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Impacts of globalization and digitalization on the future of economic statistics:
Session 1: Globalization and policy needs

Globalization and the fall in productivity growth. The role of official statistics – the experience of Statistics Poland, selected issues[*]

Note by Statistics Poland

Summary

      This document is presented to the Conference of European Statisticians seminar on "Impacts of globalization and digitalization on the future of economic statistics" for Session 1: "Globalization and policy needs" for discussion.

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[*] This document was submitted late due to delayed inputs from other sources.
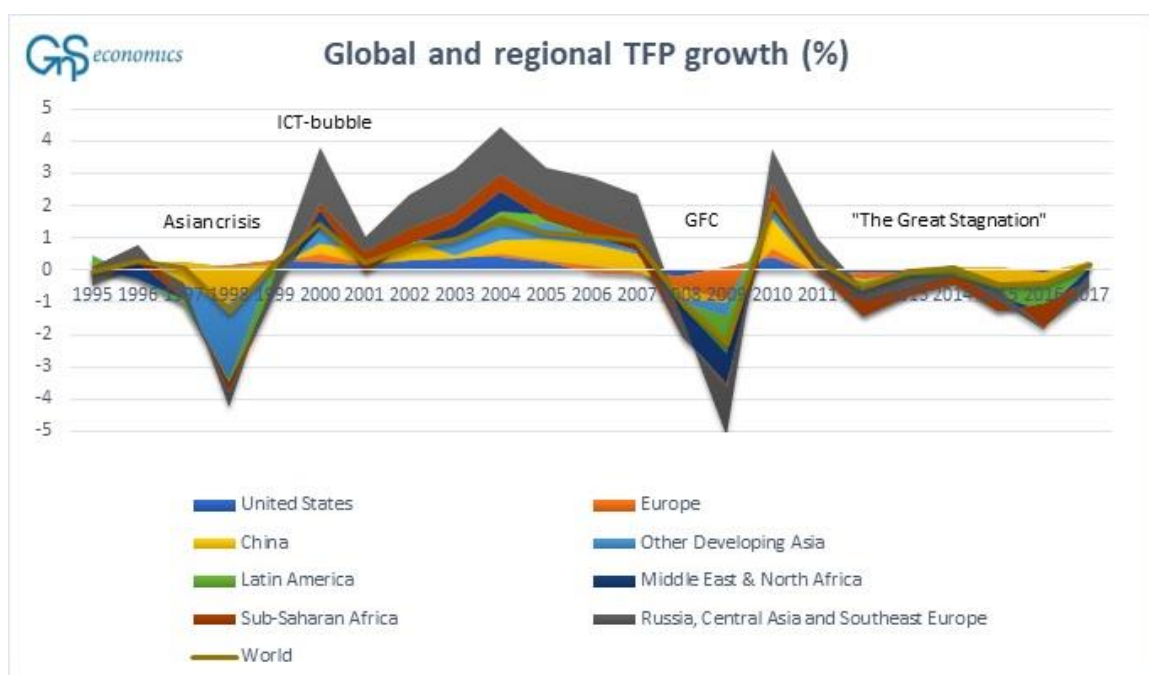
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I. Introduction

1.   The significance of productivity as the main factor of economic growth has been confirmed on numerous occasions both in qualitative and quantitative analysis and for many countries and time periods. Paul Krugman describes it as: "productivity isn't everything, but, in the long run, it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker". Paul J. Meyer (an American businessman) explained that "productivity is never an accident. It is always the result of a commitment to excellence, intelligent planning, and focused effort." Hence the productivity is a measure of the efficiency with which societies connect their people, resources and tools to develop the economy (see Cusolito and Maloney. 2018).

2.   Measures of productivity are the key indicators for the analysis of economic growth. As OECD Productivity Manual emphasizes (see OECD 2001, OECD 2013), there are many different approaches to measuring productivity, and the choice of proper productivity measure depends on the purpose of measurement and the availability of data. The primary classification of productivity measures consists of unit-factor productivity measures (relating output to a single input, e.g. labour productivity) or multifactor productivity measures (relating production to the weighted average of the inputs, e.g. total factor productivity (TFP)).

3.   The correct measurement of productivity and the indication of its main determinants are the fundamental issues in the theory of economic growth. Recent studies indicate that after the last global financial crisis (GFC) the slowdown in the growth of the technology frontier is confirmed (cf. OECD 2015, International Monetary Fund 2016, Gustavo et al. 2017, Cusolito and Maloney. 2018 and Grover Goswami et al. 2019, World Bank 2020). Lack of return to total factor productivity (TFP) growth path recorded before GFC observed for many economies is called "productivity puzzle" (cf. Haldane, (2017), see Chart 1). Some economic and econometric analysis indicates that the productivity growth can, to a large extent, be explained by factors related to globalization (Melitz 2003, McMillan and Rodrick 2011, Liu, Mian and Sufi 2018). Developing countries have become more integrated into the world economy since the early 1990s. Globalization has facilitated the transfer of technology and has contributed to increasing productivity. However, we observe very varied results among developing countries, suggesting that the consequences of globalization depend on how countries integrate with the global economy. On the other hand, the observed decline in long-term interest rates is associated with the increasing market concentration and productivity gap between industry leaders and followers and, as a result, slower productivity growth. The literature distinguishes several significant and interrelated global factors that are to shape future labour efficiency and productivity. These factors include the emergence of increased working hours through the development of artificial intelligence, labour force restructuring which includes the reallocation of labour from low- to high- productivity sectors, and the integration of global value chains. In recent years, against the background of the digital revolution and its integration with global value chains, we could expect increases in the total factor productivity. However, for many countries, the anticipated increases in productivity are not observed. Therefore, the search for external factors, appropriate economic policy, market regulations or institutional settings that will stimulate the growth of individual productivity of enterprises is currently one of the main challenges in the field of economic growth. If the increase in productivity has not slowed down in recent years, then the appearance of the productivity puzzle can be associated only with TFP measurement problems. Thus, the answer to the question: to what extent the different methods of measuring TFP can lead to proper and more precise conclusions about the determinants of productivity of enterprises is of great scientific and practical importance.

Chart 1.
Regional and global growth rates of total factor productivity (TFP) in percentage points

Source: GnS Economics, Conference Board

4. The development of the enterprise data analysis has completely changed the scope and perspectives of research on economic policy. It has been proven that micro-data studies are one of the most effective tools for investigating microeconomic causality and understanding their macroeconomic consequences. Despite the growing demand for decision-makers on the analysis of competitiveness and productivity of enterprises in international perspective, cross-country studies for many countries are still scarce. The main reason for the deficit of research on firm-level productivity are the following features of data samples:

(a) Individual data are mainly collected for administrative purposes,

(b) Data are confidential,

(c) There are significant problems to improve cross-country data comparability.

5. The productivity stagnation across the world over the past two decades has forced to rethink both productivity measurement and analysis (see Chart 1). Several research projects aiming at solving the productivity puzzle have been launched recently. From the start of 2019, the Halle Institute for Economic Research has been coordinating a new EU project entitled MICROPROD, where researches try to find the answer to: why productivity growth is slowing in industrialised countries. For several years the World Bank productivity project aims to bring global decision makers closer to productivity measures and determinants (see Cusolito et al. 2018, Grover Goswami et al. 2019, Fugie et al. 2020).

6. In this document, we describe an example of the research project on productivity conducted by Statistics Poland and the International Monetary Fund (IMF). In 2018 a new cooperation model was introduced between the IMF and Statistics Poland. Experiences of Statistics Poland related to the data analysis, statistical modelling methods, as well as experience in research cooperation in this new model, are to be shown. The result of this cooperation is summarized in the form of IMF 2019 Country Report No. 19/38. The goal of our analysis was to measure the total factor productivity (TFP) for non-financial enterprises in Poland in 2005-2017. Based on econometric panel data models describing the production function of the company, TFP distributions are determined for the whole sample and conditional to selected productivity determinants. The new approach to cooperation between official statistics institution and external institution (here one of international financial institution) allowed to obtain outcomes unforeseeable within the usual form of cooperation.

The economic policy statements made by IMF were based on the analysis performed on enterprises micro-data, but any micro-data were made accessible outside Statistics Poland.

II.   The role of official statistics in measuring productivity

7.   Official statistics are a source of crucial information on economies. In the information age, providing reliable data and high-quality information by national statistical institutes (NSIs) around the world is increasingly essential for our economies and societies. NSIs provide data needed for several economic productivity measures, including output per hour (labour productivity) and in some cases, multifactor productivity indicators for the whole economy and a range of economic sectors. The official statistics also face a challenge to provide more advanced analysis based on micro-data and more sophisticated modelling tools.

8.   Under constant returns to scale, perfect competition and immediate adjustments, total factor productivity growth is equivalent to well-known Solow's residual. The Solow TFP time series is now part of the official statistical books of many countries through growth accounting systems, e.g. the productivity program of the U.S. BLS[1], OECD works and the EU-KLEMS productivity and growth accounts. In this approach, the neoclassical Cobb-Douglas production function implies that the rate of growth of gross value added equal to the weighted sum of growth rates of capital and labour, with weights given by input shares, plus the TFP growth. As a result, the pace and structure of economic growth can be examined using the standard growth accounting system (see Hulten 2009). Growth accounting is also developed to analyse growth at the sectoral level.

9.   The KLEMS productivity accounts present economic processes ex-post, from the supply-side point of view. They evolved from a neoclassical economic growth theory formulation in the form of Solow's decomposition from the 1950s. This theory is fundamental for two main methodology options presently carried out worldwide. One of them is the OECD methodology, aiming more at maximising international comparability, even at the expense of some compromises against the theory. Dale Jorgenson and his associates developed the basic methods of KLEMS growth accounting. The Department of Macroeconomic Studies and Finance of Statistics Poland, within the so-called "experimental statistics", carries out studies to implement KLEMS economic productivity accounts in the Polish conditions. The results of these studies have been published among others on the Statistics Poland website and within scientific journals, moreover a number of analytical issues, their solutions and methods used are presented at scientific conferences.

10.   The methods mentioned above are built under strong premises. The growth accounting systems- regardless of their importance and achievements - did not allow to solve the number of the current problems on productivity and did not enable to investigate firm-level determinants of productivity growth. There is a need to use new growth statistics based on microdata. The relaxing of the assumptions of perfect competition, the constant return to scale, flexible markets and focusing on firm-level data sets allows introducing new measures of firm-level productivity and answer questions about the impacts of globalization related factors on productivity growth. In this new approach, the firm is the centre of productivity analysis. Individual productivity growth can be decomposed into three components: within-firm component, between-firms component and selection effects (see Cusolito and Maloney 2018). The within component is related to firm internal abilities, e.g. managerial and labour force skills, utilization of technological knowledge and innovation capacity and in our study, it is approximated among others by firm characteristics such as size, export intensity and ownership status of the enterprise. The between component corresponds to the contribution of inter-sectoral reallocation of resources, e.g. market concentration. Selection effects are associated with the process of entrances of new firms on the market and exit of low-productivity enterprises.

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[1] The Bureau of Labor Statistics, https://www.bls.gov/dpr/.

A. A new model of cooperation between Statistics Poland and the International Monetary Fund

11.   A new model of cooperation between Statistics Poland and the International Monetary Fund led to the research project on measuring the productivity of enterprises in Poland. This project was aimed at measuring TFP and identifying the determinants of productivity for enterprises in Poland in the period of 2005-2017. We estimated the production function by applying the econometric method of control functions. Under weak assumptions, this method allows for a consistent estimation of labour and capital elasticities of gross value added. We determined empirical distributions of TFP for the whole sample and conditional to a broad group of productivity determinants. It allows for determining new productivity indicators which take into account within-firm and between-firms components and selection effects. So far, the number of such studies available worldwide is scarce. The results of this project are one of only a few attempts to measure TFP based on micro-panel data (cf. van Beveren 2012, Ackerberg, Caves and Frazer 2015 and references to literature therein). The main reason for this constraint is the limited access to microdata and lack of econometric tools.

12.   The aim of the cooperation agreement between Statistics Poland and IMF was to develop new statistical measures of firm-level TFP for Poland. By law, individual microdata should be kept confidential, and aggregate statistics shall only be published. The protection of data collected for statistical purposes is a fundamental principle of official statistics. Statistical confidentiality is not a problem of legal prohibition or a matter of tradition in official statistics, but it is a much deeper challenge. Maintaining the secrecy of microdata is crucial to enhance data integrity and credibility. These fundamental issues are closely related to respondents' confidence in official statistics, as well as the liability of the NSIs for company damage if their data were disclosed. Statistics Poland, in cooperation with the IMF, managed to reconcile these contradictions and propose a developmental approach to micro-data studies. Within this cooperation Statistics Poland was responsible for maintaining statistical confidentiality and microdata access, data operations and microeconometric modelling, whereas IMF staff provided the methodology, economic interpretation of aggregate statistics and policy recommendations.

B. Firm-level gross value added and total factor productivity: Evidence from Poland

13.   Statistics Poland compiled and processed the firm-level data using the method proposed by Levinsohn and Petrin (2003) (hereinafter the LP model). The data used in our study originate from annual reports for years 2005-2017 on the business activity of all Polish enterprises employing at least ten employees. All data are reported in the Annual Enterprise Survey of Statistics Poland. When estimating the production function, the emerging problems of endogeneity of explanatory variables, endogeneity of attrition and omitted individual prices, should be addressed (see Ackerberg, Benkard and Pakes 2007, van Beveren 2012). We estimated the production function by applying the LP model, which under weak assumptions, allowed for a consistent estimation of labour and capital elasticities of gross value added (GVA). We determine empirical distributions of TFP for the whole sample and conditional to selected productivity determinants. A set of explanatory variables included, among others the following:

- Ownership status with four categories: state-owned enterprises (SOE), private domestic enterprises (PDE), foreign-owned enterprises (FOE) and enterprises with undetermined ownership (EUO).

- Export intensity with three categories: non-exporter, moderate export, and high export intensity.

- Market concentration[2] with three categories: high, moderate and low.

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[2] Market concentration was approximated using the Herfindahl-Hirschman index (HH_index) determined on the basis of PKD divisions.
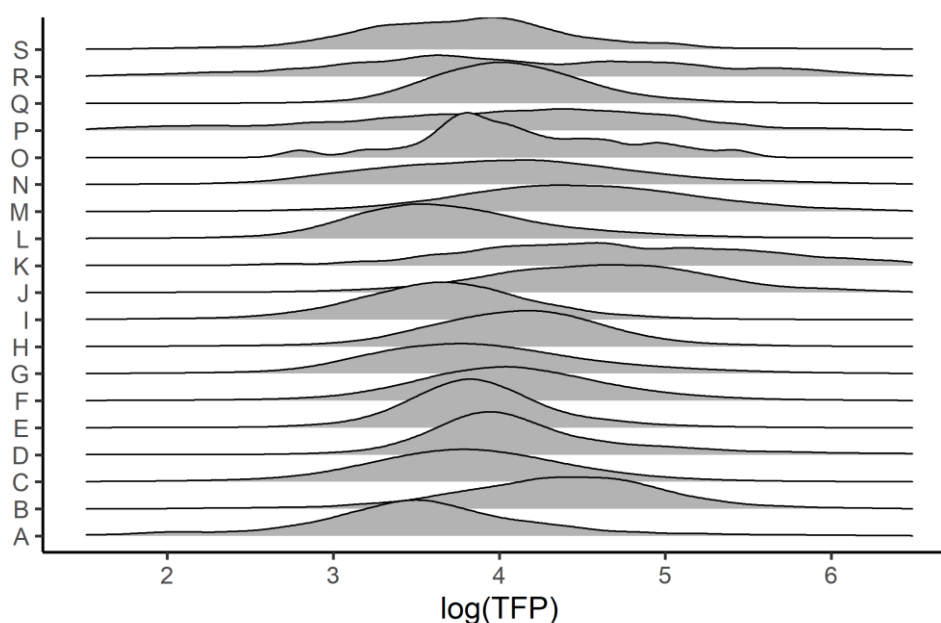
- Enterprise size with three categories: small, medium and large enterprises.

- Sector of economy with 14 categories based on sections of the Polish Activity Classification (PKD 2007).

14.   Below, we present several micro-based statistics on GVA and TFP for Poland.

15.   The distribution of logs of total factor productivities among manufacturing companies (see Chart 2, section C) is similar to the empirical density function of productivity coefficients in the whole sample. At the same time (see Chart 2), we observe a significant increase in the economic efficiency of enterprises in the sections: K (activities supporting financial and insurance services), J (Information and Communication), M (Professional, Scientific and Technical Activity) and B (Mining and Quarrying) (see Chart 2). We note that the $\log TFP$ distribution for companies performing financial and insurance activities (section K) is very diffuse and right-skewed; hence this sector of the economy includes companies with the highest values of total factor productivity.

Chart 2.
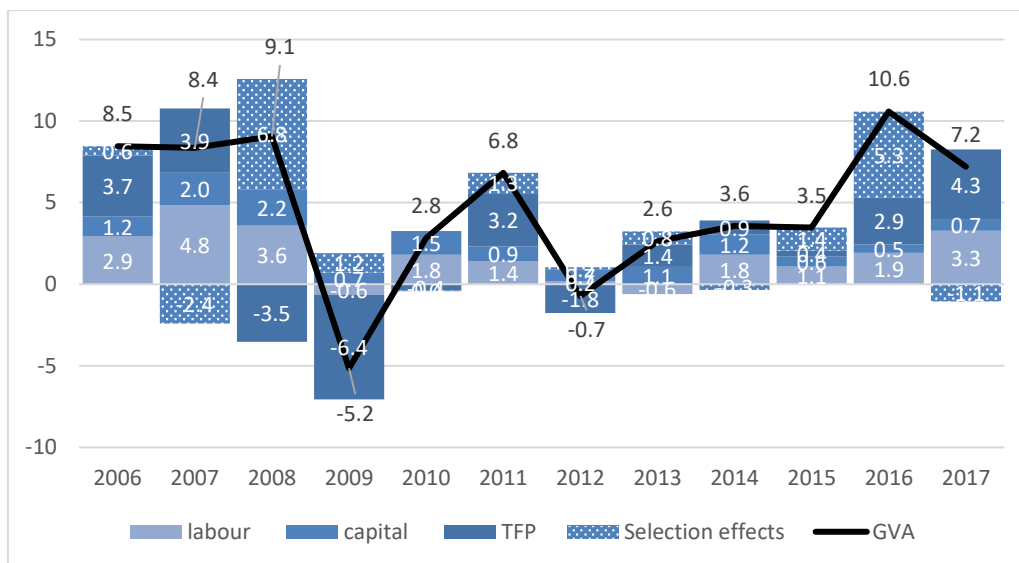**Conditional distributions of $\log TFP$ by PKD sections**

Notes: estimation of the empirical density function of $\log TFP$ using Gaussian kernel density estimators.

Source: Statistics Poland own research based on the survey of non-financial enterprises in Poland and LP model.

16.   The increase in GVA in 2017 for the surveyed enterprises (see Chart 3) was determined mainly by a change in the aggregate level of TFP (4.3 pp) followed by the increase in labour input (3.3 pp) and to the least extent by changes in the capital (0.7 pp). It is worth noting that in 2009, compared to the previous year, there was a sharp decrease in GVA by 5.2% for the surveyed enterprises, while in 2016-2017 the growth of GVA returned to the levels before 2009, achieving 10.6 pp and 7.2 pp.

Chart 3.

Decomposition of GVA growth for the surveyed non-financial enterprises in Poland in 2005-2017 (in pp)
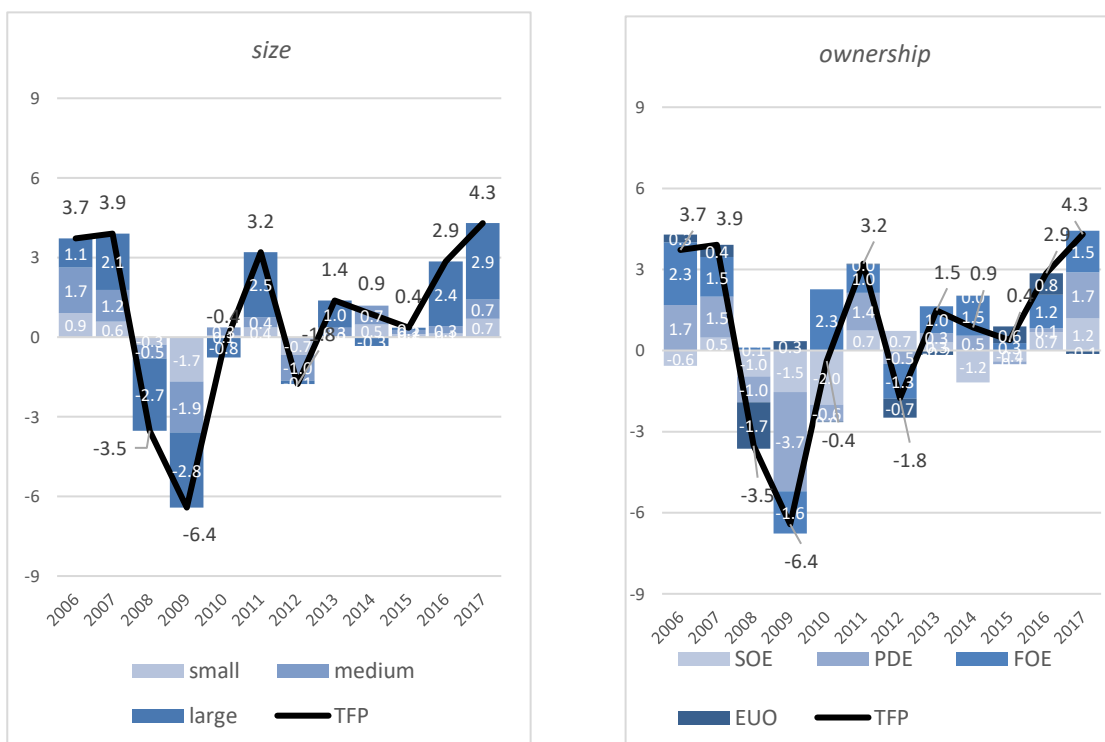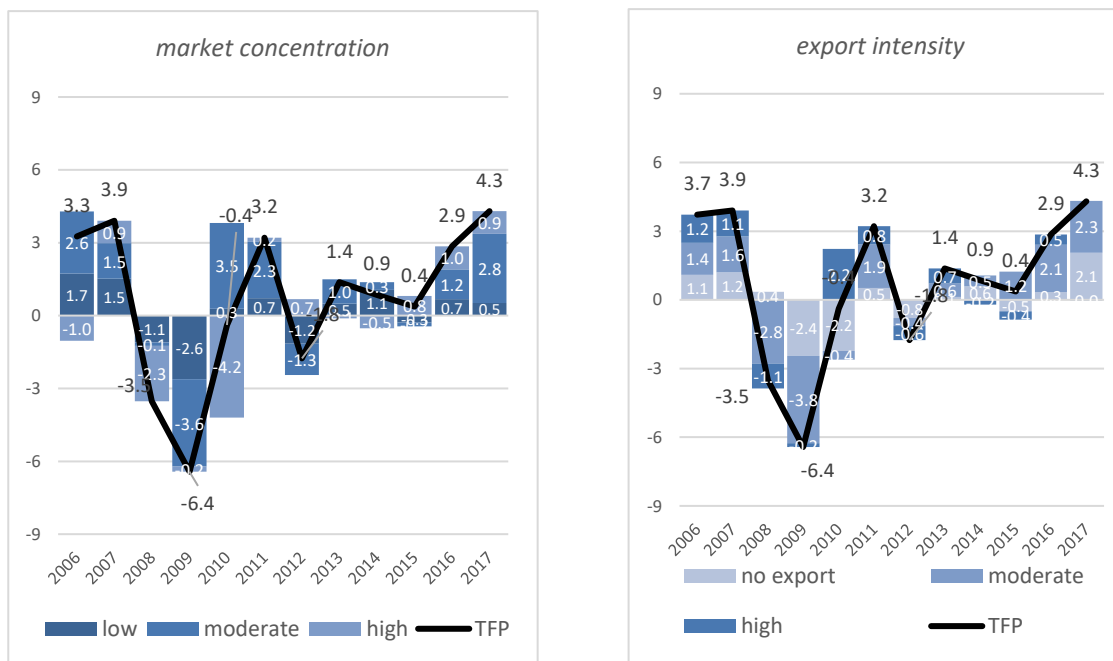

Notes: GVA in constant prices of 2010.

Source: Statistics Poland own research based on the survey of non-financial enterprises in Poland and LP model.

17.   The contribution of total factor productivity to GVA growth in 2017 is 4.3 pp. Chart 4 shows that TFP growth is mainly determined by large enterprises (2.9 pp), entities operating on the moderate competitiveness market (2.8 pp), exporting enterprises (2.3 pp) and private and foreign-owned entities (3.2 pp). The contribution of the aggregate TFP ratio to the growth of GVA was negative in 2008-2010 and in 2012. Since 2015, there has been a growing trend in TFP shares in the growth of GVA to the level of 4.3 pp in 2017.

Chart 4.

Decompositions of TFP contribution to GVA growth for the surveyed non-financial enterprises in Poland in 2006-2017 by productivity determinants (in pp)

Notes: ownership status with four categories: state-owned enterprises (SOE), private domestic enterprises (PDE), foreign-owned enterprises (FOE) and enterprises with undetermined ownership (EUO).

Source: Statistics Poland own research based on the survey of non-financial enterprises in Poland and LP model.

III.   Conclusions and recommendations

18.   The recent literature lists several global factors that can significantly influence on current productivity levels. It has been proven that micro-data studies are one of the most effective tools for investigating microeconomic causality and understanding their macroeconomic consequences. Accurate measurement of the firm-level total factor productivity is feasible thanks to appropriate methods of estimating the production function equation.

19.   Maintaining confidentiality of microdata is an impassable obstacle for uncontrolled sharing microdata with a broad audience. Therefore, we developed a new model of cooperation between NSIs and the decision makers, where NSI manage microdata sets and protect statistical confidentiality. Then, under the supervision of the decision makers, NSI performs microeconometric analysis and delivers aggregate statistics. Finally, decision makers give an economic interpretation and formulate policy recommendations and actions.

20.   Statistics Poland plans to develop the microdata-based analysis of potential output and deliver new measures of the output gap. The first results on the firm-level measurement of the output gap will be presented at the CIRET 2020 conference. We plan to develop methods and models of measuring potential output and output gap that take into account the degree of capacity utilization of enterprises. For finding the determinants of capacity utilization, we will propose more adequate models of right-censored data by extending Tobin's models.

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