The Productivity Puzzle in Network Industries: Evidence from Electricity, Gas and Water Sectors

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Introduction

This paper examines the existence of a productivity puzzle in energy and water sectors. It looks at the value added total factor productivity (TFP) growth of the combined electricity, gas and water sectors (EGW) using the EU KLEMS database for the period 1998-2015. The productivity puzzle relates to the observation that overall productivity is flat-lining (and in some cases, falling) in many advanced economies after decades of steady growth. We compare the trend of UK productivity growth with its peers (France, Germany, Italy, Netherlands, Spain, USA) for the different network industries. Even though five out of the seven countries in this study are among the world's ten largest economies, trend productivity growth in most of them has been negative or very low in the last decade. This study compares our sectoral growth rates with overall industry growth for our seven countries and evaluates the contribution of inputs (labour and capital) to the growth of value added.

Methods

Growth Accounting measures the growth of economic activity by examining changes in a set of inputs (such as labour, capital and intermediate inputs) over time and by an unaccounted or unexplained growth (known as the Solow residual) which represents the total factor productivity (TFP) growth. The TFP growth estimations and discussion in this study are based on the growth of value added instead of gross output then intermediate inputs have been excluded from the TFP analysis. Theories about growth accounting methods and applications have evolved over time following some influential studies. The EU KLEMS database makes use of the growth accounting methodology for estimating the value added growth and the factors that contribute to it, for details see Timmer et al. (2007).

Results

Results from the TFP analysis of the EU KLEMS data show that for the period of study TFP growth for EGW sectors in general had a positive contribution to the value added growth during the period 1998-2005, with some exceptions, see Fig. 1. However, over the whole period of analysis, average annual TFP growth has been negative for all the countries except for Germany and Netherlands. Italy has the lowest average annual TFP growth. A closer look indicates that Italy has performed badly even before the financial crisis in 2009 and worse after it, with a peak negative TFP growth in 2000 (-7.5%). This is not surprising, considering that Italy is one of the worst performing economies in the Eurozone. A long-lasting impact on Italy's economy is expected because of the financial crisis (Morsy and Sgherri, 2010). In the USA, EGW sectors have been noticeably affected by the 2001 dotcom crisis. In the case of the UK a negative average annual TFP growth is observed before the 2008 crisis, starting in 2005. During the financial crisis and the years after (2008-2010), TFP growth for EGW sectors was negative, excluding Germany. France was the most affected (-7.00 p.a.). After 2010 EGW sectors show an anaemic improvement in TFP growth in France and the UK, but in both cases still below zero. For the period 2011-2015, Germany had a positive average annual TFP growth but Spain and Italy showed negative TFP growth. The consequences of the European debt crisis in 2011/12 may explain the continuing shrinking of the TFP growth for EGW sectors in the period 2011-2015. According to EC (2013), the impact of the crisis on GDP and employment (combined) for the period 2007-2011 was very high in Spain, high in Italy and moderate in the UK and France. It is clear that TFP growth for EGW sectors have suffered from the consequences of economic downturns but to different extents. TFP growth rates have not returned to the pre-crisis levels (2005 and backwards). In the case of the UK, a continuation of the TFP growth downward trend is envisaged because of

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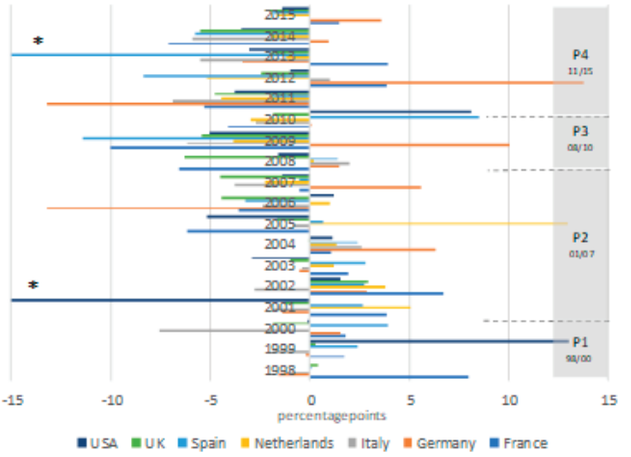

(*) USA and Spain with a negative annual TFP growth of 15.5 and 21.9 in 2001 and 2013 respectively.
P1: period 1998/00, P2: period 2001/07, P3: period 2008/10, P4: period 2011/15. Source: EU KLEMS da

Figure 1 TFP Growth for EGW Sectors per Year

the uncertainty following its Brexit referendum in 2016.

Looking at the average annual TFP growth of all industries in our countries, it is noticeable that EGW sectors have been hit more (with lower annual growth rates), except in Germany. Italy and Spain also have a negative annual average TFP growth for all industries. There are other factors that may also contribute with the downward trend of TFP growth in our EGW sectors, many of them supported by a set of regional (European) and national sector reforms in favour of the energy transition and water security. These might include substantial increases in capital cost due to the addition of renewables and increased interconnection and lower demand as a result of increased energy efficiency (which itself might add capital costs). Meanwhile increased renewable generation displaces fossil fuel plants and lowers wholesale prices. This implies higher input costs at time of lower revenues (and apparent value added) and hence lower measured TFP growth. In general, an increase in electricity generation is observed from 1998 to around 2007/08 but a deaccelerated/flat growth rate after that. Lower energy consumption is also observed across our countries. For instance, final consumption (energy use) decreased in 5 out of 6 European countries during 1998-2017. An evaluation of household energy consumption shows that 3 out of 6 European countries decreased their consumption, with Germany the one with the highest reduction, 19.6% (1998-2017). In the UK a decrease in both electricity and gas household consumption. The other driver could be that increased competition in the energy market (for both wholesale and retail gas and electricity) may contribute to lower prices. One way to measure competition is to look at market share of the largest firm. We note that the share in electricity generation has decreased over time (excluding France). Italy and Spain are the ones with largest reduction during the period 1999-2016, while Germany and the UK kept a flat share. In terms of the water sector, increased water stress (due to climate change and rising population) has led to pressure to reduce water consumption and water system losses. Italy, Germany and France are among the European countries with the lowest freshwater resources per inhabitant. This may explain a tendency towards lower productivity in this sector. Measured productivity may be further lowered by investments for improving water quality (in line with stricter regulation) and the need to invest more to replace aging infrastructure.

Finally, in terms of the composition (factor inputs) in the growth of value added, we observe that capital rather than labour is the one that has driven the trend of value added growth across the seven countries. The contribution of capital in this growth is especially important in the UK and less relevant (in comparison with labour) in Germany.

Conclusions

The productivity puzzle is present is the individual countries, especially in the UK. There are different reasons that may explain the weakness of the value added TFP growth, including increased investment requirements at a time of flat or falling demand (or rising demand but with insufficient supply in the case of water), driven by wider economic factors or others such as climate change pressures. However, productivity growth especially in electricity and gas sectors may have been negatively affected by the energy transition which has required higher levels of inputs at the same time as competition, regulation and falling demand, which have limited the ability to raise revenues and hence value added. Under these circumstances, recovery in TFP growth for EGW sectors is not expected to happen in the short-term. The EGW sectors need to internalize the changes driven by the energy transition and global warming and to adapt their operation and economics in line with this.

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Attendee Comments

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"Learning from both perspectives, industry and academic point of view has always been my motivation to pursue my interest in the energy sector and for that reason, attending the IAEE conference has allowed me to learn from the experts."