, a household with an employed female, and a household with an unemployed female.

[1] The demand and supply of childcare services is not explicitly modeled thus also omitted is the childcare tax credit (See Box 1).

[2] An unadjusted gender pay gap is assumed so that the average difference in potential market earnings between male and females is 22.8 percent, the 2016 value of the gender pay gap in the Czech private sector.

The value to the household of the female worker participating, V^E, is given by the following equation:

$$V^E\left(x_m, x_f, a; \mu\right) = \max_{a'}\left\{\ln c - B\frac{\bar{h}^{1+1/\gamma}}{1+1/\gamma} + \beta E\left[\max\left\{V^E\left(x_m', x_f', a'; \mu'\right), V^N\left(x_m', x_f', a'; \mu'\right)\right\}\right]\right\}$$

subject to

$$c + a' = wx_m\bar{h}(1-\tilde{\tau}_m) + wx_f\bar{h}\left(1-\tilde{\tau}_f\right) + (1+r)a + T$$

$$a' \geq \bar{a}$$

$$\mu' = \nabla(\mu)$$

where c is household consumption, a' is household savings, w is the market wage, r is the real rate of return on assets, $\tilde{\tau}_m$ and $\tilde{\tau}_f$ are net tax rates of male and female workers, T is lump-sum transfers, $\bar{a}$ is the borrowing limit, and ∇ is the transition operator for the law of motion of the distribution of households. The preference parameters are given by β, the discount factor, B, the preference for leisure parameter, and γ , the Frisch elasticity of labor supply.

The value to the household of the female worker staying at home, V^N, is given by the following equation:

$$V^N\left(x_m, x_f, a; \mu\right) = \max_{a'}\left\{\ln c - B\frac{0^{1+1/\gamma}}{1+1/\gamma} + \beta E\left[\max\left\{V^E\left(x_m', x_f', a'; \mu'\right), V^N\left(x_m', x_f', a'; \mu'\right)\right\}\right]\right\}$$

subject to,

$$c + a' = wx_m\bar{h}\left(1-\tilde{\tau}_{m,f}\right) + (1+r)a + T$$

$$a' \geq \bar{a}$$

$$\mu' = \nabla(\mu)$$

where $\tilde{\tau}_{m,f}$ is net tax-rate when female worker is unemployed.

It is assumed that the government budget is always in balance and factor markets clear:

$$\int_{A,X} w(x_m\bar{h}\tilde{\tau}_m + x_f h\tilde{\tau}_f + x_m\bar{h}\tilde{\tau}_{m,f})\mathbf{1}_{\{a'=a'(x,a,\mu),h^*\}}\, d\mu = \int T\, d\mu$$

The measure, μ, is defined over a σ-algebra of A and X, where A and X represent the sets of all possible realizations of assets a and productivities x_m and x_f.

In equilibrium, wages adjust to clear the labor market and an equilibrium reservation wage distribution emerges for female labor supply which governs the participation decision for different asset levels. The tax code is one determinant of this distribution so changes in the tax code will also affect female labor force participation. The structure of the problem precludes the use of local

perturbation methods and requires global iterative methods for a solution. The model is solved using the algorithm employed by Chang and Kim (2007).

The baseline calibration of the model matches reasonably well the Czech earnings distribution and the female labor force participation rates. The parameters that govern the Markov earnings process are borrowed from Chang et al. (2011) who use U.S. individual household level data from the Panel Study of Income Dynamics (PSID) to estimate the wage process. The preference for leisure parameter is calibrated to match the Czech female labor force participation rate and yields a baseline of 66.4 percent. Unfortunately, data unavailability precludes a comparison of the baseline wealth distribution. The gender earnings gap is exogenously imposed to reflect on average the most recent data of the unadjusted observed earnings gap in the Czech private sector, 22.8 percent.[3]

[3] The model is unable to reproduce a comparable equilibrium pay gap due to selection effects. That is, the preference and technology parameters are such that only high-earning women participate in the market which reduces the equilibrium gender pay gap. To explain the contribution to TFP growth of reduced misallocation of labor due to gender and race discrimination, Hsieh et al. 2013 estimate an occupational choice model in which firms earn rents via gender and race discrimination.

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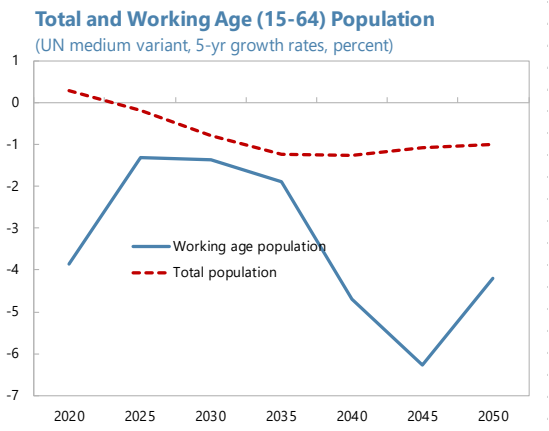
LABOR PRODUCTIVITY IN THE CZECH REPUBLIC: STOCKTAKING AND POLICIES

Higher productivity growth is needed to offset the impact of population aging and sustain external competitiveness. This paper analyses sectoral and factor contributions to labor productivity and aims to diagnose key determinants of productivity growth. Historically, labor productivity growth in the Czech Republic has been concentrated in manufacturing and has mainly been driven by capital deepening, rather than total factor productivity (TFP). This paper examines TFP developments in terms of factor allocation and technology diffusion. We find no signs of major misallocation of capital and labor across or within sectors. At the same time, we find that Czech companies have wide and growing dispersion of productivity within sectors, which could indicate a lack of technology diffusion. The weak performance of lagging firms, which tend to be smaller, younger and more leveraged, appears to be playing a major role in holding back aggregate productivity.

A. Motivation

1. A declining labor force implies the need for higher productivity growth to maintain convergence. The demographic outlook is poor, with the working age population projected to decline by 6 percent by 2030 and 21 percent by 2050.[1] At the same time, the old-age dependency ratio is projected to increase from 28 percent to 40 percent by 2030 (and to almost 60 percent by 2050). This means that maintaining robust GDP growth per capita will require increasing productivity growth above the historical average. Additionally, reduced labor supply will push wages and labor unit costs up. Strong productivity growth will therefore also be important to preserve competitiveness.

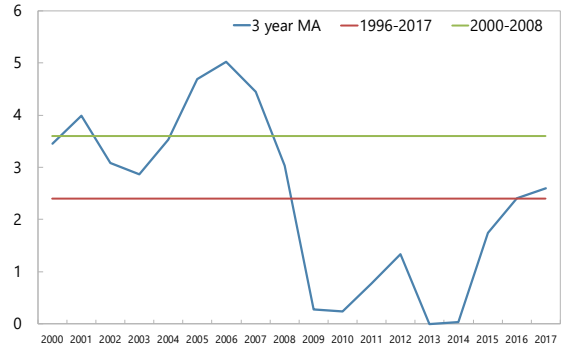


Source: United Nations, *World Population Prospects, 2017.*
Note: Projections are available at five-year intervals starting in 2020.

2. Productivity growth is recovering after the post-crisis slump, but its sustainability is uncertain. Like many advanced economies, the Czech Republic experienced a significant slowdown in productivity growth after the crisis: labor productivity growth fell from an average of 3.5 percent during 2000–08 to less than 1 percent during 2008–14. Recently, labor productivity has been recovering, reaching 2.8 percent in 2017, above the historical average of 2.4 percent. Whether this can be sustained for a long period remains unclear. Additionally, a cross-country comparison shows that post-crisis productivity growth in the Czech Republic was below the average of neighboring economies, raising the question whether some idiosyncratic factors have slowed productivity growth in the Czech Republic.

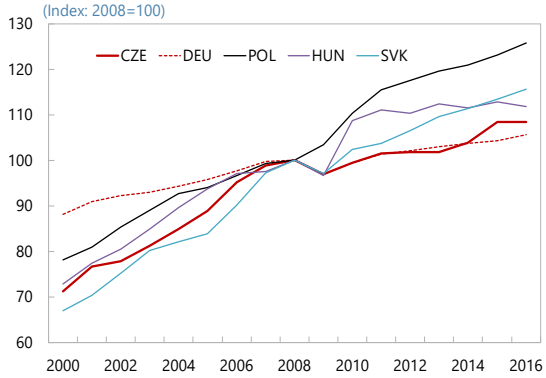
[1] See United Nations *World Population Projections*, 2017. Projections are available at five-year intervals, with the latest historical observation in 2015 and the projections from 2020 onward.

Real Labor Productivity per Person
(GDP per total employment, year-on-year percent change)



Sources: Eurostat

Evolution of Real Value Added per Hour Worked
(Index: 2008=100)



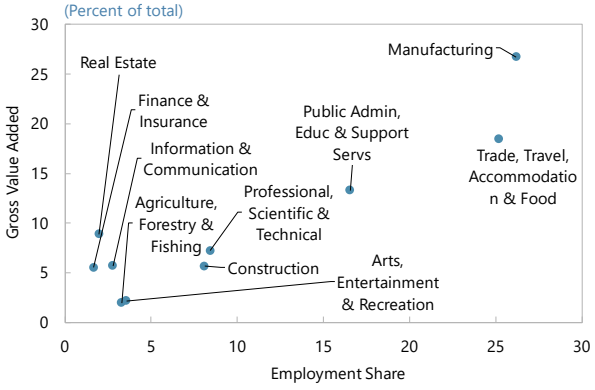
Sources: OECD; and IMF staff calculations.

3. This paper analyses sectoral and factor contributions to labor productivity and aims to diagnose key factors affecting total factor productivity growth. The paper is structured as follows: Section B looks at sectoral contributions to labor productivity and the role of sectoral shifts. Section C evaluates the contributions of capital deepening and total factor productivity (TFP) to labor productivity. Section D examines TFP in terms of factor allocation and technology diffusion. Section E discusses future issues likely to affect productivity growth. Section F concludes and outlines possible policy implications.

B. Sectoral Contributions to Labor Productivity

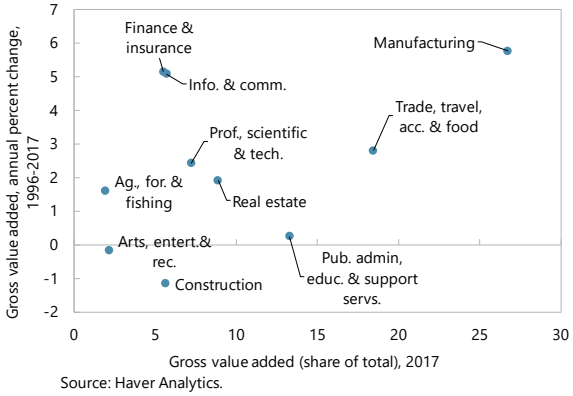
4. The manufacturing sector has been contributing the most to aggregate labor productivity growth. The manufacturing sector in the Czech Republic has the largest share not only of value added, but also employment, followed by trade, travel, accommodation and food preparation sectors. Over the last 20 years, manufacturing has experienced the fastest growth in value added (at 6 percent average real growth per year) and in labor productivity. The rise of manufacturing in the Czech Republic is notably different to most other advanced economies.

Gross Value Added and Employment Shares, 2017
(Percent of total)



Source: Haver Analytics.

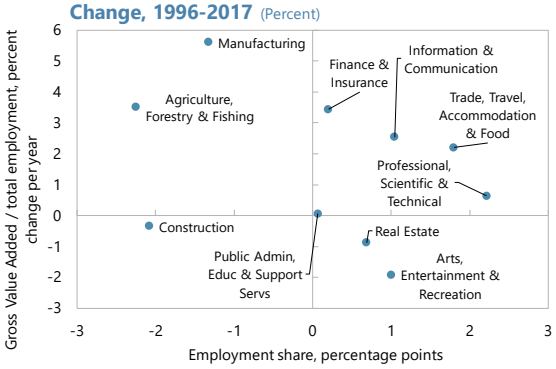
Gross Value Added



Source: Haver Analytics.

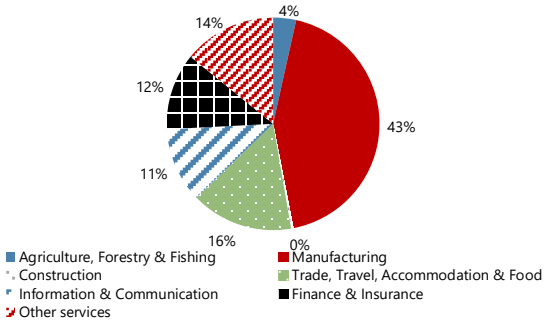
5. Sectoral shifts in the Czech economy have helped productivity growth. Similar to other advanced economies, the share of service sectors in employment has increased, while the share of agriculture has declined significantly. The share of manufacturing has declined since 1996, but remains significantly higher than in other economies with similar income per capita levels. A simple counterfactual exercise shows that if employment in each sector had remained the same as in 1996, aggregate productivity growth would have been slightly lower. Therefore, unlike many advanced economies, sectoral shifts have had a *positive* impact on aggregate labor productivity, as sectors with higher productivity growth increased their share of employment.

Average Labor Productivity and Employment Share Change, 1996-2017 (Percent)



Source: Haver Analytics.

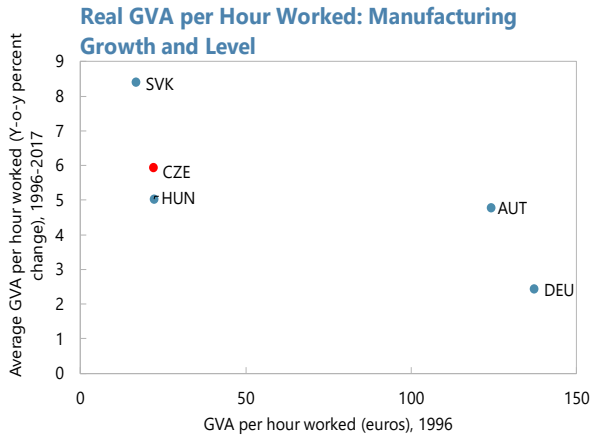
Contribution to Labor Productivity Growth, 2013-17
(Change as a percent of total)



Sources: Haver Analytics; and IMF staff calculations.

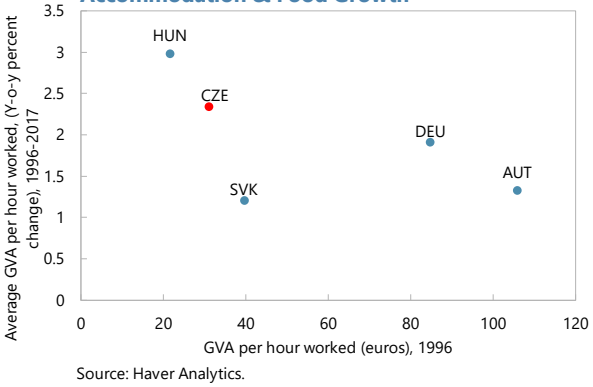
6. Sectoral labor productivity gaps with leading neighboring economies remain large, despite some catch-up. Labor productivity in most sectors has been converging to the level of those in frontier economies—for example, the productivity growth rate in manufacturing has been significantly higher in the Czech Republic than in Germany or Austria. Productivity growth in trade, travel and food services sectors has also been above that in most peer countries. Nevertheless, the gaps in sectoral productivity remain high.

Real GVA per Hour Worked: Manufacturing Growth and Level

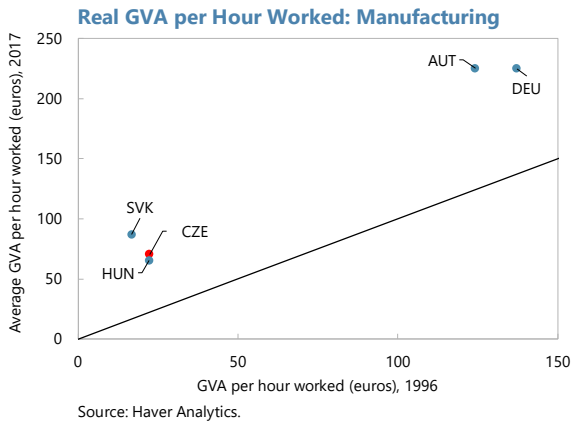


Source: Haver Analytics.

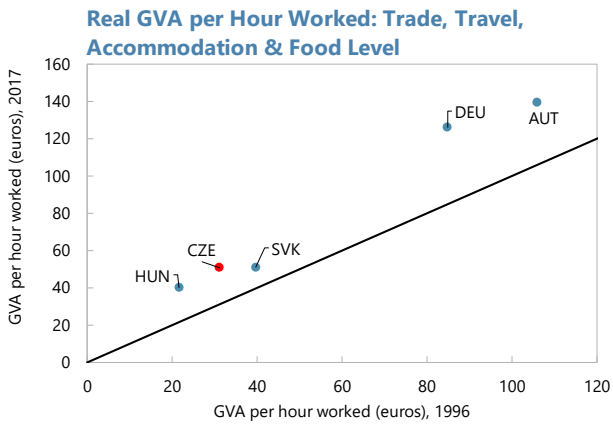
Real GVA per Hour Worked: Trade, Travel, Accommodation & Food Growth



Source: Haver Analytics.



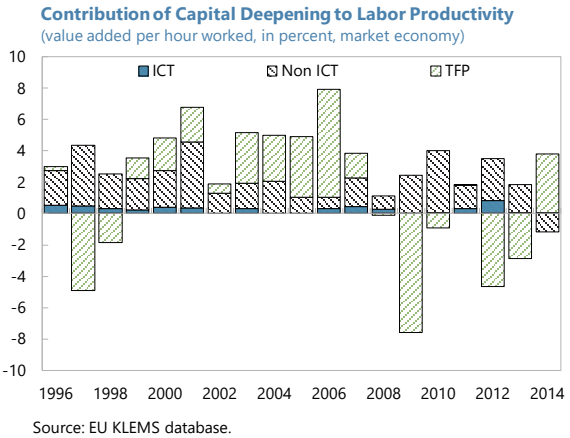
Source: Haver Analytics.



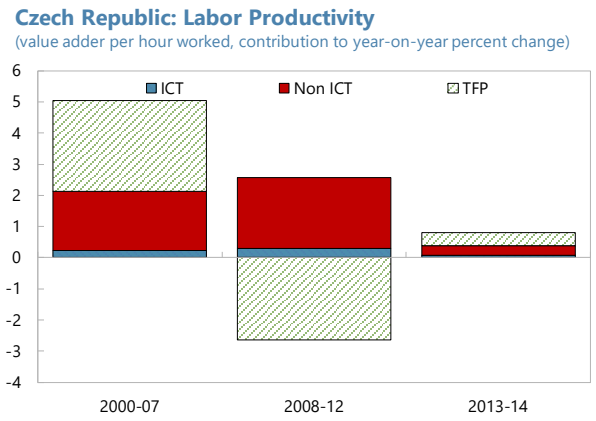
Source: Haver Analytics.

C. Factor Contributions to Labor Productivity

7. Overall labor productivity has been predominantly driven by capital deepening, rather than TFP.[2] Consistent with the concentration in manufacturing and participation in the global supply chains, often funded by FDI, capital investment has been very high. Indeed, non-ICT capital has been the most consistent and largest contributor to labor productivity growth over the past two decades. Even during the boom period of 2001 to 2007, non-ICT capital deepening averaged nearly 2 percent per year, compared with TFP growth of 3 percent per year.[3] (TFP growth from 2008 to 2014 was substantially negative.) As a result, capital stock per employee has reached high levels, and the current level of capital stock per employee in the Czech Republic is close to that of Germany. Some other Visegrad economies have had higher TFP contributions. In comparison to Germany, ICT capital investment is very low.



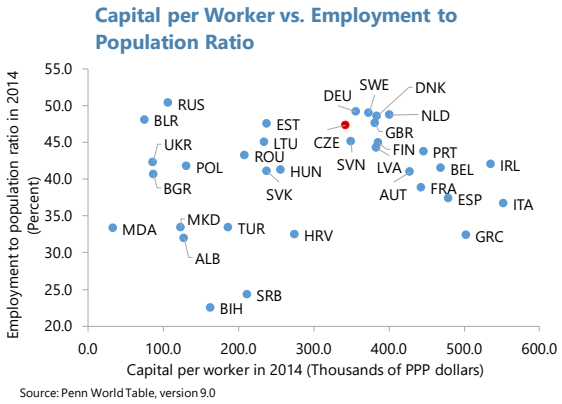
Source: EU KLEMS database.

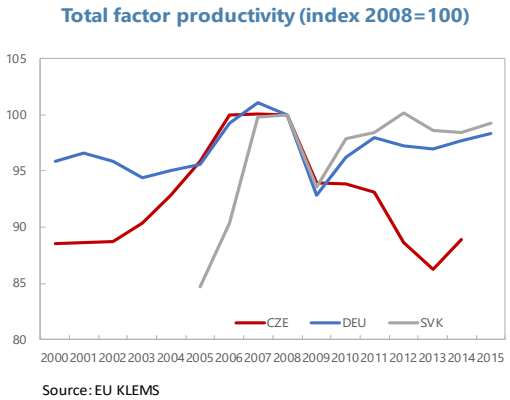


Sources: 2017 EU KLEMS Data; and IMF staff calculations

[2] TFP data used for analysis is available only until 2014 and does not take into account growth developments in 2015–17.

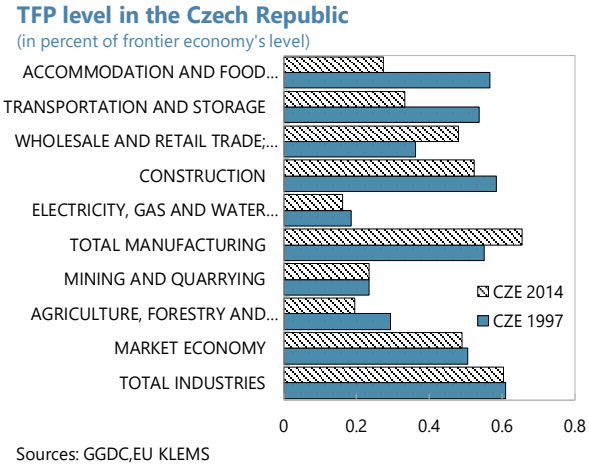
[3] Data are sourced from OECD "Contributions to labor productivity growth" http://stats.oecd.org/index.aspx?queryid=66347





8. TFP growth has been middling after the crisis. Unlike Germany and Slovakia, where TFP growth started to recover after 2009, the recovery in the Czech Republic's TFP only started in 2014.[4]

9. The TFP level gap with frontier countries remains high. The Czech Republic's initial level of TFP in 1997 was estimated at 60 percent of the frontier economy (Germany).[5] Following IMF (2015), we estimate the current gaps in productivity, namely, we chain-link the 1997 levels from the Groningen Growth and Development database by using data on TFP growth rates from the EU-KLEMS database. Overall, the distance to frontier in 2014 remained close to that of 1997, at 40 percent, but results differ by sector: in manufacturing and trade sector, the gap has somewhat declined, while in other sectors, including construction, transportation and storage, accommodation and food services, the productivity gap with the frontier has widened. The manufacturing sector now has the smallest gap. Measurement issues are an important caveat in these estimates, as errors due to industry misclassification, cross-country comparability of hours worked, and capital services used can be larger in the levels data. As such, differences in TFP levels should be viewed with care.



10. This analysis suggests that improving labor productivity growth will mainly require an improvement in TFP growth. To understand past developments and identify obstacles for higher TFP growth, we look at two issues that can affect aggregate productivity: the efficiency of factor allocation and technology dispersion across firms.

[4] Note that the TFP data used for this analysis is available only until 2014, and therefore does not account for growth developments from 2015 onwards.

[5] These estimates are from the Groningen Growth and Development data on productivity levels.

D. TFP Drivers: Factor Allocation and Technology Dispersion

11. Aggregate productivity growth in the economy is determined by technology, its diffusion and factor allocation across firms. Technology, e.g. the physical efficiency with which output is produced for a given number of factor inputs, determines an individual firm's productivity and, hence, influences aggregate productivity of the economy. A large dispersion of firm-level TFP, especially if driven by high number of laggard firms, can negatively affect aggregate TFP. At the same time, the allocation of factor inputs (capital and labor) across firms will also influence aggregate productivity.[6]

12. The efficiency of factor allocation *across* sectors is assessed. Efficient allocation of factors in the economy requires the actual capital share of each sector to be consistent with its share as determined by the production function and value-added share of the sector (see Annex 1 for details). Deviation from the optimal allocation reduces the aggregate productivity of the economy. In this counterfactual exercise, we set the U.S. as a benchmark economy and calculate the potential TFP gains the Czech Republic and other neighboring countries could achieve by reallocating capital and labor across sectors in the way it is allocated in the U.S.[7,8]

13. Capital and labor allocation across sectors is on a par with that in the United States. In fact, the Czech economy is doing better than the benchmark country—reallocating capital and labor across sectors to match the U.S. allocation would have a small *negative* effect on TFP:[9] if the Czech Republic were to readjust its capital allocation to achieve the comparable level of capital distortion, its aggregate productivity would decrease by 1.5 percent.[10] The overall TFP change can be broken down into contributions from labor and capital. Cross-sector labor allocation is found to be relatively undistorted: reallocation would only bring a 0.1 percent increase in aggregate TFP.[11]

Relative to U.S.	Full Adjustment	Labor Adjustment	Capital Adjustment
Germany	1.4%	-3.0%	4.5%
Czech Republic	-1.4%	0.1%	-1.5%
Poland	-0.2%	-5.5%	5.7%
Slovakia	-2.9%	-0.4%	-2.5%
Austria	1.7%	2.0%	-0.3%
Slovenia	-4.5%	3.6%	-7.7%

[6] For example, more could be produced by simply reallocating existing resources from less productive companies to more productive ones without any changes in individual technologies used.

[7] To estimate α, we need to set a benchmark country that is relatively distortion-free. Here we use U.S. as our benchmark economy because it is known to be relatively-distortion free with reliable data.

[8] These results are calculated using EU KLEMS data, September 2017 release.

[9] The result is the average over 1987 to 2015. Averaging over different periods (e.g., 2010 to 2015) does not affect the result qualitatively.

[10] However, benchmark U.S. is not perfect in allocation of resources itself. TFP gains from reallocating labor across sectors is 1.9% and TFP gains from reallocating capital across sectors is 10.6% for the U.S. TFP gains from both adjustments is 12.7% (averaged from 1998 to 2015).

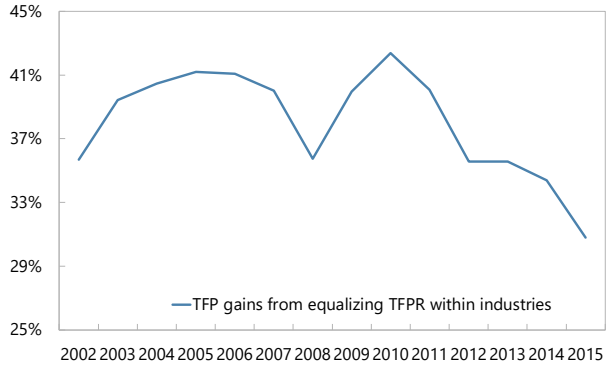
[11] The result is robust for different ranges of α (calculated with KLEMS 2017) and averaging over different periods.

Hence, while there is some room for improvement (i.e. TFP gains from eliminating misallocation in the benchmark country, the U.S., are estimated at 13 percent), allocation of factors *across sectors* in the Czech Republic does not appear to be holding back productivity.

14. *Within*-sector misallocation of factors in the manufacturing sector is assessed. To estimate the efficiency of within-sector factor allocation, we use firm level data[12] to assess how reallocating capital and labor within narrowly defined industries (2-digit NACE) would increase sectoral TFP. We focus on manufacturing sector due to the data availability and the fact that it has the highest value-added share in the economy (see Annex I for details).

15. Misallocation of factors within manufacturing sector exists, but is not exceptional, and it has been improving since the crisis. The efficiency of allocation of capital and labor within subsectors deteriorated after the crisis: in 2010 the manufacturing sector could have increased the aggregate TFP by 42 percent by reallocating the factors across firms. Since then, the allocation has been improving; the latest data (2015) show the potential gains from reallocating resources have reduced to 31 percent. The number is comparable to the U.S. 1987 level of misallocation within the manufacturing sector of 30.7 percent (Hsieh and Klenow, 2009). The conclusion is similar to that for cross-sectoral allocation—although there is room for improvement, allocation of factors across firms within sectors would not appear to be a significant issue, if the results for manufacturing are typical for the whole economy.

TFP gains from eliminating misallocation within manufacturing
(Lower number indicates better allocation of resources)



Sources: ORBIS data, IMF staff calculation

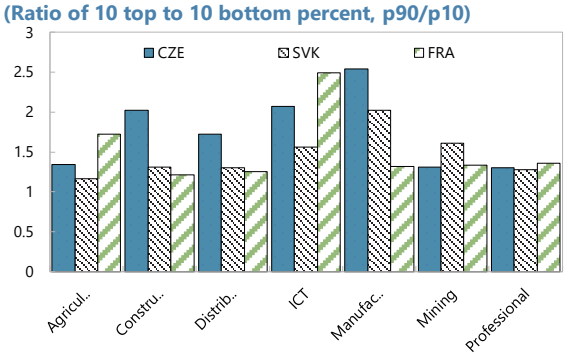
16. Technology diffusion among the Czech companies seems to be lower than in some other countries. Czech companies have wide and increasing TFP dispersion, measured as a ratio of productivity levels for the within-sector top 10th percentile firm to the bottom 10th percentile firm.[13] For instance, in the Czech Republic, a manufacturing firm at the top 10th percentile of the productivity distribution is 2.5 times more productive than the one at the bottom 10th percentile, while in France the difference is 30 percent.[14] TFP dispersions are especially notable in the construction, distribution, ICT, and manufacturing sectors. Additionally, the gap between the most productive and lagging firms has been increasing over the years.

[12] Data are from the Orbis database from the Bureau van Dijk.

[13] The result is robust to other measures of dispersion such as ratio of top 25th percentile to 75th percentile.

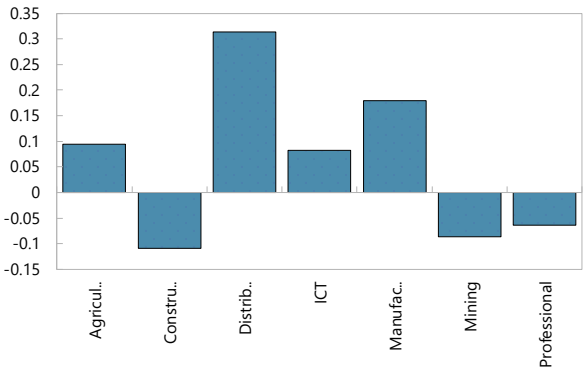
[14] In Slovakia, the difference for the manufacturing sector is 2. The quality of the Orbis data for Austria and Germany do not allow for a similar comparison.

TFP Level Dispersion by Sector
(Ratio of 10 top to 10 bottom percent, p90/p10)



Sources: Orbis, IMF staff calculations

Change in TFP Level Dispersion by Sector, 2015-2004
(Change in ratio of TFP level of the 10 top to 10 bottom percent)



Sources: Orbis, IMF staff calculations

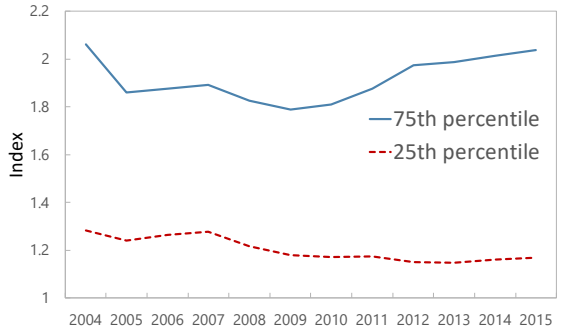
17. Stalling TFP growth of the bottom 25 percent could be the cause of widening dispersion. While the productivity level of the firms in the 25th percentile of the distribution has been increasing since 2009, the productivity of bottom 25th percentile has been stalling; as a result, the productivity gap has widened since the crisis.

Firms Characteristics by the Level of TFP

Sector	Firms with TFP level in bottom 25 percentile			Firms with TFP level in bottom 25 percentile		
	Size category	Age	TFP growth	Size category	Age	TFP growth
Agriculture	1.81	19.94	0.2%	2.54	22.01	0.7%
Construction	1.78	18.20	-1.3%	1.80	17.57	1.6%
Distribution	1.61	18.13	-1.3%	1.67	18.27	0.8%
Finance	1.33	17.50	-2.0%	1.89	20.14	-0.2%
ICT	1.39	17.80	-1.8%	1.61	17.58	1.1%
Manufacturing	2.58	20.68	-1.1%	2.38	18.76	0.8%
Mining	1.93	21.31	-2.7%	2.86	20.78	0.3%
Non-market	1.57	19.59	-3.4%	1.75	15.59	0.2%
Personal	1.46	17.16	-1.6%	2.09	17.29	1.4%
Utilities	2.22	19.92	-1.4%	2.29	19.04	0.7%

18. Improving TFP levels of the bottom 25 percent of firms would significantly increase aggregate TFP. Raising the productivity levels of all firms in the bottom 25 percent of the distribution to the level of the firm at the 25th percentile would increase sectoral productivity; the mining sector would benefit the most, with gains of 13 percent, while manufacturing, utilities, and the ICT sector could improve TFP by more than 5 percent.

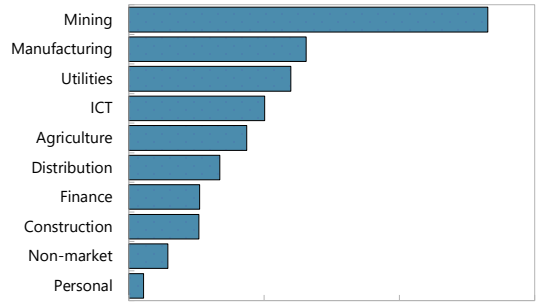
TFP level of firms in top 25 and bottom 25 percentile



Sources: Orbis, IMF staff estimates

Change in aggregate TFP level from raising TFP of bottom 25 percent

(percent)



Sources: ORBIS, IMF staff estimates

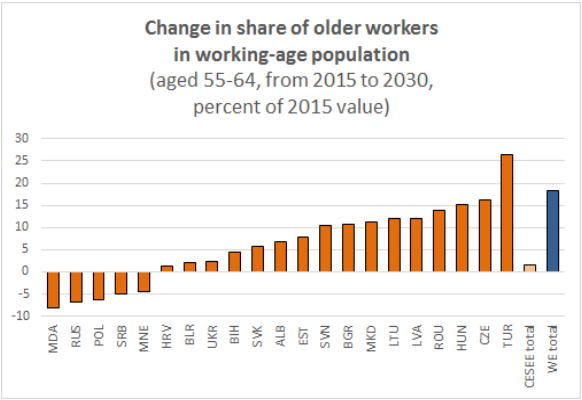
19. Low TFP growth is associated with smaller, more indebted and younger firms.[15] Regression analysis indicates that firms' age and size are positive associated with productivity growth, while higher indebtedness is negatively associated.[16] These results suggest that policy measures to address the needs of younger and smaller firms (particularly in the sectors that have seen widening gaps) could result in higher sectoral and aggregate productivity in the Czech Republic.

Age and Size Impact on TFP growth

	(1) TFP growth
Size category	0.001***
Age	0.002***
Debt to assets ratio	-0.0001***
Sector dummies	Included
Time dummies	Included
Number of obs.	341,067
Number of firms	79,330
R-sq between	0.04

E. Future Issues

20. The impact of future structural shifts on aggregate productivity is uncertain. Theory and empirical evidence suggest that the Czech economy is likely to increase the share of production and employment in services, and reduce it in manufacturing sector. The question of whether this development will drag down aggregate productivity remains open. There is a widely-held belief that manufacturing is crucial for productivity and income convergence, and, indeed, in the Czech Republic, the productivity level and growth has been significantly higher in manufacturing. However, the recent evidence (IMF, 2018) shows that a shift toward services need not necessarily hinder aggregate productivity growth and convergence.



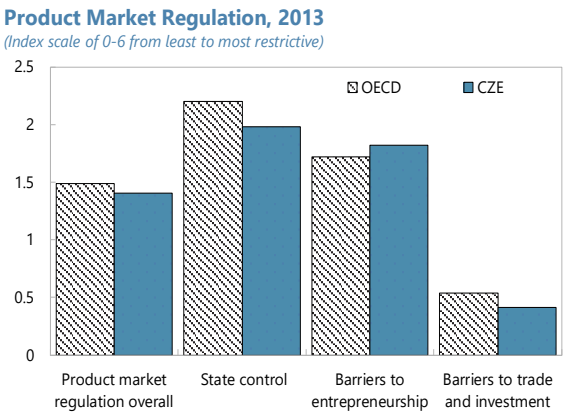
[15] Export orientation and R&D expenditures were also considered, but there were too few observations to draw robust inferences.

[16] Note that this regression shows simple association not causation. As typical in these sorts of regressions, only small amount of variation is explained by the variables, notwithstanding that they are highly significant.

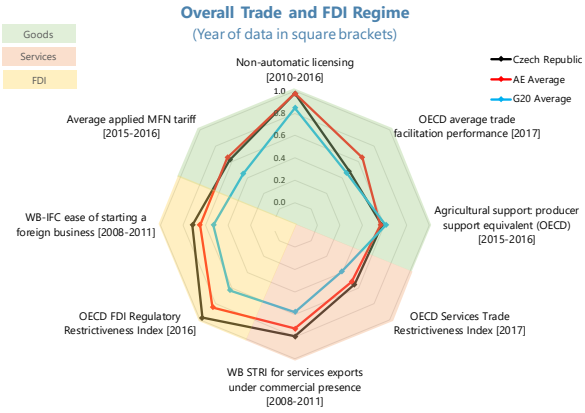
21. Headwinds to productivity growth are likely to come from demographics. An increasing share of older workers in labor force is often associated with declining productivity growth.[17] UN population projections show that the Czech Republic will have the largest increase in the share of older workers in the region: the share of those aged 55+ in the labor force is projected to increase from 16 percent in 2015 to 22 percent in 2030.

F. Policy Implications

22. There are no signs of distortions causing major labor or capital misallocation *across* or *within* sectors. There is a margin to improve productivity by eliminating some distortions, but the level of potential gains from achieving the theoretically optimal allocation of factors of production is not outstanding compared to other relatively distortion-free advanced economies. This finding is consistent with the Czech Republic having overall liberalized goods and labor markets, responsive financial market and openness to trade. Nor does a lack of capital appear to be holding back productivity growth; in fact, increased capital intensity has been the major contributor to labor productivity growth, consistent with substantial inward FDI and free flow of capital across borders.



Sources: OECD PMR indicators



Source: Cerdeiro, D.A. and R.J. Nam. 2018. "A multidimensional approach to trade policy indicators," IMF Working Paper.

23. Rather, weak performance of lagging firms within sectors appears to be playing a major role in holding back aggregate productivity. Sectoral labor productivity has been converging to higher income neighbors, but the gap remains large, and the total factor productivity gap with the frontier economies has remained unchanged over the last 20 years. Czech companies have wide and growing dispersion of productivity within sectors, which could indicate lack of technology diffusion. The good news is that better firms are recovering the productivity quickly and it should help further convergence. On the other hand, the lower tail is falling behind and accounts for a substantial drag on aggregate TFP. The latter finding is consistent with evidence in other advanced economies (e.g. Haldane, 2017).

[17] See Feyrer (2007) and Aiyar et al. (2016)

24. Current theories for widening dispersion and implications for public policy are diverse. Given the already high level of liberalization of the Czech economy, there are no "low-hanging fruit" in terms of policy fixes. The credit crisis made it difficult for small firms to obtain finance; however, this explanation for low productivity growth seems implausible for the Czech Republic given high liquidity, low interest rates, and a healthy banking sector. Weak dispersion of managerial capital could be another potential culprit. Increasing market concentration and "innovator takes all" markets could be another factor that could explain the widening dispersion. In terms of policies, government should look for the changes that can improve business conditions for small and young firms. These could include reducing fixed regulatory/compliance costs; making application of regulations more predictable and consistent across the regions; and investing in infrastructure, including virtual infrastructure and e-government.

Annex I. Model Specifications

Sectoral misallocation (Aoki 2012): For each sector i, we can measure how capital and labor deviates from the optimal allocation. TFP relative to benchmark (i.e. efficient) economy is then

$$\ln(TFP_{cz}/TFP_{BM}) \simeq \sum_i \bar{\sigma}_i ln \frac{A_i^{CZ}}{A_i^{US}} + \sum_i \bar{\sigma}_i \left\{ \alpha_i ln \frac{\lambda_{Ki}^{CZ}}{\lambda_{Ki}^{BM}} + (1-\alpha_i) ln \frac{\lambda_{Li}^{CZ}}{\lambda_{Li}^{BM}} \right\}$$

where $\lambda_{Li/Ki}$ is deviation of capital/labor from optimal allocation, $\bar{\sigma}_i$ is sector's share of value added. $\lambda_{Li/Ki} = 1$ when capital or labor is optimally allocated to the sector i. Since U.S. is relatively distortion-free economy, its' capital intensity of each sector is used to set capital intensity α_i. Results show how reallocating capital and labor across sectors to match the U.S. level distortion would affect country's aggregate productivity *without changing total amount of capital and labor* present in the economy.

Within sector misallocation (Hsieh and Klenow 2009): We assume industry output is a CES aggregate of differentiated products. The production function for each differentiated product is given by a Cobb-Douglas function of firm TFP, capital, and labor: $Ys_i = {Ks_i}^{\alpha_s} {Ls_i}^{(1-\alpha_s)}$. "Physical" productivity in industry s, firm i is defined as $As_i = \frac{Ys_i}{{Ks_i}^{\alpha_s}(wLs_i)^{(1-\alpha_s)}}$, where Y is output, K is capital, and wL is labor compensation. "Revenue productivity" is defined as TFPR$s_i = \frac{Ps_i Ys_i}{{Ks_i}^{\alpha_s}(wLs_i)^{(1-\alpha_s)}}$, where Ps_i is the price of output produced by firm i. TFPRs_i is a function of marginal revenue products of labor and capital of the firm i. Assuming joint log-normal distribution of As_i and TFPRs_i, industry TFP is related to firm-level TFP and distortions in the following way:

$$\log TFP_s = \frac{1}{\sigma} \log\left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1}\right) - \frac{\sigma}{2} \mathrm{var}\,(\log\, TFPRs_i)$$

where σ is elasticity of substitution between firm value added.[1]

In an economy with no distortions, TFPR should be equalized across firms within industry. Large dispersion of TFPR (marginal products) in a given industry indicates poor allocative efficiency within that industry,[2] as the efficient allocation of inputs requires marginal products to be equalized across firms in a given industry. If Y is actual output, let Y_e be efficient level of output, then $100(\frac{Y_e}{Y} - 1)$ shows how much TFP could be increased by reallocating capital and labor within industries.

[1] We set $\sigma = 3$. Note that gains from liberalization are increasing in σ and estimates of the substitutability of competing manufacturing firms in the trade and industrial organization range from 3 to 10 (Hsieh and Klenow 2009).

[2] Industry level elasticity of output to capital: α_s is calculated from U.S. manufacturing industry database, averaged over (1958-2011) (http://www.nber.org/nberces/)

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