INTERNATIONAL MONETARY FUND

IMF Country Report No. 19/38

REPUBLIC OF POLAND

SELECTED ISSUES

February 2019

This Selected Issues paper on Republic of Poland was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with the member country. It is based on the information available at the time it was completed on January 4, 2019.

Copies of this report are available to the public from

International Monetary Fund • Publication Services
PO Box 92780 • Washington, D.C. 20090
Telephone: (202) 623-7430 • Fax: (202) 623-7201
E-mail: publications@imf.org Web: http://www.imf.org
Price: $18.00 per printed copy

International Monetary Fund
Washington, D.C.

INTERNATIONAL MONETARY FUND

REPUBLIC OF POLAND

SELECTED ISSUES

January 4, 2019

Approved By
European Department

Prepared by Federico Joaquin Díez, Yevgeniya Korniyenko, Krzysztof Krogulski, Robert Sierhej, and Xin Cindy Xu.

CONTENTS

WHAT DRIVES WAGE GROWTH IN POLAND?[1]

1. Following several years of moderate dynamics, wage growth in Poland has recently picked up faster than labor productivity. Nominal wages grew by about 4 percent (y/y) during 2010–16, but accelerated since mid-2017, reaching 7.6 percent in Q3:2018, the fastest pace since 2009.[2] Meanwhile, real wages increased from about 2½ percent during 2010-16 to 5½ percent in Q3:2018. The pick-up in wage growth has been broad-based across all sectors. Labor productivity adjusted for changes in output prices, which had been growing by about 4½ percent during 2010-16, accelerated to 6½ percent in 2018. As a result, real unit labor costs (RULCs) have increased moderately (Figure 1).

2. The increase in RULCs occurred alongside an unprecedently-tight labor market. Since 2014, the unemployment rate has fallen by more than 1 percentage point per year, reaching a record-low of 3.8 percent in Q3:2018, which is below rates in most other EU members. Vacancy and job turnover rates also point to a very tight labor market, and firms—especially in construction and industry—report that labor scarcity is an obstacle to expanding output. Nonetheless, nominal wage and RULC growth have not reached the double-digit pace seen during the period of very rapid GDP growth before the global financial crisis.

3. The more subdued RULC dynamics compared with the pre-crisis period, despite the now-lower unemployment rate, may reflect the recent influx of foreign workers (FWs). Simplified procedures allowing citizens of six CIS countries to work for part of the year have helped to ease labor shortages. The sharp acceleration in FWs has been driven by both push and pull factors, as rising demand for labor in Poland coincided with a deteriorating economic situation in Ukraine. While precise statistics on FWs are not available, the number is estimated at above 1 million in effective full-time equivalents (around 5 percent of total employment, compared with less than 1 percent in 2014), with the vast majority arriving from Ukraine.[3] Adjusted for FWs, employment growth has been stronger and labor productivity growth has been weaker. For example, for 2017, while official statistics indicate that employment grew by 1.4 percent (y/y), staff estimates that adjusting for FWs (which are only partly captured in employment statistics) raises employment growth to 2.8 percent.[4] Consequently, adjusted real labor productivity growth declines by 1.7 percentage points to 1.8 percent.

---

[1] Prepared by Krzysztof Krogulski and Xin Cindy XU. We are grateful to the Polish authorities, including the National Bank of Poland, the Ministry of Finance, The Ministry of Family, Labor and Social Policy, and Statistics Poland for their helpful comments.

[2] Wage data is from Statistics Poland, based on firms' reporting data, which covers only workers with a regular labor code contract. Therefore, this wage data does not include foreign workers (FWs) employed on civil law contracts, which account for the majority of FWs (about 75 percent of those hired under the simplified procedure in 2017).

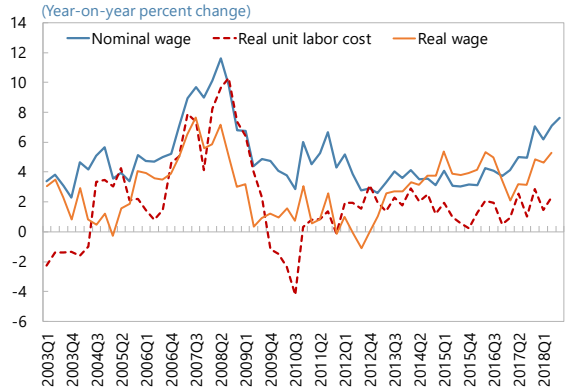
[3] Under the simplified statement procedure, FWs from six non-EU Eastern European and Caucasian countries are permitted to work in Poland for up to 6 months within any 12-month period. Most FWs are from Ukraine.

[4] Employment data comes from the labor force survey (LFS), which covers only persons that resided in Poland for at least 12 consecutive months immediately prior to survey date. Consequently, workers employed based on the simplified procedure are excluded from LFS statistics. LFS employment data included only 57,000 non-EU citizens in 2017, while data from the Ministry of Family, Labor and Social Policy suggests that employers issued around 0.9 million declarations of intention to employ FWs in the first half of 2018.

Figure 1. Labor Market Condition

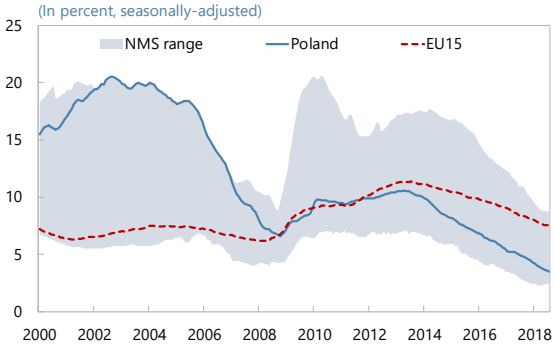
Wage and Unit Labor Cost

(Year-on-year percent change)



Unemployment Rates

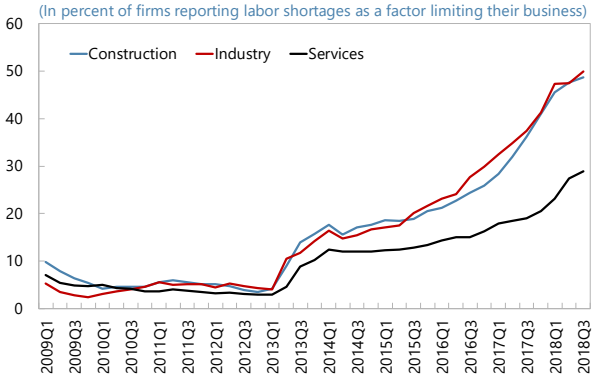
(In percent, seasonally-adjusted)



Note: NMS includes Bulgaria, Czech, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland, Romania, Slovakia and Slovenia.

Labor Shortages

(In percent of firms reporting labor shortages as a factor limiting their business)



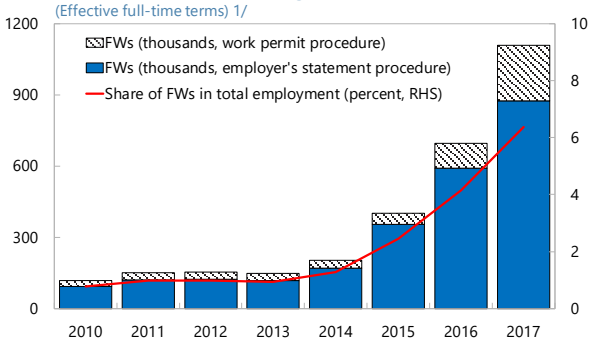
Selected Labor Market Indicators

(In percent of working-age population)

Note: NMS includes Bulgaria, Czech, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland, Romania, Slovakia and Slovenia.

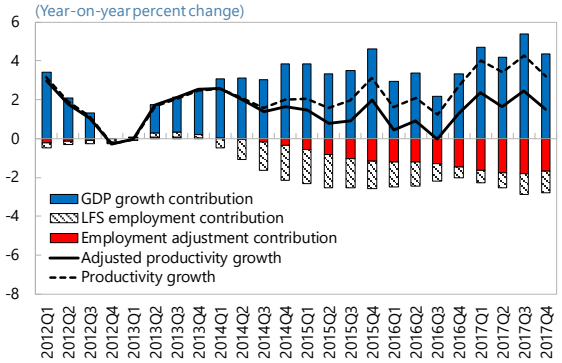
Estimated Stock of Foreign Workers

(Effective full-time terms) 1/



Adjusted Labor Productivity Growth

(Year-on-year percent change)



Sources: Statistics Poland, The Ministry of Family, Labor and Social Policy, Eurostat and IMF staff estimates.
1/ Foreign workers in effective full-time terms are calculated using average duration of permits and statements. Actual number may be smaller, as statements may not result in employment and potential double-counting of workers switching from statement-based employement to work pertmits.

4. To more systematically identify the long- and short-term drivers of Polish wages, we estimate an error-correction model (ECM). The empirical methodology follows recent IMF work (2017, 2018a, 2018b), while also taking into account Poland-specific labor market characteristics, notably the important role of FWs. The empirical model is specified as follows:

$$dlogW_t = \alpha + \beta_d * D_{t-i} + \beta_f * F_{t-i} + \beta_{fw} * FW_t + \delta * (\phi_1 logRW_{t-i} - \phi_2 logTLP_{t-i}) + \varepsilon_t$$

- The **dependent variable** ($dlogW_t$) is the change in nominal wages, defined as total compensation of employees per hour worked;
- The **error correction term** $\delta * (\phi_1 logRW_{t-4} - \phi_2 logTLP_{t-4})$ captures the long-run relationship between the real wages and trend labor productivity. When real wages deviate from their long-run equilibrium level, this deviation impacts wage dynamics in the short term, prompting a return to equilibrium, with the pace determined by δ.
- **Additional determinants of short-run wage dynamics,** following an augmented Philips curve, include:
  - *Domestic factors* (*D*): inflation expectations; FW-adjusted changes in labor productivity; the unemployment rate gap, proxied as the deviation from the HP-filtered equilibrium unemployment rate, and underemployment indicators (change in the share of involuntary part-time employment, temporary employment and self-employed);
  - *Foreign factors* (*F*): labor market conditions in the euro area and Ukraine;
  - *Foreign worker-related variables* (*FW*): share of FWs in total employment; and the change in the FW share in total employment.

5. Over the long run, real wages have tended to move with trend productivity, but overshot their fitted value since mid-2016, coinciding with a jump in productivity. In line with the literature, the level of real wages in the long run is found to track trend labor productivity. The estimated coefficient is significant and close to unity, as would be expected. However, real wages have exceeded their long-run predicted level beginning in mid-2016, coinciding with an acceleration in labor productivity, but which is captured in trend productivity only with a long delay (Figure 2). These residuals are partly explained by the short-run determinants of the model.

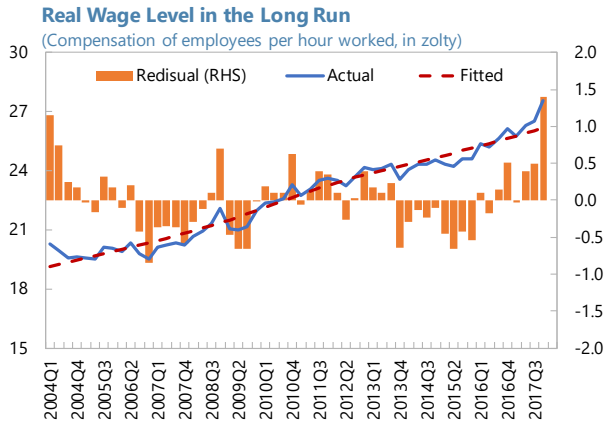
6. The short-run behavior of nominal wages is found to depend primarily on domestic factors and the error correction term. The estimated coefficient on the unemployment rate gap is negative and significant across all regression specifications, confirming the expected inverse relationship between unemployment and wage growth.[5] In addition, labor productivity growth and the error correction item are significant in all regression specifications. However, expected inflation (based on consensus forecasts) is not significant in any specification. This finding is robust to alternative measures of inflation expectations, including surveys by the NBP and the ECB, as well as actual CPI data. Finally, foreign spillovers do not seem to matter, with insignificant coefficients on labor market indicators in the euro area and Ukraine (Table 1, column 7–8).

[5] However, other indicators of labor market slack do not show statistical significance (Table 1, column 2–6), possibly reflecting the strong correlation among the different indicators, and implying that the unemployment rate gap already captures well the extent of labor slack.

Figure 2. Long Run Relationship Between Real Wage and Trend Labor Productivity

Variables	Log Real Wage Level
Log labor productivity trend (Adj by foreign workers)	0.847***
	(0.0240)
Constant	5.728***
	(0.0739)
Observations	56
R-squared	0.959

Standard errors in parantheses
***p<0.01, **p<0.05, *p<0.1



Note: The regression sample covers quarterly data from 2004Q1 to 2017Q4.
Source: IMF staff estimates.

Table 1. Poland: Short Run Drivers of Nominal Wage Growth

VARIABLES	(1) Nominal Wage Growth	(2) Nominal Wage Growth	(3) Nominal Wage Growth	(4) Nominal Wage Growth	(5) Nominal Wage Growth	(6) Nominal Wage Growth	(7) Nominal Wage Growth	(8) Nominal Wage Growth
L4.Unemployment rate gap (FW adj.)	-0.976***	-1.093***	-0.940***	-0.968***	-0.846***	-0.938***	-0.820***	-0.830***
	(0.217)	(0.271)	(0.213)	(0.214)	(0.235)	(0.210)	(0.268)	(0.270)
L4.Inflation expectation	-0.325	-0.441	-0.0484	-0.322	-0.235	-0.0878	-0.570	-0.607
	(0.506)	(0.533)	(0.530)	(0.499)	(0.506)	(0.501)	(0.837)	(0.846)
L4.Labor productivity growth (FW adj.)	0.612***	0.634***	0.628***	0.655***	0.621***	0.647***	0.643***	0.638***
	(0.152)	(0.156)	(0.150)	(0.153)	(0.151)	(0.150)	(0.151)	(0.152)
Change in share of temporary emp.		0.258						
		(0.355)						
Change in share of involuntary PT emp.			-0.929					
			(1.034)					
Change in share of agri. self employment				-1.317				
				(0.841)				
Change in share of non-agri. self emp.					1.531			
					(1.120)			
Change in share of underemployment (tem+PT+self)						-0.716	-0.473	-0.405
						(0.518)	(0.620)	(0.638)
Euro area wage growth							0.527	0.544
							(0.732)	(0.738)
Ukraine unemployment rate gap								-0.144
								(0.270)
L4. error correction item	-52.74***	-56.96***	-50.89***	-53.72***	-48.97***	-51.95***	-53.29***	-52.57***
	(12.13)	(13.50)	(12.14)	(11.98)	(12.35)	(11.76)	(11.97)	(12.13)
Constant	3.722***	3.845***	2.819**	3.083**	3.302**	2.613*	2.786**	2.881**
	(1.245)	(1.262)	(1.382)	(1.294)	(1.272)	(1.338)	(1.366)	(1.388)
Observations	57	57	56	57	57	56	56	56
R-squared	0.552	0.557	0.572	0.573	0.568	0.581	0.585	0.588

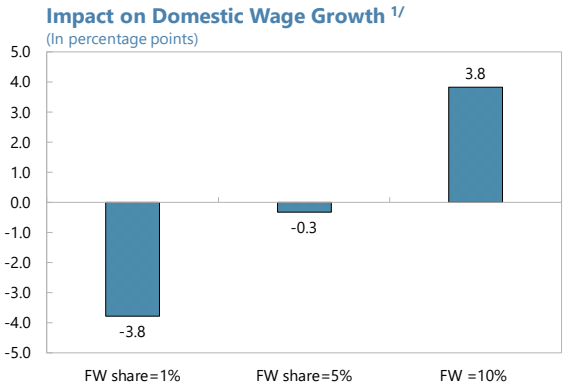
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: IMF staff estimates.

7. Foreign workers are found to significantly affect wage dynamics, with the net impact depending on their share in total employment. FWs may affect wages of Polish workers through two channels. First, provided they have similar skills and experience, FWs can substitute for Polish workers, reducing their bargaining power and dampening their wages. Second, if FWs bring different skills to the labor market they can serve as complements to Polish workers. In particular, FWs may be employed in sectors where Polish workers are in short supply (e.g., agriculture, construction and household services), freeing-up Polish workers to reallocate to more productive activities or to perform more complex tasks, which yield them higher wages. In addition, an increase in FWs can allow the economy's production frontier to shift outward, enabling firms to meet an increase in demand that benefits both foreign and Polish workers.

Table 2. Poland: Short Run Drivers of Nominal Wage Growth—Role of Foreign Workers

	(1) No FW adj. 2004Q1-2017Q4	(2) With FW adj. 2004Q1-2017Q4	(3) With FW adj. 2004Q1-2014Q4
VARIABLES	Nominal Wage Growth	Nominal Wage Growth	Nominal Wage Growth
L4. UE gap (FW adj.)	-0.976***	-0.887***	-0.903***
	(0.217)	(0.190)	(0.224)
L4.Inflation expectation	-0.325	-0.767	-0.435
	(0.506)	(0.618)	(0.845)
L4.Labor Productivity Growth (FW adj.)	0.612***	0.589***	0.605***
	(0.152)	(0.126)	(0.141)
Change in the share of FWs in total employment		-4.626***	-9.577
		(1.016)	(9.169)
Share of FWs in total employment		-1.228*	-1.749**
		(0.667)	(0.822)
Change in FW share* FW share of total employment		2.074***	9.177
		(0.519)	(13.36)
L4. Error correction item	-52.74***	-66.31***	-68.54***
	(12.13)	(10.37)	(11.85)
Constant	3.722***	5.813***	5.094**
	(1.245)	(1.682)	(2.234)
Observations	57	56	44
R-squared	0.552	0.711	0.705



Source: IMF staff estimates.
1/ Estimated impact of 1 ppt increase in the share of foreign workers in total, using the regression coefficients of all three FW-related variables from table 2 column 2.

8. Empirical evidence suggests that both these effects have been at play in recent years. The significantly negative coefficients on the share—and the change in the share—of FWs in total employment implies a dampening effect on wages of Polish workers, while the significantly positive coefficient on the interaction term indicates that FWs support wages of Polish workers (Table 2, column 2).[6] The net impact of these two opposing effects depends on how large is the share of FWs in total employment, with larger support provided to wages when the FW share is higher.[7] As shown in the simulation in the illustrative chart, from an initial FW share of 10 percent, a one percentage point increase in the FW share raises wages of Polish workers by 3.8 percent. However, when the FW

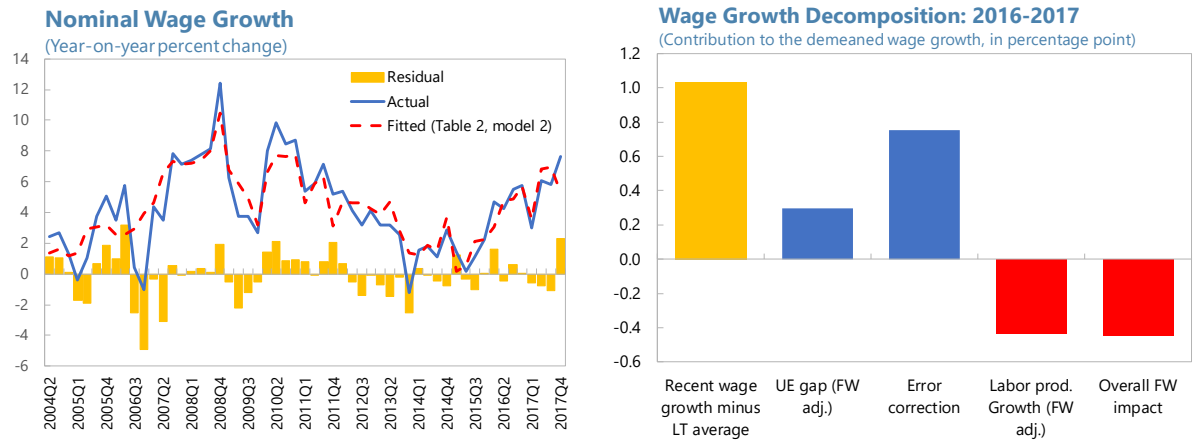
[6] When the regression is run on the pre-2015 period, which excludes the recent surge in FWs (Table 2, column 3), the interaction term becomes insignificant.

[7] Intuitively, if FWs earn less than Polish workers, part of the savings from employing additional FWs can be allocated to support the wages of Polish workers.

share is small, the wage dampening effect tends to dominate. The current FW share of around 5 percent is close to the point where FWs have a neutral effect on wage growth, although in recent years as the share of FWs rose, the wage-dampening effect was likely to have dominated. While the overall fit of the model (as measured by the R^2) improves considerably when controlling for FWs (compare columns 1 and 2), these results should be considered preliminary in view of the relatively short time series and significant measurement issues with the FW data.

9. In all, the empirical evidence suggests the recent acceleration in wage growth is largely explained by the tight labor market and the elimination of the previous "wage undershoot," while sluggish productivity and FWs are key dampening factors. The acceleration in nominal wage growth relative to the long-run average during 2016–17 can be decomposed into its constituent parts using the short-run empirical model (Table 2, column 2). A large part of the wage increase reflects the correction from earlier years when real wages were below their predicted long-run level during 2013–15, as shown in Figure 2. When economic conditions subsequently improved, wage growth picked up to restore real wages to their long-term level. In addition, wage growth was supported by growing labor scarcity. On the other hand, the more-sluggish labor productivity (after adjusting for FWs) and the net dampening effect of FWs held down wage growth. Looking ahead, with real wages currently above the level consistent with trend productivity, correction of the overshoot would be expected to dampen future wage growth. However, actual wage dynamics will also depend on the tightness of the labor market, the share of FWs and labor productivity dynamics.

Figure 3. Decomposition of the Recent Wage Acceleration



Source: IMF staff estimates.

Appendix I. Tables of Key Variables

Appendix Table 1. List of Key Variables

Variables	Description	Source
POL_wage gr	YoY growth rate of total labor compensation per hour worked in Poland	Eurostat, National Accounts
UE_GAP	HP-filtered gap of headline unemployment rate	LFS
UE_GAP_migrant	HP-filtered gap of unemployment rate adjusted by migrant workers	LFS, Ministry of Labor
CPI_exp	1 year ahead expected inflation	Consensus Forecast
LPgr	Growth rate of real labor productivity per hour	Eurostat, National Accounts
TLP	HP-filtered trend real labor productivity per hour	Eurostat, National Accounts
LPgr_migrant	Growth rate of real labor productivity per hour adjusted by migrant workers	Eurostat, Ministry of Labor
InvoPT_emp_delta	YoY change in the share of involuntary part-time workers in total employment	Eurostat
Tem_emp_delta	YoY change in the share of temporary workers in total employment	Eurostat
Self_emp_delta	YoY change in the share of self-employed workers in total employment	Eurostat
Migrant_total	The share of temporary migrant workers (statement procedure) in total employr	Ministry of labor
Dmigrant_total	YoY change in the share of migrant workers in total employment	Ministry of labor
EA_wagegr	YoY growth rate of total labor compensation per hour worked in EA	Eurostat

Appendix Table 2. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
POL _wagegr	58	3.73	3.11	-1.16	12.66
UE_GAP	82	0.00	1.28	-3.12	2.10
UE_GAP_migrant	70	0.00	1.40	-3.31	2.64
CPI_exp	66	2.65	0.95	1.03	5.96
LPgr	58	2.81	1.84	-0.86	7.27
LPgr_migrant	58	2.34	2.13	-1.56	7.16
Tem_emp_delta	69	0.97	1.56	-1.10	4.80
InvoPT_emp_delta	80	0.01	0.41	-0.68	1.39
Self_emp_delta	76	-0.24	0.45	-1.17	0.78
Migrant_total	80	0.76	1.33	0.00	5.53
Dmigrant_total	80	0.22	0.49	-0.09	1.81
EA_wagegr	78	2.36	0.84	0.05	3.83

References

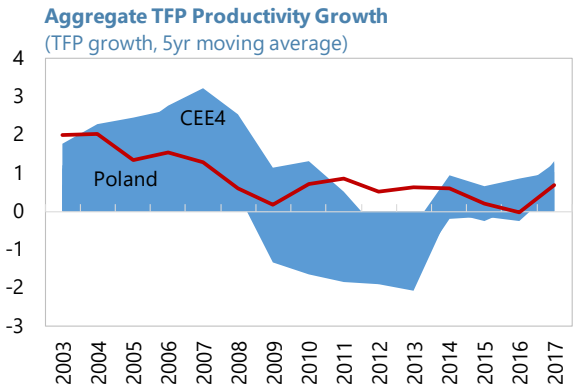
International Monetary Fund, 2017. "*Recent Wage Moderation in Sweden,*" IMF Country Report 17/351 (Washington).

————, 2018a, "*United Kingdom: Selected Issues*," IMF Country Report 18/43 (Washington).

————, 2018b, *Regional Economic Outlook: Europe* (Washington).

STRUCTURAL CHARACTERISTICS AND FIRM-LEVEL TOTAL FACTOR PRODUCTIVITY: EVIDENCE FROM POLAND AND EMERGING EUROPE[1]

1. With total factor productivity (TFP) crucial for a country's long-run growth, it is important to understand its drivers. Poland's TFP grew rapidly after the turn of the century, which has been attributed to the rapid increase in foreign direct investment and Poland's integration into regional supply chains.[2] However, since the GFC, aggregate TFP growth has halved. Similar TFP slowdown patterns have occurred in other Central and Eastern European countries. Globally, the TFP slowdown began even before the GFC, likely reflecting a combination of slower innovation at the technology frontier (with implications for productivity spillovers to the rest of the world), as well as population aging and the fading effects of past structural reforms.



Note: CEE4 consists of Czech Republic, Hungary, Slovak Republic, Slovenia.
Sources: Conference Board; and IMF staff calculations.

2. Looking at firm-level data can shed light on which characteristics may be driving the macro-level TFP dynamics.[3] For example, aggregate TFP could slow if resources do not flow to the most efficient firms, or because firms with characteristics that tend to be associated with lower TFP (e.g., firm-age or certain types of ownership) are becoming more prevalent. This paper uses two complementary sources of firm-level data for Poland to explore these questions. The first is a dataset prepared specifically for this study by Statistics Poland (Polish acronym GUS), and covers non-financial firms with more than nine employees.[4] The second source is a cross-country database

[1] Prepared by Federico Joaquin Díez, Yevgeniya Korniyenko, Krzysztof Krogulski, and Robert Sierhej. This work has benefited from discussions and comments by the Polish authorities, including the National Bank of Poland, the Ministry of Finance, and Statistics Poland.

[2] See Poland 2017 IMF Selected Issues Paper.

[3] From a macro perspective, TFP can be computed in two different ways. One approach is to use national accounts data to construct an aggregate production function and interpret the (Solow) residuals as aggregate TFP. The other approach relies on estimating a firm-level production function, obtaining the residuals (TFP), and use a weighting method to aggregate the firm-level results to produce TFP of the average firm. Both methods should, in theory, deliver similar results if the micro-sample is representative of the overall economy. The first method is simpler to compute, and always has macro representativeness. The second method, in turn, addresses endogeneity issues that can contaminate the link between economy-wide TFP and usage of the factors of production, and it also provides a much more granular perspective by allowing one to analyze the underlying heterogeneity across different segments of firms.

[4] The data set covers much of the enterprise sector that reports to Statistics Poland; nevertheless, it is not a randomized sample. Third-party access to individual firms' data is not permitted. Statistics Poland kindly compiled and processed the firm-level data using the method proposed by Levinsohn and Petrin (2003), as described in Appendix I.

of firm-level financial statements and ownership structure called Orbis, provided by the Bureau van Dijk, a Moody's Analytics company, which is used to compare Polish firms with those in other countries. While not identical, both data sets generate results that are quite similar in terms of the key structural characteristics that influence firm-level—and, hence, economy-wide—TFP.

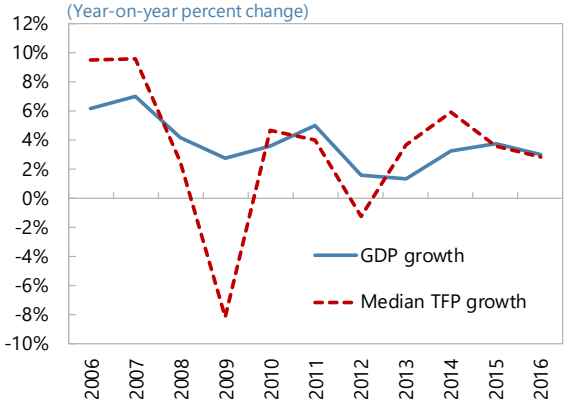
A. Firm-Level TFP: Statistics Poland Data[5]

3. This section presents findings on the firm-level determinants of TFP based on data from Statistics Poland. The sample covers 2005–16 and includes more than 48 thousand nonfinancial firms per year (on average) with 4.6 million employees and annual sales at PLN1.4 trillion. Similar to the aggregate structure of the economy, manufacturing and wholesale and retail trade are the two largest sectors in the sample in terms of gross value added (GVA). Very-large and large firms dominate the sample in all sectors. Within the sample, state-owned enterprises (SOEs) are dominant in mining and energy and water supply (utilities) sectors, while foreign-owned firms have a dominant role in manufacturing, trade, and transport and ICT sectors.

4. TFP has been the main driver of GVA growth. GVA grew by a cumulative 56 percent during 2005–16, with TFP accounting for more than a third of the increase. This aggregated firm-level TFP dynamics is broadly similar to GDP dynamics, with post-GFC TFP growth remaining mostly positive, but appreciably-lower than the pre-crisis average.

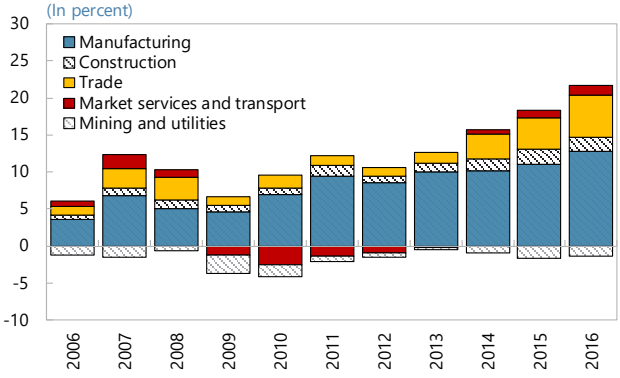
5. Manufacturing and trade contributed the most to productivity gains. Of the sample-wide cumulative increase in TFP during 2005–16 (just above 20 percentage points), firms in the manufacturing sector account for the majority of the increase. The trade and construction sectors also contributed positively to TFP growth, with the latter enjoying the highest rate of TFP growth in the sample. At the same time, productivity dynamics were negative in the mining and utilities sectors.

GDP and TFP Growth
(Year-on-year percent change)



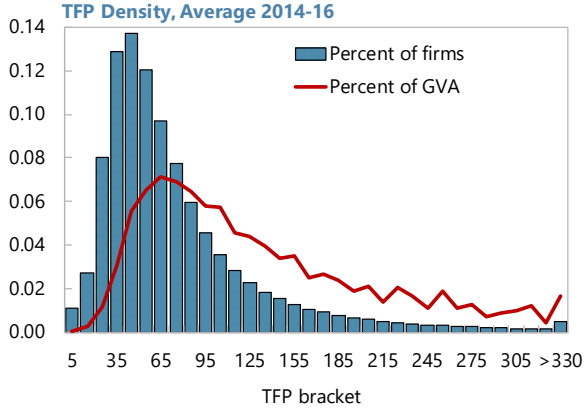
Sources: Statistics Poland; and IMF staff calculations.

Contributions to Cumulative TFP Growth by sector
(In percent)



Sources: Statistics Poland; and IMF staff calculations.

TFP Density, Average 2014-16



Sources: Statistics Poland; and IMF staff calculations.

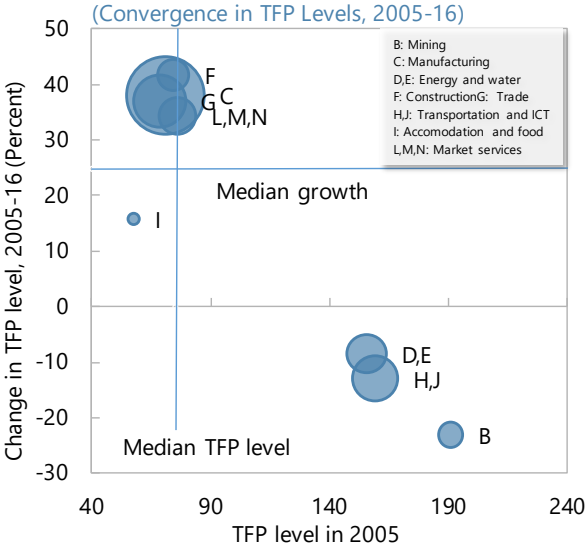
[5] Prepared by Krzysztof Krogulski and Robert Sierhej.

6. The majority of firms are at the lower end of the TFP distribution, although a gradual convergence is underway. The TFP distribution is highly skewed to the left, with the bulk of firms located in the lower-half of the TFP distribution. There has been a gradual TFP convergence, as evidenced by diminishing inter-quartile distance and, from a sectoral perspective, higher productivity growth in those sectors starting at low TFP levels. However, the long right tail of the TFP distribution suggests there is still ample catch-up potential for less-productive companies.

7. The largest firms are more productive but less dynamic. Very-large companies—those with more than 250 employees—are the most productive (their TFP level was 50 percent higher than for other firms in 2016). However, the TFP gap between very-large and other firms halved during the sample period, suggesting that very-large firms did not manage to sustain their initial productivity advantage. This finding is consistent with the sector-specific pattern, as those sectors with a high share of very-large firms (e.g., mining and utilities) recorded falling levels of productivity.

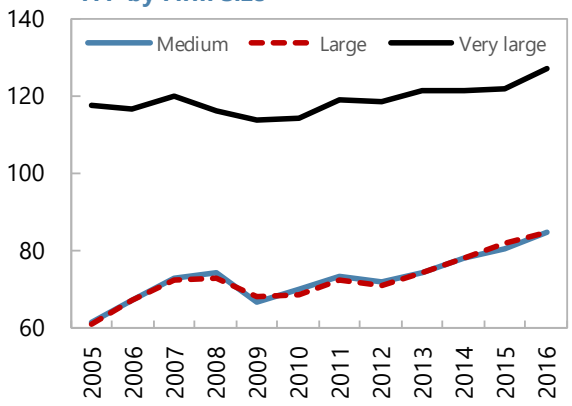
8. Foreign-owned and export-oriented firms have the highest TFP. Foreign-owned firms have substantially higher TFP than state-owned enterprises (SOEs) or domestic private firms. In addition, foreign-owned firms exhibited the strongest productivity gains. While initial TFP levels of foreign-owned firms and SOEs were roughly equal, a decade later foreign-owned firms were 33 percent more productive. Domestic private firms were less productive than SOEs, although their TFP has been catching up rapidly. Participation in global trade is also positively correlated with productivity, with export-oriented firms having much-higher TFP than firms serving only the domestic market. Moreover, TFP of export-oriented firms suffered less than other firms during the GFC.

TFP Distribution
(Convergence in TFP Levels, 2005-16)



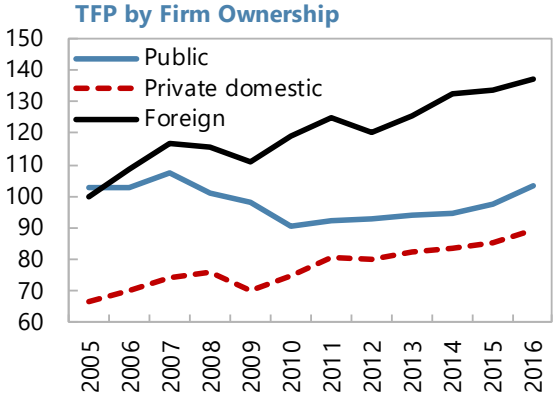
Sources: Statistics Poland; and IMF staff calculations.

TFP by Firm Size



Sources: Statistics Poland; and IMF staff calculations.

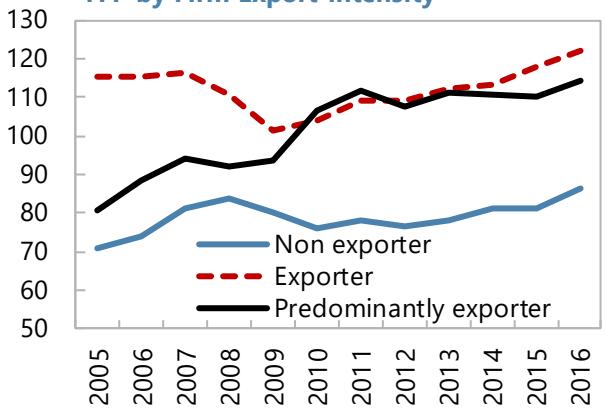
TFP by Firm Ownership



Sources: Statistics Poland; and IMF staff calculations.

9. TFP in manufacturing displayed characteristics similar to the whole sample. Productivity convergence occurred also within manufacturing—the largest sector. Divisions with the highest TFP in 2005 posted more subdued TFP gains relative to those which begun with lower TFP. The fastest TFP increase occurred in high-tech sectors such as production of computers and electronics, and electrical equipment. Very large firms are both the most productive and have the strongest TFP growth. Exporters are visibly more productive and foreign-owned firms have the highest TFP level. Contrary to the whole sample, SOEs in manufacturing posted the most impressive TFP gains.

TFP by Firm Export Intensity



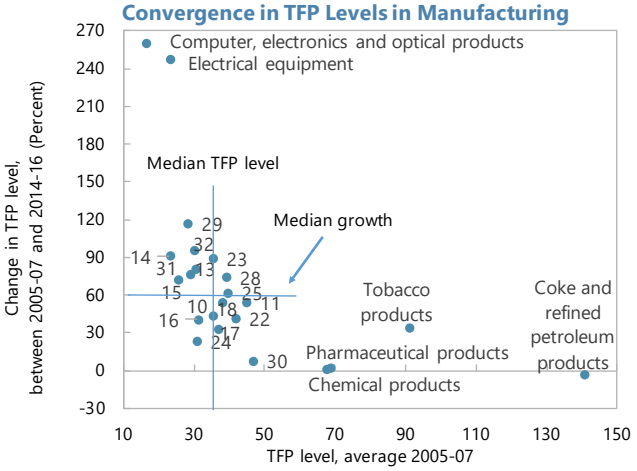
Sources: Statistics Poland; and IMF staff calculations.

B. Firm-Level TFP: ORBIS Data[6]

Firms' TFP and Structural Characteristics

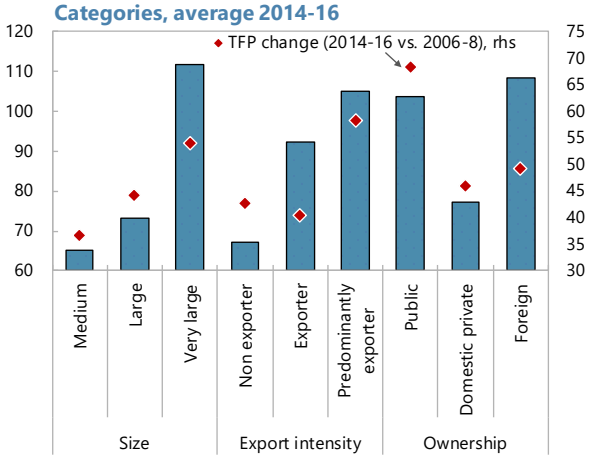
10. This section explores how firms' productivity dynamics vary according to their structural characteristics. The analysis is based on two Orbis databases (Orbis financials covering 2000–15 and Orbis ownership covering 2006–15).[7] These firm-level data cover around 20 percent of total employment and about 40 percent of operational turnover revenue (as reported by Eurostat and OECD) in the Polish economy, although the sample is not randomized (Appendix II). Further, the sample also includes data on four Central and Eastern European countries (Czech Republic, Hungary, Slovak Republic, and Slovenia), Italy, and Spain. For the analysis, we look only at the firms operating in the market economy (e.g., firms operating in nonmarket sectors, e.g., "public administration and defense" are excluded). Orbis ownership database makes it possible to identify the ultimate/direct owner of a

Convergence in TFP Levels in Manufacturing



Sources: Statistics Poland; and IMF staff calculations.

Average TFP Across Manufacturing Divisions, by Categories, average 2014-16



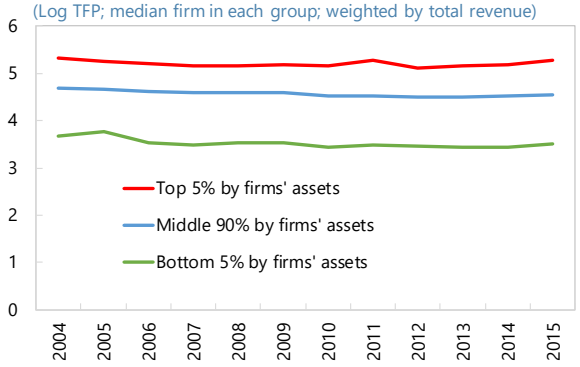
Sources: Statistics Poland; and IMF staff calculations.

[6] Prepared by Federico Joaquin Díez and Yevgeniya Korniyenko.

[7] The sample period is limited by access to Orbis data. TFP was computed using the Levinsohn and Petrin (2003) methodology.

company.[8] We use this information to classify companies into three groups: firms owned/controlled by the Polish government, foreign firms, and domestic private firms.[9] In terms of number of firms, state-owned enterprises (SOEs) account only for three percent of the total sample, but their share in the total assets is significantly larger (about 20 percent).

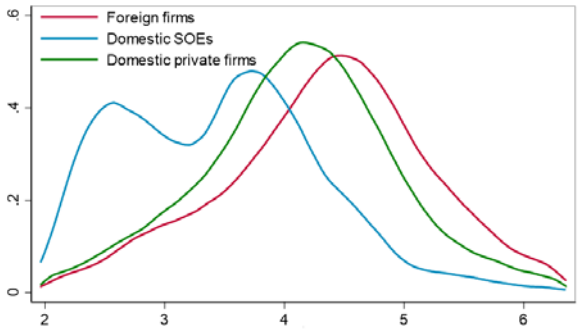
TFP Level by Firm Size (Total Assets)
(Log TFP; median firm in each group; weighted by total revenue)



Sources: ORBIS; and IMF staff calculations.

11. Small and medium-size enterprises (SMEs) have lower TFP levels than large firms. Polish SMEs are less productive, on average, than are larger firms, while the largest firms by size of assets are the most productive ones. This ranking by size of firms has remained stable over time. However, it varies by sector and by ownership type.

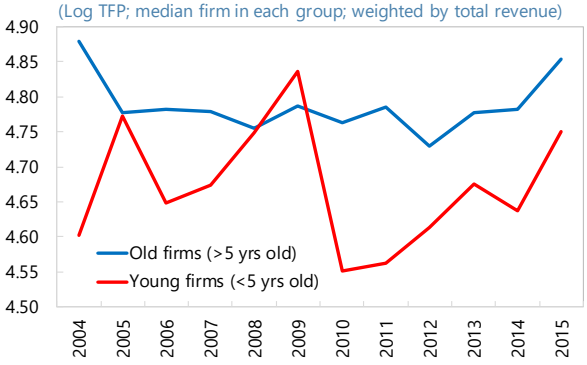
TFP by Firm Ownership
(Density log TFP)



Sources: ORBIS; and IMF staff calculations.

12. TFP varies by type of ownership, with foreign-owned firms being more productive than domestically-owned firms. The lower TFP of domestically-owned firms is partly attributable to the significant presence of SOEs with low TFP. Specifically, while the TFP distribution of private (foreign- and domestically-owned) firms approximates a normal distribution, the TFP distribution of SOEs is bi-modal, with one hump somewhat below the TFP modes of the private firms' distributions, and a second hump at the low-end of the TFP distribution. Moreover, most of the mass of the TFP distribution for SOEs is at the low-end, although the long right tail indicates that a few SOEs have high TFP. This double-hump pattern for SOEs is not unique to Poland (see details in Appendix II). Within Poland, we also find substantial heterogeneity across sectors in terms of public enterprises' efficiency. In sectors with a high concentration of SOEs (either due to the legacy of past monopolies

TFP Level by Firm Age
(Log TFP; median firm in each group; weighted by total revenue)



Sources: ORBIS; and IMF staff calculations.

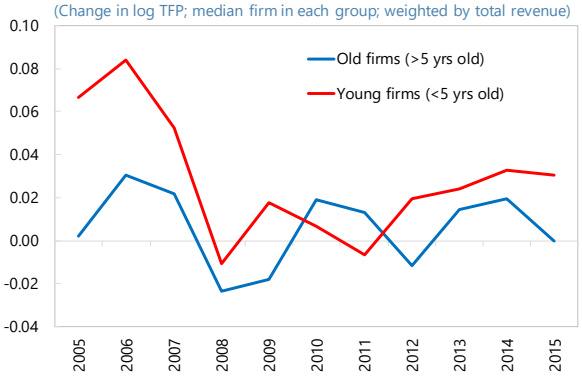
[8] We follow the approach detailed in Kalemli-Ozcan, S., and others (2016) to create a variable on ultimate/direct ownership.

[9] A firm is classified as owned/controlled by the State if the Polish government has a direct or ultimate stake of 25 percent or more; foreign firms are firms with single foreign ultimate/direct owner of 10 percent or more (as per the balance of payments definition); domestic private firms are all others.

or oligopolies or the result of market forces) both high and low TFP enterprises coexist, suggesting the presence of economic distortions.

13. Older firms have higher TFP, but the TFP of younger firms grows faster. Except for the period around the GFC, firms in Poland that are more than five-years old have higher levels of TFP relative to younger firms. However, younger firms are more dynamic, with faster TFP growth, a result that is also extensively supported by the literature.[10]

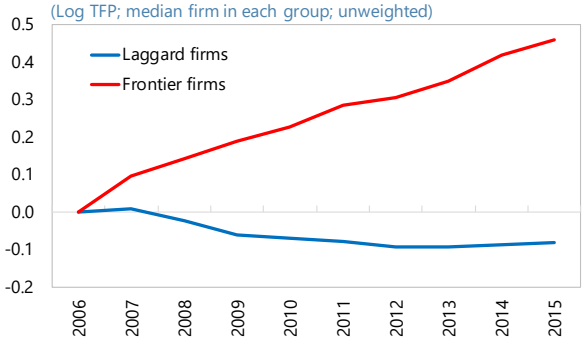
TFP Growth by Firm Age
(Change in log TFP; median firm in each group; weighted by total revenue)



Sources: ORBIS; and IMF staff calculations.

14. Firms with a larger share of investment allocated to intangible capital have better TFP performance. Investment in intangible capital can be considered a proxy for R&D investments[11]. Only about 25 percent of firms in the sample registered any investment in intangible capital. Not only do firms investing in intangible capital have higher TFP, they also have faster TFP growth than firms without such investments.

TFP for Frontier and Other Firms in Market Economy
(Log TFP; median firm in each group; unweighted)



Sources: ORBIS; and IMF staff calculations.

Note: The global frontier is measured by the average of log TFP for the top 5 percent of companies with the highest productivity levels within each 2-digit industry and year. Laggards capture the average log TFP of all the other firms. Unweighted averages across 2-digit industries are shown on the Chart, normalized to 0 in 2006. The vertical axes represent log-differences from the starting year: for instance, the frontier has a value of about 0.46 in the final year, which corresponds to approximately 46 percent higher in productivity in 2015 compared to 2006.

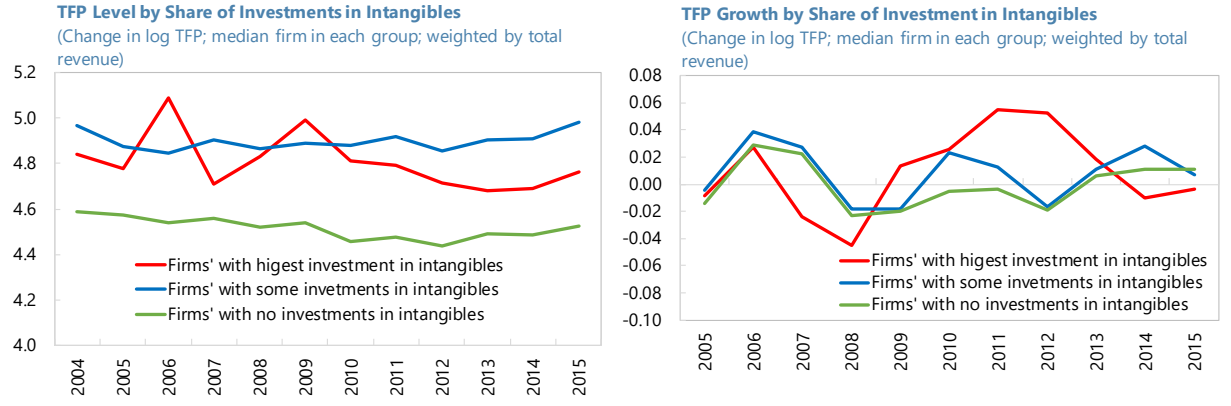
15. Small and medium-size enterprises (SMEs TFP levels of frontier firms continue to improve, while laggard firms find it difficult to catch up. Following Andrews and others (2016), laggard and frontier firms can be identified in each sector.[12] TFP of frontier firms grew significantly over the period analyzed, while the average TFP of laggard firms was significantly impacted by the GFC, and the recovery in their TFP growth rates is visible only in last few years. In manufacturing and services sectors, TFP of laggard firms was adversely impacted by the GFC and has failed to recover (with laggard manufacturing firms impacted significantly more).

[10] For example, Haltiwanger, Jarmin and Miranda (2013).

[11] Intangible assets comprise a broad range of assets, including innovative property (for example, related to R&D expenditures), software and databases, and economic competencies (branding, market research, management consulting, etc.).

[12] The global frontier is measured by the average of log TFP for the top 5 percent of companies with the highest productivity levels within each 2-digit industry and year. Laggards capture the average log productivity of all the other firms. The extent of turnover in the frontier classification is high; only 10 percent of firms identified as "frontier" in 2007 remained "frontier" in 2014.

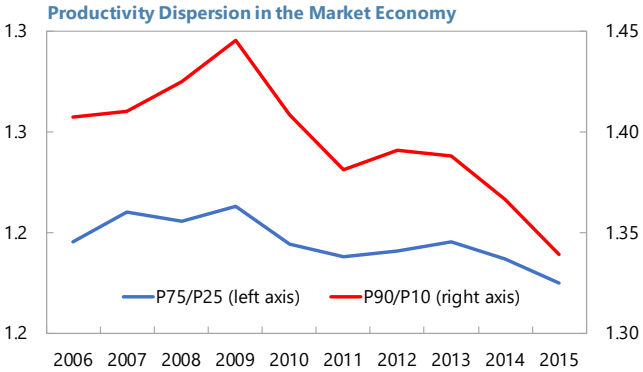
Frontier firms in manufacturing and services saw a sizable increase in TFP during the period analyzed, with the TFP increase in services twice as large as in manufacturing.



Sources: Orbis; and IMF staff calculations.

The Role of Resource Allocation

16. Following the GFC, resource allocation has become more efficient. The efficiency with which factors of production are distributed across firms is one of the main determinants of aggregate TFP. If the TFP distribution is very dispersed, aggregate productivity can be raised by reallocating resources from less-productive to more-productive firms (Hsieh and Klenow 2009). Based on the ratio of the 75th to the 25th percentiles of the TFP distribution (inter-quartile range), the dispersion of TFP across firms within a given sector has been trending down since 2009.[13] A similar result is found for the ratio of the 90th to the 10th percentiles. These results are consistent with a narrowing of the dispersion of TFP across firms and suggestive of improving resource allocation within the Polish market economy.



Sources: ORBIS; and IMF staff calculations.

Table 1. Cross-Country Comparison of Relative Allocative Efficiency
(Ratio of TFP of firms in the 75th to 25th percentiles)

	Level (2015)	Change 2006–15
Poland	1.18	-0.02
Czech R.	1.27	-0.01
Finland	1.22	0.01
France	1.19	0.01
Hungary	1.26	0.06
Italy	1.16	0.01
Spain	1.21	0.02
Slovakia	1.22	0.03
Slovenia	1.21	0.04
S. Korea	1.15	0.00

Sources: ORBIS; and IMF staff calculations.

17. In terms of allocative efficiency, Poland's performance compares favorably with other countries (Table 1). A comparison of inter-quartile ranges for other central and eastern European countries, as well as for France, Italy, Spain, and South Korea, finds that the level of inter-quartile ratio of TFP levels in 2015 in Poland is below that of the CEE4 peers, and it is broadly in

[13] The ratios were computed at the 4-digit sector level and aggregated using a sales-weighted average.

line with the advanced countries included in our analysis. Furthermore, the table also shows that Poland has seen the largest decrease in (i.e., narrowing of) TFP dispersion during 2006–15.

Analysis of Firm-Level Structural Drivers of TFP

18. An empirical analysis confirms that structural characteristics, like ownership, affect both levels and growth rates of firm TFP. Indeed, the data indicate that SOEs are associated with lower-than-average TFP levels and TFP growth rates (see Tables 4-7 of the Appendix II).[14] These findings are not restricted to Poland, as we find the same pattern when looking at peer CEE5 countries and, more broadly, to the set of countries in Europe's periphery. Further, these findings hold both across-and within-firm, indicating that these TFP differences are found by comparing firms with different ownership types and also by comparing the same firm before and after an ownership change. Moreover, the data also reveal that foreign-owned firms have above-average TFP levels and growth rates. Once again, these trends are not just limited to Poland but carry through to the set of comparator countries.

19. Firms' ownership structure can shape TFP outcomes. As just mentioned, foreign firms are more productive than their domestic counterparts as foreign firms operating in Poland are more likely to be located near the global technology frontier. It follows that a larger presence of foreign firms will be associated with higher productivity levels—this can occur through the transmission of better technologies and practices to local affiliates or to domestic partners of the foreign firm (e.g., a local supplier to a global supply chain). In addition, the presence of foreign firms could enhance productivity even further through other channels as well. For instance, openness to imports and FDI exert positive pressure on domestic competitiveness. Foreign-owned firms can influence TFP through greater competition, as a higher degree of market competition can encourage firms to improve their TFP (within firm) and tilt the market structure towards a more efficient allocation of resources (across firms).[15] Our findings also indicate that, in some cases/sectors, the prevalence of SOEs can act as a drag on productivity. That is, our findings indicate that SOEs are systematically less productive and grow at a slower rate than private firms (controlling for other factors), suggesting that their pervasiveness could negatively affect aggregate TFP outcomes. Still, since the data also show that some SOEs are as productive as private firms, our empirical results may indicate the presence of substantial heterogeneity in SOE management and the regulatory framework under which they operate.

[14] To put our findings in perspective, our analysis implies that if all SOEs were instead privately owned, the resulting aggregate TFP level would be, all else equal, almost nine percent higher. This figure originates from using our estimated coefficient on the SOE dummy to compute a counterfactual aggregate TFP, taking into account the number of SOEs and their size. The increase in TFP results from comparing the actual with the counterfactual TFP (of course, this is a back-of-the-envelope calculation since the "all else equal" condition may not fully hold in such a case).

[15] Similar positive impact of foreign ownership on firms' productivity was found in OECD (2014), "Perspectives on Global Development, 2014" and in IMF, 2018 APD REO.

20. Domestic institutions also affect TFP growth. The literature has identified several institutional characteristics that can affect firm TFP like the flexibility of the labor market, government efficiency, restrictiveness of regulation, affordability of financial services as well as the quality of institutions (e.g., judicial independence, impartial courts, and protection of property rights). Along these lines, we find a positive and statistically significant effect of relaxing product market regulations on TFP growth for both foreign and domestic private firms in our sample (see Table 8 of the Appendix II).[16] Interestingly, the restrictiveness of regulation is less important for SOEs. In addition, we also find that younger firms grow their TFP at a faster pace than older firms. This suggests that the aggregate level of TFP can be raised by creating a conducive environment for entrepreneurship and reducing barriers to firm entry so that new businesses are created, and existing ones continue to scale-up their operations.

21. Investments in intangibles are key for TFP growth. We find that investments in intangibles are one of the key factors explaining why some firms have higher TFP growth rates in Poland and in the set of comparator countries. Further, this finding holds across and within firms, indicating that those firms that rely relatively more on intangible assets grow faster than those that do not, and that if a firm increases its intangibles it is likely to increase its TFP growth rate. The result holds for all companies, which implies that both direct and complementary R&D spending for accessing new technologies or facilitating the adoption of global advanced technologies by resident firms appears to be effective in boosting TFP growth.

C. Conclusions and Implications

22. Ownership structure of firms plays critical role in TFP performance. Analyses presented in this paper using both Statistics Poland and Orbis data show that foreign-owned firms are associated with strong TFP performance through above-average TFP levels and growth rates. In contrast, the prevalence of SOEs was found to be a drag on TFP outcomes. In addition, the paper also found evidence of strong convergence in firms' TFP growth rates and that greater openness (measured by export intensity) and more investment in innovation are beneficial to TFP growth.

23. Continuous structural reforms are key to boosting TFP growth. Our findings suggest the need to create an environment conducive to entrepreneurship by reducing barriers to entry and ensuring a level playing field between state owned and private firms, while also avoiding barriers to scaling up businesses while encouraging investments in innovation and R&D. The results also highlight the potentially high macroeconomic costs for the Polish economy, through lower TFP growth, stemming from the prevalence of SOEs and from decreases in participation by foreign firms in the economy—reflected, for instance, in lower levels of foreign direct investment since the GFC. Finally, these findings point to the need to sustain (or increase) efforts toward structural reforms in order to boost TFP growth and sustain Poland's future growth performance among regional and global peers.

[16] A similar result is found by Budina et al. (2018) for a larger sample of EU countries.

References

Andrews D., Criscuolo C. and P.N. Gal, 2016, "The Best Versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy", OECD Productivity Working Papers, No. 05 (Paris: Organization of Economic Cooperation and Development).

Budina, N., P. Deb, F. Díez, J. Fan, J. Luzi, F. Misch, A. Shabunina, 2018. "Drivers of Firm Productivity Growth and Misallocation," Mimeo.

Haltiwanger, J., R. Jarmin, and J. Miranda. 2013. "Who Creates Jobs? Small vs. Large vs. Young." *The Review of Economics and Statistics*, Vol. 95, Issue 2, pp. 34–361.

Hsieh, C., and P. J. Klenow, 2009, "Misallocation and Manufacturing TFP in China and India," *The Quarterly Journal of Economics,* Vol. 124, No. 4.

International Monetary Fund, 2016, "Central, Eastern and Southeastern: How to Get Back on the Fast Track?" *Regional Economic Issues* (May).

————————, 2017, Poland: Selected Issues.

————————, 2018, "Productivity Growth in Asia: Boosting Firm Dynamism and Weeding out the Zombies" Asia Pacific Department, Regional Economic Outlook, Chapter 3.

Kalemli-Ozcan, S., and others, 2016, "How to Construct Nationally Representative Firm-Level Data from the ORBIS Global Database," NBER Working Paper, No. 21558 (Cambridge, MA: National Bureau of Economic Research).

Levinsohn, J. and A. Petrin, 2003, "Estimating Production Functions Using Inputs to Control for Unobservables," *Review of Economic Studies*, Vol. 70, No. 2.

Olley, G. Steven and Ariel Pakes, 1996, "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica,* Vol. 64, No. 6, pp.:1263–1298.

OECD, 2014, "Perspectives on Global Development 2014: Boosting Productivity to Meet the Middle-Income Challenge," (Paris: Organization of Economic Cooperation and Development).

————————,2015, "The Future of Productivity," (Paris: Organization of Economic Cooperation and Development).

Rovigatti, Gabriele, 2017, *Production Function Estimation in R: The Prodest Package*, Working Paper (Milano, Italy: Bocconi University).

Van Beveren, Ilke, 2012, "Total Factor Productivity Estimation: a Practical Review," *Journal of Economic Surveys*, Vol 26, No. 1, pp. 98–128.

Appendix I. Measuring Total Factor Productivity (TFP) of Non-Financial Enterprises in Poland[1]

A. Introduction

1. TFP is an unobservable variable, which measures the efficiency of transforming inputs into the output of an enterprise. The measurement of TFP is obtained as the residual component of production function. Firm-level production function estimates for the selected sample of Polish non-financial enterprises were made using econometric method.[2] The first part of this appendix describes preparation of the database and presents main characteristics of the sample, and the second presents methodology of TFP estimates.

B. Building Firm-Level Database and Main Structural Characteristics of the Sample

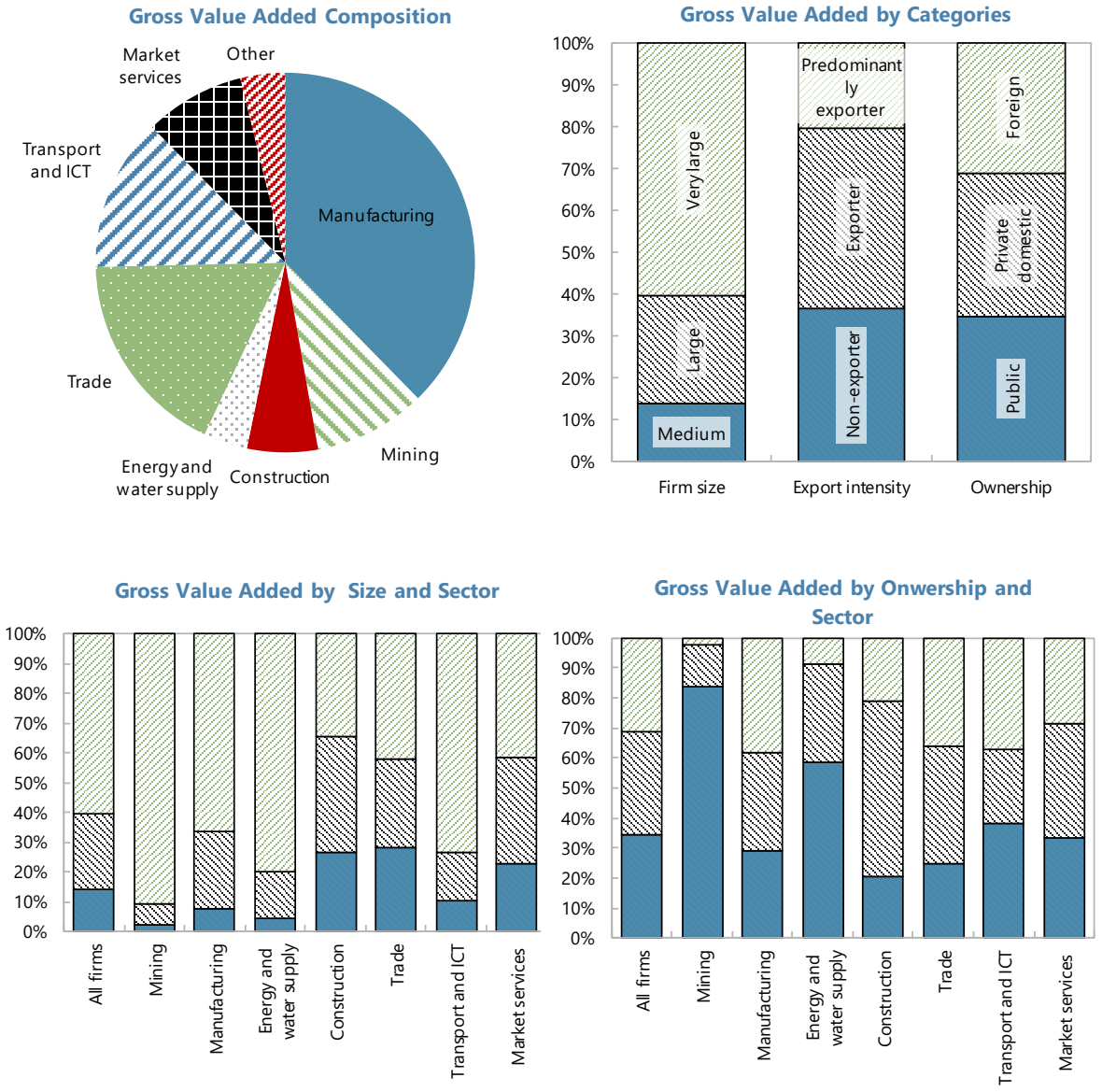
2. The data originated from annual reports of non-financial firms employing more than 9 persons for 2005–16 (reported to Statistics Poland, GUS, on SP statistical form). Building the final database required combining data sets for individual entities; adding external data (sections of activity,[3] deflators, etc.); generating variables for analysis (e.g., control variables); removing outliers. Expert data preparation was based on the following rules: removing firms with no positive net revenue from sales and firms with zero cost of materials and energy, external services and travel expenses. In addition, companies meeting at least one of the following conditions were removed: value of fixed assets at the beginning and end of the year was zero; number of full-time equivalent employees was zero; labor cost (wages and social contributions) was zero. Data were edited to replace missing values with zeros for the following variables: business travel expenses, intangible assets, costs of production for own use, value of goods and materials sold, excise tax, value of semi-finished products and production in progress, stock of finished products. In result, we obtained a consistent firm-level database, cleaned from outliers, and containing auxiliary, output, and control variables.

[1] Prepared by M. Błażej, M. Górajski, D. Kotlewski, A. Rynio (Statistics Poland).

[2] All estimates were performed in R statistical software, in particular the following R packages: prodest, estprod, dplyr, plm (Rovigatti, 2017) were used.

[3] It required transition from PKD-2004 to PKD-2007 classification of activities in 2008.

Appendix I. Figure 1. Sample Structure



Source: Statistics Poland.

3. Database used in the study includes over 585 thousand statistical units, 67 percent of all observations registered in the SP reports for the years 2005–16. Time-varying sample covered on average more than 48 thousand firms per year, with 4.6 million employees and annual sales at PLN1.4 trillion. While this is majority of the enterprise sector reported by GUS, the results must not be generalized because sampling was not based on a representative method. Firms were grouped according to sector of activity, ownership, size of employment, or export orientation to see if such factors are related to TFP. Main structural characteristics are presented in Appendix I Figure 1.

C. Estimating Firm-Level TFP with Econometric Production Function Models

4. Assuming that value added, Y_{it}, of enterprise i in period t is described by the Cobb-Douglas production function:

$$Y_{it} = A_{it} K_{it}^{\beta_k} L_{it}^{\beta_l}, \quad (1)$$

where L_{it}, K_{it}, are, respectively labor and capital inputs used in production process, and A_{it} is an idiosyncratic Hicks-neutral technological change. Y_{it}, K_{it} were measured, respectively, by deflating value added and fixed capital of firms to 2010 prices.[4] Technological change can be decomposed as:

$$A_{it} = TFP_{it}\, U_{it} = e^{\beta_0} V_{it}\, U_{it}. \quad (2)$$

Thus A_{it} is unobservable variable that can be expressed as a product of the constant term e_0^{β}, volatility of individual productivity V_{it} and idiosyncratic white noise $U_{it} = e^{u_{it}}$. If y_{it}, l_{it}, k_{it} are logarithms of Y_{it}, L_{it}, K_{it}, then:

$$\omega_{it} = \beta_0 + \ln V_{it} = \beta_0 + v_{it} \quad (3)$$

represents logarithm of productivity of enterprise i. Hence production function (1) can be rewritten in log-linear form as:

$$y_{it} = \omega_{it} + \beta_k k_{it} + \beta_l l_{it} + u_{it} \quad (4)$$

Coefficient ω_{it} is often interpreted as a state variable in the enterprise decision problem of selecting factor inputs, while the error term u_{it} represents so-called unpredictableproductivity shock.

Equation (4) is estimated in order to determine individual total factor productivity. As a result, we obtain an estimator of logarithm of TFP:

$$\hat{\omega}_{it} = \hat{\beta}_0 + \hat{v}_{it} = y_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_l l_{it}. \quad (5)$$

It follows from (5) that individual total factor productivity is given by:

$$\widehat{TFP}_{it} = e^{\hat{\omega}_{it}}, \quad (6)$$

which can be then used to analyze determinants of individual productivity or to produce aggregated section or division productivity.[5]

---

[4] Fixed capital was defined as average annual level of fixed assets $K = (FK_{12} + FK_0)/2$.

[5] Firm-level TFP was winsorized by removing the top and bottom percentile from TFP_{it} distribution. TFP_{it} aggregation of firms from a given sector $i \in S$ in year t was a weighted average:

$$TFP_{S,t} = \sum_{i \in S} w_{it}\, TFP_{it},$$

where weights $w_{it} = \frac{K_{it}^{\beta_k} L_{it}^{\beta_l}}{\sum_{i \in S} K_{it}^{\beta_k} L_{it}^{\beta_l}}$ reflected the size of a firm in the sector.

5. In course of estimation, problems of endogeneity, sample selection bias or omitted variables needed to be addressed (see van Beveren 2012). Classical OLS estimation of production function often produce positive bias of labor coefficient β_l and negative bias of capital elasticity of output β_k. Robust estimation methods, such as instrumental variables estimation, generalized method of moments or control function methods (see Olley and Pakes, 1996, and Levinsohn and Petrin, 2003) help to address these problems. Control function methods allow for use of unbalanced panel data and introduce mechanism correcting for enterprise exits. Moreover, Olley-Pakes (OP) and Levinsohn-Petrina (LP) models solve the problem of endogeneity by employing variables that proxy for unobservable productivity shocks. OP model uses investment as a proxy, while LP model assumes that productivity can be proxied by outlays on materials and energy. Both models are estimated in a 3-step procedure. In the first step, labor elasticity is estimated under assumption that it is not correlated with TFP. In the second step, conditional survival probability of enterprise is estimated. In the final stage, using estimates from the previous two steps, non-linear regression of gross value added of surviving firms is applied. Standard errors can be obtained by bootstrapping procedure.

6. Ultimately, production function was estimated using following methods:

- the classical linear regression (pooled OLS)
- panel regressions with fixed and with random individual effects
- control function methods, inter alia, OP model and LP model.

7. Additionally, specification of selected models was enhanced to include linear trends. LP model was re-estimated on 3-year rolling sample window, producing time-variant estimates of labor and capital elasticities β_l, β_k. Statistically significant linear trend in logarithm of gross value added was confirmed. In initial period (2007-10), elasticities of labor and capital β_l, β_k deviated from full-sample estimates but differences narrowed in the following periods.

8. Taking into account estimation results and considering the trade-off between model complexity and accuracy of estimates, further analyses were conducted using baseline LP model (proxy = raw materials and energy) identified on full sample, including all firms.

Appendix II. Orbis Data and Regression Results[1,2]

Appendix II. Table 1. Orbis Database Descriptive Statistics						
	mean	p50	sd	min	max	N obs
Poland: TFP level						
Foreign Firms	4.3423	4.4014	0.8618	1.9650	6.3501	36706
SOEs	3.4655	3.4848	0.8347	1.9652	6.3435	9177
Domestic Private Firms	4.1161	4.1412	0.8099	1.9651	6.3525	252963
Poland: TFP growth						
Foreign Firms	-0.0030	0.0029	0.2147	-0.8976	0.8046	27,961
SOEs	0.0050	0.0031	0.1688	-0.8691	0.7970	7,228
Domestic Private Firms	-0.0188	-0.0127	0.2378	-0.8988	0.8045	176,796
Source: ORBIS. See https://www.bvdinfo.com/en-gb/our-products/company-information/international-products/orbis for details.						

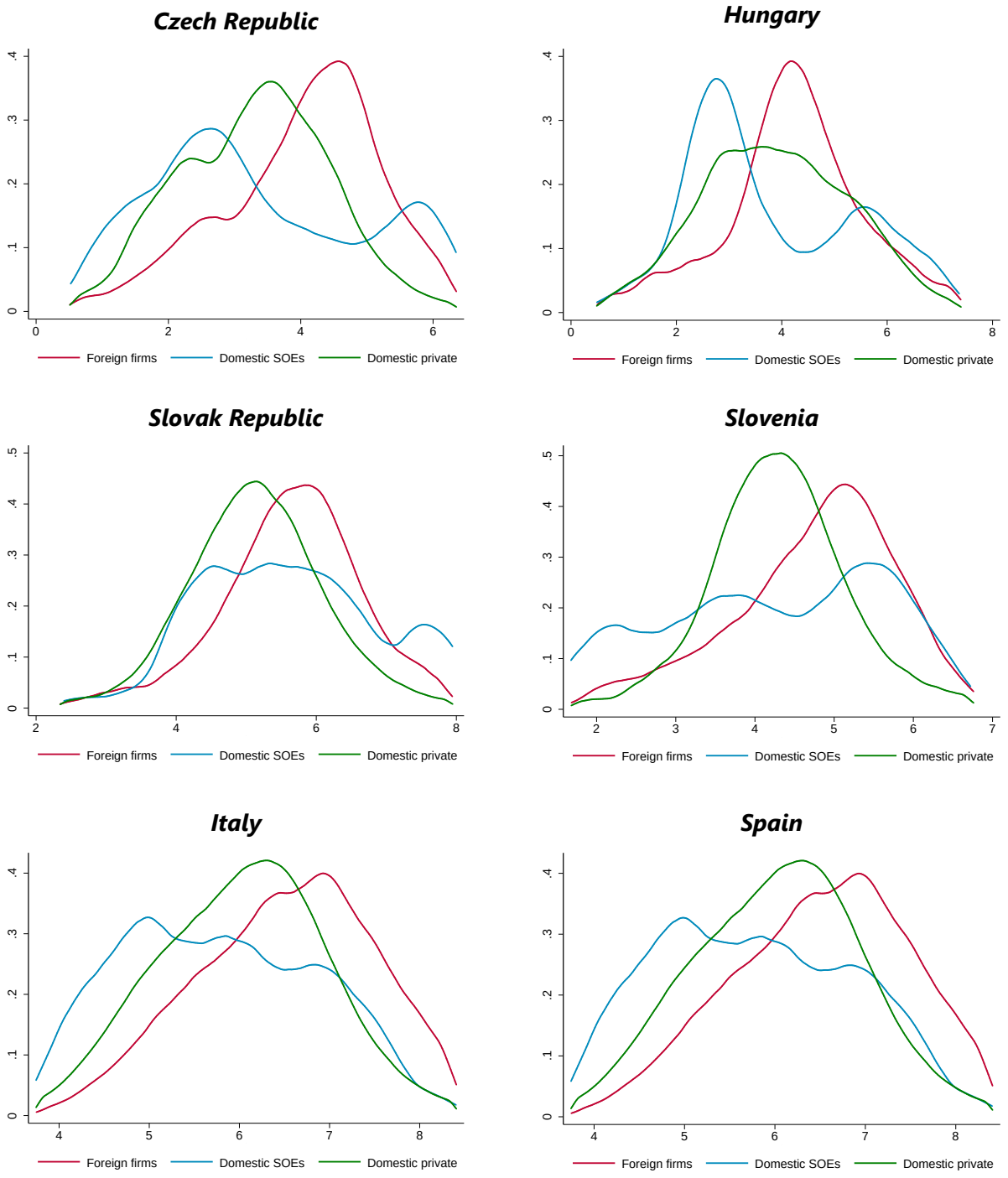
Appendix II. Table 2. Poland Ownership and Firms' Characteristics: Basic Facts		
Dependent Variable: TFP level	**Foreign Firms**	**SOEs**
Assets	0.071***	0.096***
	[7.184]	[2.812]
Revenue	0.082***	0.012
	[8.200]	[0.319]
Age	0.031***	0.066***
	[7.061]	[5.303]
N obs	289,588	289,588
Notes: Regressions include firm and industry-year fixed effects. Robust t-statistics in parenthesis. *** indicate significance at 1 percent, ** at 5 percent, and * at 10 percent, respectively.		

Appendix II. Table 3. Poland Ownership and TFP: Multinomial Regression Model		
Dependent Variable: Ownership dummy	**SOEs**	**Domestic Private Firms**
TFP	-0.0375***	-0.00658**
	(0.00161)	(0.00312)
N obs	211,378	211,378
Notes: Marginal effects of multinomial logit regression, with foreign ownership as the control category. Regression controls for age, size, industry and year fixed effects. Standard errors clustered at the firm level. *** indicate significance at 1 percent, ** at 5 percent, and * at 10 percent, respectively.		

[1] Prepared by Federico Joaquin Díez and Yevgeniya Korniyenko.

[2] The database only includes firms operating in the market economy (excluding sectors 83–99 based on NACE Rev.2).

Appendix II. Figure 1. TFP Distribution by Ownership



Sources: ORBIS; and IMF staff calculations.

Appendix II. Table 4. TFP Drivers (cross-sectional regression model)

Dependent Variable: TFP level	Poland 1	CEE5 2	CEE5+IT+ES 3	Poland 4	CEE5 5	CEE5+IT+ES 6
Foreign	0.094***	0.091***	0.159***			
	[28.063]	[28.958]	[79.815]			
SOEs				-0.421***	-0.471***	-0.264***
				[-56.376]	[-43.915]	[-38.288]
N obs	182,425	721,979	3,972,410	182,425	721,979	3,972,410
R2	0.733	0.666	0.822	0.737	0.667	0.821

Notes: Foreign (SOEs) is a dummy variable equial to one if a firm is foreign (state) owned/controled, and zero otherwise. Regressions include firm level characterists (total assets, company age, share of intangibles to total assets, variable to proxy for leverage) as controls, all regressors lagged by one year; regressions include sector-year and country-year fixed effects. Robust t-statistics in parenthesis. *** indicate significance at 1 percent, ** at 5 percent, and * at 10 percent, respectively.

Appendix II. Table 5. TFP Drivers (within-firm regression model)

Dependent Variable: TFP level	Poland 1	CEE5 2	CEE5+IT+ES 3	Poland 4	CEE5 5	CEE5+IT+ES 6
Foreign	0.019***	0.009**	0.005**			
	[3.147]	[2.408]	[2.494]			
SOEs				-0.064***	-0.054***	-0.044***
				[-2.990]	[-3.037]	[-2.936]
N obs	289,597	1,052,826	5,286,057	289,597	1,052,826	5,286,057
R2	0.928	0.947	0.972	0.928	0.947	0.972

Notes: Foreign (SOEs) is a dummy variable equial to one if a firm is foreign (state) owned/controled, and zero otherwise. Regressions include firm level characterists (total assets, age of the company, share of intangibles to total assets, variable to proxy for leverage) as controls, all regressors lagged by one year; regressions include firm, sector-year and country-year fixed effects. Robust t-statistics in parenthesis. *** indicate significance at 1 percent, ** at 5 percent, and * at 10 percent, respectively.

Appendix II. Table 6. TFP Growth Drivers (cross-sectional regression model)

Dependent Variable: TFP growth	Poland 1	CEE5 2	CEE5+IT+ES 3	Poland 4	CEE5 5	CEE5+IT+ES 6
Foreign	0.032***	0.030***	0.033***			
	[18.311]	[26.386]	[48.295]			
SOEs				-0.059***	-0.030***	-0.006***
				[-17.381]	[-11.678]	[-4.175]
Lagged TFP	-0.178***	-0.105***	-0.097***	-0.180***	-0.105***	-0.096***
	[-107.90]	[-168.57]	[-365.75]	[-107.72]	[-168.17]	[-364.64]
N obs	182,425	721,979	3,972,410	182,425	721,979	3,972,410
R2	0.733	0.666	0.822	0.737	0.667	0.821

Notes: Foreign (SOEs) is a dummy variable equial to one if a firm is foreign (state) owned/controled, and zero otherwise. Regressions include firm level characterists (total assets, age of the company, share of intangibles to total assets, variable to proxy for leverage) as controls, all regressors lagged by one year; regressions include sector-year and country-year fixed effects. Robust t-statistics in parenthesis. *** indicate significance at 1 percent, ** at 5 percent, and * at 10 percent, respectively.

Appendix II. Table 7. TFP Growth Drivers (within-firm regression model)

Dependent Variable: TFP growth	Poland 1	CEE5 2	CEE5+IT+ES 3	Poland 4	CEE5 5	CEE5+IT+ES 6
Foreign	0.006	0.005	0.00			
	[0.995]	[1.387]	[-0.147]			
SOEs				-0.051**	-0.031**	-0.025
				[-2.083]	[-1.758]	[-1.616]
Lagged TFP	-0.692***	-0.723***	-0.680***	-0.692***	-0.723***	-0.680***
	[-174.99]	[-341.74]	[-758.68]	[-174.97]	[-341.74]	[-758.68]
N obs	170,053	677,169	3,785,237	170,053	677,169	3,785,237
R2	0.501	0.492	0.482	0.501	0.492	0.482

Notes: Foreign (SOEs) is a dummy variable equial to one if a firm is foreign (state) owned/controled, and zero otherwise. Regressions include firm level characterists (total assets, age of the company, share of intangibles to total assets, variable to proxy for leverage) as controls, all regressors lagged by one year; regressions include firm, sector-year and country-year fixed effects. Robust t-statistics in parenthesis. *** indicate significance at 1 percent, ** at 5 percent, and * at 10 percent, respectively.

Appendix II. Table 8. TFP Growth and Policy Variables

Dependent Variable: TFP growth	Foreign Firms 1	SOEs 2	Domestic Private Firms 3
Regulation	-0.006***	-0.003	-0.008***
	[-4.692]	[-1.090]	[-18.492]
Lagged TFP	-0.047***	-0.023***	-0.099***
	[-33.433]	[-11.678]	[-208.115]
Size	0.007***	0.004***	0.015***
	[10.716]	[3.614]	[77.228]
Leverage	0.023***	0.037	0.039***
	[2.902]	[1.210]	[24.021]
Intangibles	0.070***	0.040***	0.085***
	[6.525]	[2.469]	[30.106]
N obs	75,624	12,011	1,580,189
R2	0.059	0.05	0.069

Notes: Regressions include firm and industry-year fixed effects. Robust t-statistics in parenthesis. *** indicate significance at 1 percent, ** at 5 percent, and * at 10 percent, respectively.