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SUBJECT: Hospital Multifactor Productivity: An Updated Presentation of Two Methodologies Using Data through 2019

I. Introduction

Section 3401 of the Affordable Care Act (ACA) requires that the market basket percentage under the Medicare prospective payment systems be reduced annually by the productivity adjustment. The ACA defines the productivity adjustment to be equal to "the 10-year moving average of changes in annual economy-wide private nonfarm business multifactor productivity (as projected by the Secretary for the 10-year period ending with the applicable fiscal year, year, cost-reporting period, or other annual period)." The Bureau of Labor Statistics (BLS) publishes the official measure of private nonfarm business total factor productivity (TFP), which was previously named multifactor productivity (MFP)[1].

The adjustment of the Medicare payment updates by the growth in economy-wide TFP has important long-run implications for hospitals and other providers that treat Medicare beneficiaries. Should providers be able to achieve the same rate of productivity gains as the economy as a whole, the Medicare payment updates would adequately compensate providers for their costs. However, should providers be unable to achieve this rate of productivity, it would be increasingly difficult for them to cover the costs of care, which would have implications for access to, and quality of, services for Medicare beneficiaries.

In order to evaluate the implications of Medicare productivity adjustments, it is necessary to compare historical rates of private nonfarm business TFP growth to those for hospitals. Although the BLS does not publish estimates of TFP for the entire hospital industry (hereafter referred to as hospital TFP), there have been previous studies that attempted such a measure. One of those studies—"Hospital Multifactor Productivity: A Presentation and Analysis of Two Methodologies," which was published in the Winter 2007-2008 issue of the *Health Care*

[1] BLS notes that this was a change in terminology only and did not affect the data or methodology. This document follows the BLS naming convention and refers to the productivity estimates as TFP.

Financing Review[2]—derived estimates of hospital TFP through 2005 using two different methods. In February 2016, OACT updated these estimates to reflect data through 2013. In the following analysis, OACT provides updated hospital TFP estimates to reflect data through 2019 and compares them to private nonfarm business TFP as well as to more recent studies that have estimated productivity gains for hospitals.

II. Summary of Findings

Hospital TFP growth through 2019 remains below BLS estimates of private nonfarm business TFP growth. Over the period 1990-2019, the average growth rate of hospital TFP using the two methodologies ranges from 0.2 percent to 0.5 percent, compared to the average growth of private nonfarm business TFP of 0.8 percent. The most recent 10-year moving average growth of hospital TFP, ending in 2019, ranges from 0.2 percent to 0.3 percent, compared to 0.6-percent growth in private nonfarm business TFP. In addition, other published estimates of hospital productivity also seem to indicate that hospitals are unable to achieve the productivity gains of the general economy over the long run. In the 2021 Trustees Report, it was assumed that hospitals could achieve productivity gains of 0.4 percent per year over the long range; this growth rate is relative to the assumed growth in private nonfarm business TFP of 1.0 percent. The updated hospital TFP estimates presented in this analysis, along with results from other researchers, suggest that 0.4 percent is still a reasonable assumed rate of productivity growth for the hospital sector.

III. Background on Total Factor Productivity

BLS defines TFP as the change in a level of outputs relative to the change in a level of two or more inputs.[3] For major sectors (such as the private nonfarm business sector), TFP measures the value-added output per combined unit of labor and capital input. For aggregate manufacturing and service industries, TFP is measured as sector output per combined unit of capital, labor, energy, materials, and purchased business services inputs. For the major sectors and most of the service industries, *output* is calculated with a deflated revenue model in which constant-dollar revenues serve as a proxy for volume of output. Output measures are not adjusted for outcomes. *Labor inputs* are defined as hours worked by all persons, classified by education, work experience, and gender, with weights determined by their shares of labor compensation. BLS adjusts hours worked to account for the composition of labor.[4] *Capital inputs* are based on capital stocks by detailed asset-type by industry. Stocks for equipment and structures are determined using Bureau of Economic Analysis (BEA) National Income and Product Accounts data on real gross investments and BLS "age/efficiency" schedules for each asset type. For the manufacturing and service sectors inputs, BLS relies on BEA's "KLEMS" tables to determine *energy, materials, and purchased services inputs* and relevant shares.

IV. OACT Estimates of Hospital TFP

[2] Cylus, *et al*., "Hospital Multifactor Productivity: A Presentation and Analysis of Two Methodologies," available at http://www.cms.hhs.gov/HealthCareFinancingReview/downloads/07-08Winterpg49.pdf.
[3] http://www.bls.gov/mfp/mprtech.pdf
[4] http://www.bls.gov/mfp/mprlabor.pdf

A. Prior Estimates

Estimates of hospital TFP were originally presented in the *Health Care Financing Review* (*HCFR*) for the period 1981-2005 and were prepared using two different methods. Method 1 derives outputs and inputs from revenues and expenses, respectively, with nominal revenues and expenses deflated by appropriate price indexes to obtain real output and input quantities. Method 2 follows the general approach used by BLS to calculate TFP; specifically, in Method 2, the same output quantities are used as those derived in Method 1, and input quantities are calculated using labor and capital quantities obtained from various government data sources.

For 1995-2005—the most recent period at the time of the *HCFR* publication—the 10-year moving average growth rates in hospital TFP for Method 1 and Method 2 were 0.3 percent and 0.6 percent, respectively. That study concluded that neither method was preferable to the other and that the inconsistences in the outcomes between the two methods made it difficult to estimate the precise level of TFP that hospitals have historically achieved.

B. Updated Estimates

OACT recently updated these hospital TFP estimates through 2019. This effort involved obtaining revenues, expenses, and price data for the period 2006-2019 from various sources, including the American Hospital Association (AHA), BLS, BEA, Census, and the CMS operating and capital input price indexes used for the Medicare inpatient prospective payment system (IPPS). In addition to deriving new estimates for the 2006-2019 period, the calculation of hospital TFP prior to 2006 was also updated to incorporate revisions to the underlying source data that occurred since the 2007 publication of the estimates.

In general, when updating the hospital TFP estimates, OACT followed the methodology for Methods 1 and 2 described in the original *HCFR* study. There were a few modifications made to the methodology and data sources as described below.

For Method 1, to derive operating expenses in the original *HCFR* study, due to limited data, we estimated investment losses and interest expenses based on average ratios obtained from AHA data through 1993. For these updated estimates, we instead used data from Medicare cost reports from hospitals to allow us to use non-operating expense and interest data through 2019. In addition, for Method 1 and Method 2, to derive intermediate inputs for the updated estimates, the rebased and revised 2014-based and 2018-based operating and capital input price indexes were used in place of the 2010-based operating and capital input price indexes used in the original *HCFR* study.

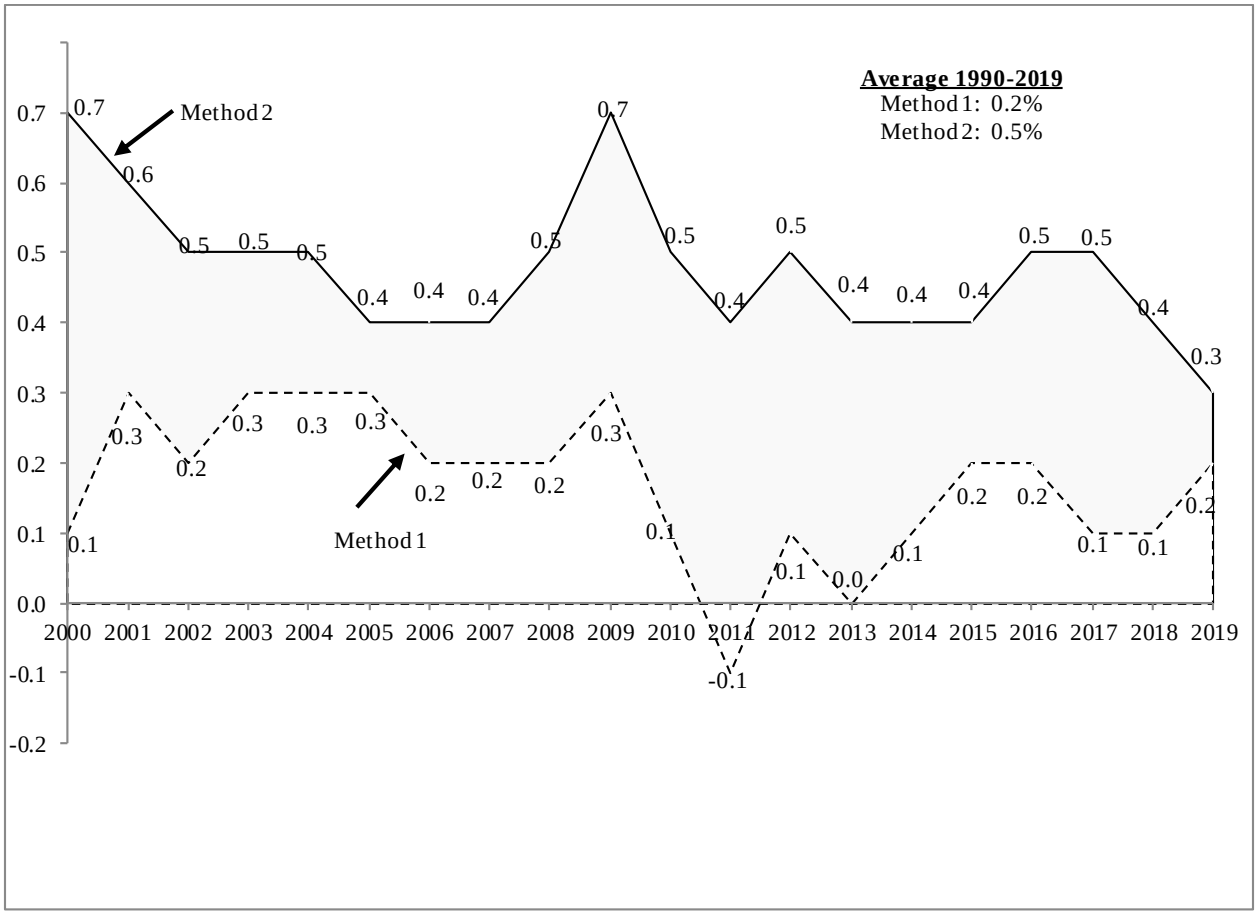
For Method 2, one primary modification to the methodology involved the derivation of the labor inputs. Previously, the principal data source was the Current Population Survey (CPS) data from the BLS. However, during detailed reviews of the official BLS methodology for deriving private nonfarm business TFP, OACT found that the BLS primarily uses the Current Employment Survey (CES) to determine labor input quantities. This data source was also presented as a sensitivity analysis in the 2007 publication. Accordingly, the updated hospital productivity estimates presented in this analysis rely on the CES data, which result in a method that is more consistent with the BLS methodology for measuring productivity. In addition, for the Method 2 capital inputs, the *HCFR* study used BEA chain-type quantity indexes; however,

these indexes are no longer published by BEA. Therefore, for these updated estimates, Method 2 capital inputs are derived using current-cost net stocks and fixed-dollar net stocks using the methodology provided by BEA.

Estimating TFP for the hospital industry is a complex process that requires numerous data sources. OACT's analysis is based on two methodologies, of which Method 2 is more similar to the BLS approach. Still, there are two notable differences between Method 2 and the approach used by BLS: (1) that BLS labor inputs reflect a labor composition adjustment, and (2) that BLS capital inputs are based on "age/efficiency" schedules that differ from those utilized by the BEA. OACT's analysis indicates that incorporating these two methodological differences into the Method 2 TFP estimates would likely lead to lower growth rates than presented here.

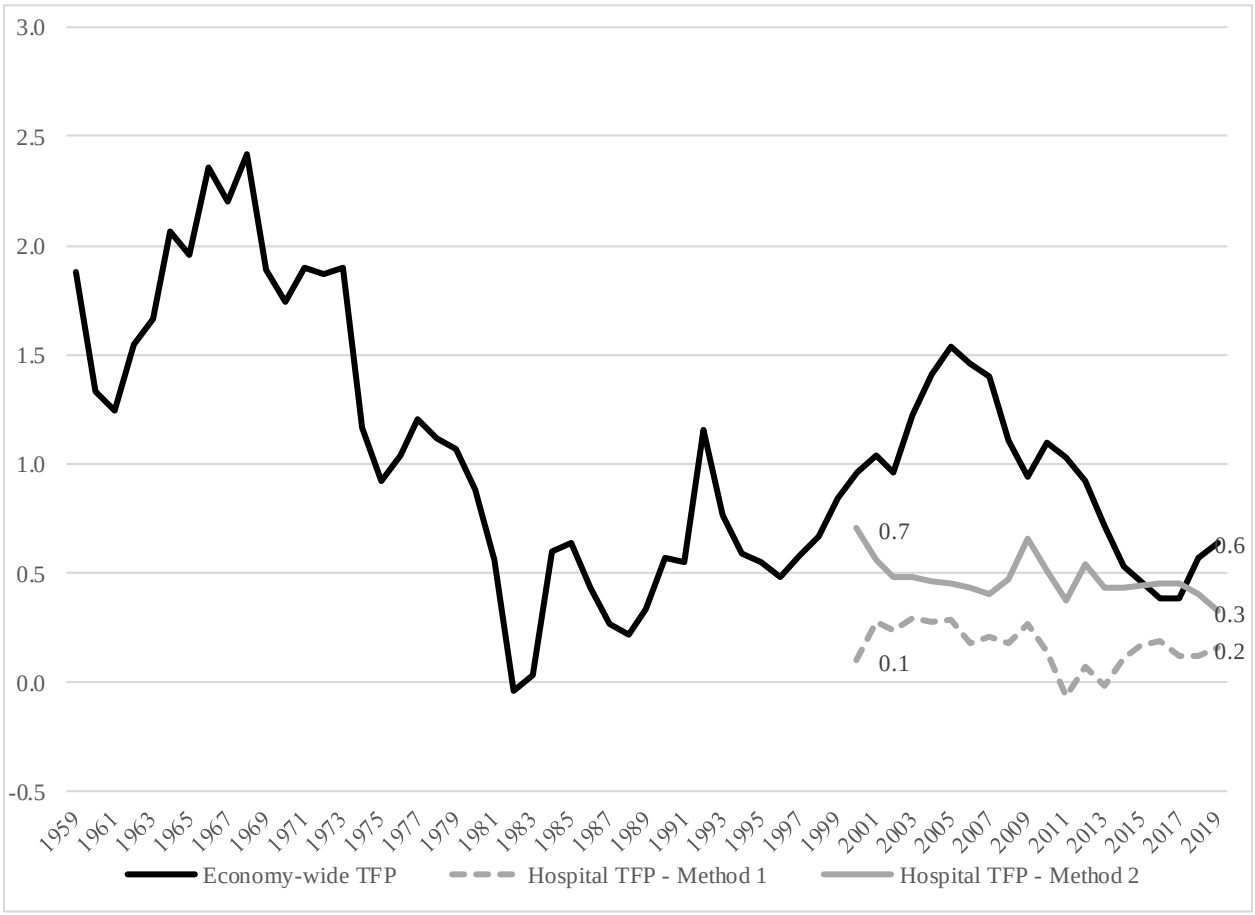
Based on the updated data and methods, the most recent 10-year moving average growth rates (2009-2019) in hospital TFP for Method 1 and Method 2 are 0.2 percent and 0.3 percent, respectively (Chart A; see also the Appendix, which provides the 10-year moving average growth rates of Method 1 and Method 2 hospital TFP components). Over the years 1990-2019, the average growth in hospital TFP is estimated at 0.2 percent for Method 1 and 0.5 percent for Method 2.

Chart A: 10-Year Moving Average Growth Rates of Hospital TFP



Because Medicare payments are adjusted by the 10-year moving average in private nonfarm business TFP, it is important to compare the range in the results obtained from Method 1 and Method 2 with the economy as a whole. Based on the most recent data published by BLS for private nonfarm business TFP (released November 18, 2021), the 10-year moving average growth in TFP for the period ending in 2019 is 0.6 percent (Chart B). For the most recent 10-year period of available BLS private nonfarm business TFP (2010-2020), the average growth rate was 0.2 percent. Over the years 1990-2019, the average annual growth in private nonfarm business TFP is 0.8 percent.

Chart B: 10-Year Moving Average Growth Rates of Hospital TFP and Economy-Wide TFP



V. Validation of Results

A. Comparison to Other Recent Measures of Hospital Productivity

In October 2015, BLS published a new measure of *labor* productivity for private community hospitals from 1993 through 2012 (Chansky, Garner, and Raichoudhary, hereafter

referred to as the Chansky study).[5] BLS has updated these estimates with more recent data through 2018 and over the 1993-2018 time period, the average hospital *labor* productivity growth was 0.4 percent; by comparison, OACT estimated hospital *labor* productivity growth to be 0.8 percent using Method 1 and 1.4 percent using Method 2. All of these measures are lower than the 2.0-percent growth in *labor* productivity for the private nonfarm business sector. Conceptually, the difference between the estimate of *labor* productivity in the Chansky study and the estimates from Methods 1 and 2 is mostly due to the output measure; that is, the output growth in the Chansky study is lower than the OACT deflated revenue output growth. Rather than using a deflated revenue model, Chansky measured output growth using a "course of treatment" model in which output growth was based on weighted inpatient service and outpatient service indices. Both indices were developed using a Tornqvist aggregation of inpatient discharges (or outpatient visits) for each DRG category (or disease category). It is also important to note that, whereas the *labor* productivity estimates in the Chansky study represent only private community hospitals—thereby excluding state and local hospitals as well as inpatient psychiatric hospitals—the OACT hospital productivity measures presented in this analysis are an attempt to reflect productivity gains for all hospitals.

In November 2021, BLS published TFP and related measures for 61 North American Industry Classification System (NAICS) industries and 20 aggregate sectors. Specifically, BLS published a TFP measure for NAICS 622 and NAICS 623 combined, titled "Hospitals and nursing and residential care facilities." Over the 1990-2019 time period, TFP growth for Hospitals and nursing and residential care facilities averaged -0.5 percent, or 1.0 percentage point lower than the OACT Method 2 average growth in hospital TFP. Conceptually, the BLS measure reflects only for-profit hospitals but also includes nursing and residential care facilities whereas the OACT measure reflects all hospitals (both for-profit and non-profit). The BLS measure also includes an adjustment for labor composition effects. Comparing the detailed data for these two measures, the major reason the BLS measure grows slower is due to differences in the input shares and the growth in labor inputs.

In its March 2015 issue, *Health Affairs* published a study of hospital MFP growth for Medicare patients for three select diagnoses: heart attack, heart failure, and pneumonia (Romley, Goldman, and Sood).[6] Over the period 2002-2011, the average productivity growth for these three diagnoses, when adjusted for patient severity, was approximately −0.6 percent, −0.5 percent, and 0.8 percent, respectively.[7] It is difficult to compare the results from this analysis to either OACT's hospital TFP estimates or Chansky's study on *labor* productivity, as the *Health Affairs* article is limited in scope, which the authors acknowledge by stating "…our conclusions might not be generalizable beyond the conditions studied."

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[5] http://www.bls.gov/opub/mlr/2015/article/new-measure-of-labor-productivity-for-private-community-hospitals-1993-2012.htm

[6] Romley, *et al*., "U.S. Hospitals Experienced Substantial Productivity Growth During 2002-11," available at http://content.healthaffairs.org/content/34/3/511.full.html.

[7] This study received attention because of its major conclusion that U.S. hospitals achieved substantial productivity over the 2002-2011 period. However, consistently positive productivity growth was observed only when there was an adjustment for patient outcomes, defined by the number of patients who survived 30 days without an unplanned readmission.

B. The Relationship between Productivity and Profit Margins

There is an important relationship between productivity and profit margins: productivity growth is equal to change in profit margin less a price differential term (output price growth less input price growth). This relationship is reflected in the historical data for the overall economy and is a key determinate in deriving health sector price growth used in the long range health spending models.[8]

Using Medicare cost report data, OACT calculated an average change in total facility profit margins for all hospitals of 0.1 percent over the years 1998-2019. The average output price growth during this same period (based on the BLS Producer Price Index for Hospitals) is 2.8 percent, and the average input price growth (as measured by the IPPS operating and capital market baskets) is 2.7 percent. These components together produce an implied productivity growth rate of 0.1 percent, which is slightly below OACT's range of hospital TFP estimates over this same time period (0.2 to 0.5 percent). Using an alternative hospital output price growth—BEA's chain-type price index for the hospital industry—produces an implied hospital TFP growth of 0.2 percent, which is within OACT's range of hospital TFP estimates.

VI. Conclusion

Based on updated analysis and other research, OACT believes that it is reasonable to assume that hospitals can achieve productivity gains of 0.4 percent per year over the long range. This rate of growth is below the assumed growth in private nonfarm business TFP of 1.0 percent.

[8] The measure of health sector price growth is an important factor in determining long-run health care and Medicare spending growth assumptions used in the Trustees Report. The model used to derive these long-range spending growth rates reflects both the impact of health sector prices and the impact of behavioral responses to relative health sector prices. (If such prices were to increase faster than economy-wide prices, with health care taking a larger share of economic resources, then consumers would be more price sensitive.) Thus, the health spending model needs to reflect health sector prices that are conceptually consistent with the measure of economy-wide prices that reflect transaction prices for purchased goods and services.

Appendix

Table 1: 10-Year Moving Average Growth Rates of Method 1 Hospital TFP Components

	Outputs	Labor	Capital	Intermediate Inputs	Combined Inputs	TFP	Labor Productivity
2000	2.9%	1.9%	3.3%	4.1%	2.8%	0.1%	1.0%
2001	2.8%	1.6%	3.0%	3.8%	2.5%	0.3%	1.2%
2002	2.6%	1.6%	2.6%	3.6%	2.4%	0.2%	1.0%
2003	2.7%	1.6%	2.6%	3.6%	2.4%	0.3%	1.1%
2004	2.9%	1.8%	3.1%	3.9%	2.6%	0.3%	1.1%
2005	3.2%	2.0%	3.1%	4.1%	2.9%	0.3%	1.1%
2006	3.3%	2.4%	3.3%	4.3%	3.1%	0.2%	0.9%
2007	3.3%	2.4%	3.3%	4.0%	3.1%	0.2%	0.8%
2008	3.4%	2.8%	3.6%	3.7%	3.2%	0.2%	0.6%
2009	3.4%	2.9%	4.4%	3.3%	3.1%	0.3%	0.5%
2010	3.2%	2.8%	4.2%	3.3%	3.1%	0.1%	0.4%
2011	2.9%	2.7%	4.0%	3.1%	3.0%	-0.1%	0.1%
2012	3.1%	2.6%	4.1%	3.3%	3.0%	0.1%	0.4%
2013	2.7%	2.3%	3.8%	3.1%	2.7%	0.0%	0.4%
2014	2.7%	2.1%	3.2%	3.1%	2.6%	0.1%	0.6%
2015	2.8%	2.0%	3.0%	3.4%	2.6%	0.2%	0.8%
2016	2.9%	2.0%	2.8%	3.5%	2.7%	0.2%	0.8%
2017	2.9%	2.1%	2.5%	3.6%	2.8%	0.1%	0.7%
2018	2.8%	1.8%	2.5%	3.9%	2.7%	0.1%	1.0%
2019	2.8%	1.7%	1.8%	4.0%	2.7%	0.2%	1.1%

1\TFP is calculated using the annual data. The data presented represent the 10-year moving average growth rate of the annual data.

Table 2: 10-Year Moving Average Growth Rates of Method 2 Hospital TFP Components

	Outputs	Labor	Capital	Intermediate Inputs	Combined Inputs	TFP	Labor Productivity
2000	2.9%	0.8%	2.9%	4.1%	2.2%	0.7%	2.1%
2001	2.8%	1.0%	2.8%	3.8%	2.2%	0.6%	1.8%
2002	2.6%	0.9%	2.8%	3.6%	2.1%	0.5%	1.7%
2003	2.7%	1.1%	2.8%	3.6%	2.2%	0.5%	1.6%
2004	2.9%	1.3%	3.0%	3.9%	2.5%	0.5%	1.6%
2005	3.2%	1.6%	3.1%	4.1%	2.7%	0.4%	1.5%
2006	3.3%	1.8%	3.2%	4.3%	2.9%	0.4%	1.5%
2007	3.3%	1.9%	3.5%	4.0%	2.9%	0.4%	1.4%
2008	3.4%	2.0%	3.6%	3.7%	2.9%	0.5%	1.3%
2009	3.4%	2.0%	3.7%	3.3%	2.7%	0.7%	1.4%
2010	3.2%	1.9%	3.8%	3.3%	2.7%	0.5%	1.3%
2011	2.9%	1.7%	3.7%	3.1%	2.5%	0.4%	1.2%
2012	3.1%	1.5%	3.8%	3.3%	2.5%	0.5%	1.6%
2013	2.7%	1.2%	3.7%	3.1%	2.3%	0.4%	1.5%
2014	2.7%	1.1%	3.6%	3.1%	2.2%	0.4%	1.6%
2015	2.8%	1.2%	3.5%	3.4%	2.3%	0.4%	1.6%
2016	2.9%	1.2%	3.3%	3.5%	2.4%	0.5%	1.6%
2017	2.9%	1.3%	3.1%	3.6%	2.4%	0.5%	1.6%
2018	2.8%	1.1%	2.9%	3.9%	2.4%	0.4%	1.7%
2019	2.8%	1.3%	2.7%	4.0%	2.5%	0.3%	1.6%

1\TFP is calculated using the annual data. The data presented represent the 10-year moving average growth rate of the annual data.