Explaining growth: halving our ignorance

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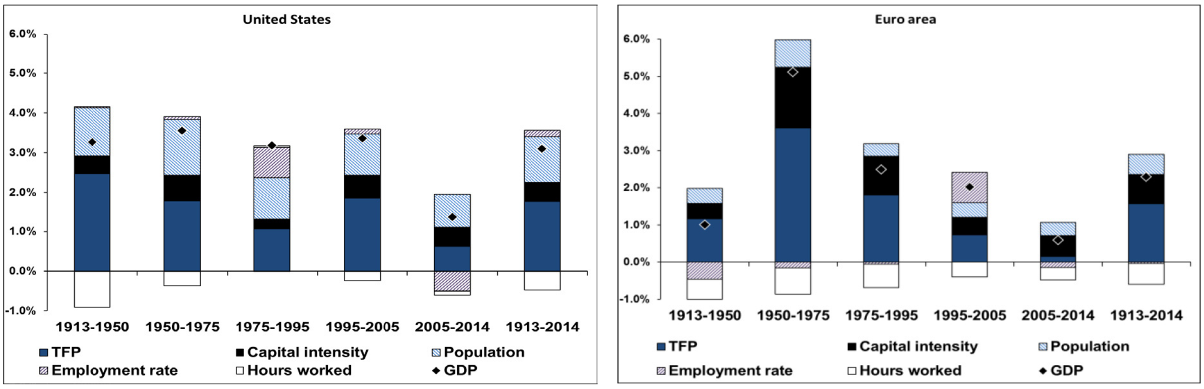
A large proportion of economic growth remains unexplained by labour and capital factors. When the quality of these factors and the diffusion of innovation are taken into account, the unexplained share is reduced by roughly half. We thus remain ignorant as to the sources of a significant share of growth.

Chart 1: GDP growth: contributions of capital and labour

Total economy - % and percentage points



Sources: Bergeaud, Cette, Lecat (2016), see www.longtermproductivity.com

In the majority of economies now classified as advanced, the period extending from the start of the second industrial revolution at the end of the 19th century to the 1970s was marked by the most exceptional rates of growth in human history. However, since the 1970s, growth in GDP per capita has slowed markedly, in particular at the start of this century. Growth accounting (Solow, 1957) provides a framework for measuring the roles played by production factors (capital, i.e. all fixed assets, and labour) in determining growth. Approaches of this type find that the majority of growth in the 20th century in industrialised countries is explained by growth in total factor productivity (TFP), which is the residual in the growth accounting breakdown.

Chart 1 breaks GDP growth down into changes in capital intensity (capital per employee), population, the employment rate and hours worked, with the residual representing TFP growth. This residual explains roughly half the GDP growth observed since 1913 (around 50% in the United States and 71% in the euro area). The next most important contributors are demographic growth (in the case of the United States) and increasing capital intensity (for the euro area). However, the residual or TFP is also the main factor behind the slowdown in GDP growth since 1975.

TFP therefore accounts for both the exceptional growth seen in the 20th century and the slowdown since 1970. However, it is also a residual in an accounting calculation and thus, to use the expression coined by Abramovitz (1956), constitutes “a measure of our ignorance”.

Factor quality and technology diffusion

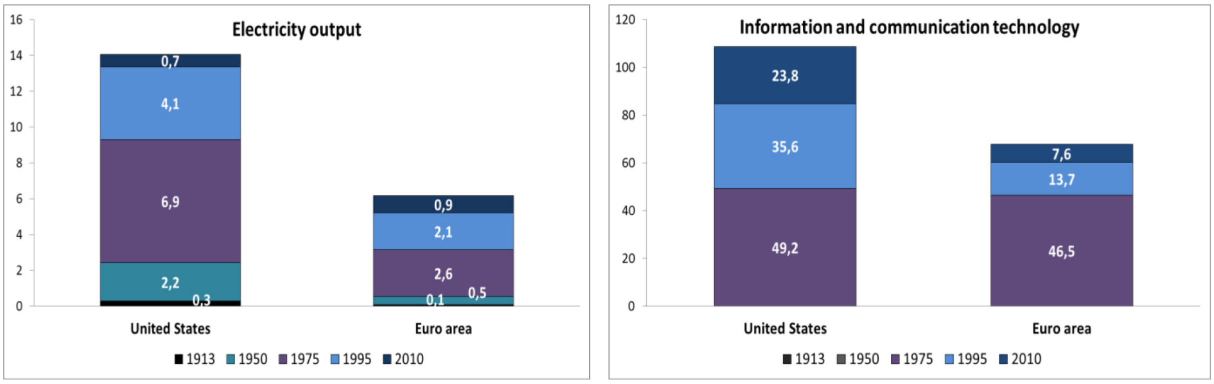
The improvement in TFP is often attributed to technological progress, which is still largely regarded as “manna from heaven”, to use the words of Hulten (2000). This is due in part to difficulties in identifying the roles played by production factor quality and technology in determining productivity growth.

To attempt to reduce our “ignorance”, we estimate the role played by production factor quality and technology diffusion in determining TFP growth in 17 OECD countries over the period 1890-2013 (Bergeaud, Cette and Lecat, 2017). Production factor quality is captured by average education levels and the average age of capital equipment stock, where recent equipment is regarded as being more productive. The impact of technology diffusion on TFP growth is captured through the diffusion of general-purpose technology, electricity and information and communication technology (ICT), which are often seen as representative of the main waves of technology diffusion observed over the course of the 20th century.

The average length of schooling for the working-age population increased sharply over the period, from 5.3 years in the United States and 4.8 years in the euro area in 1900 to 12.8 and 11.5 years respectively in 2010. The average age of capital stock fluctuates markedly depending on the period, by 2.6 years in the United States and by 3.8 years in the euro area. It is also extremely cyclical. With regard to technology diffusion, the evolution is impressive: between 1913 and 2010, electricity output per inhabitant was multiplied by a factor of over 50 in the United States, and 80 in the euro area which had a lower starting point. Similarly, the ICT capital ratio (nominal ICT capital stock over nominal GDP) rose from around 0.04 in 1970 in both the United States and the euro area to around 0.1 in the United States and 0.07 in the euro area in 2010 (see Chart 2).

Chart 2: Electricity output and ICT diffusion

Electricity output in kWh per thousand inhabitants and ICT capital divided by nominal GDP (X1000)



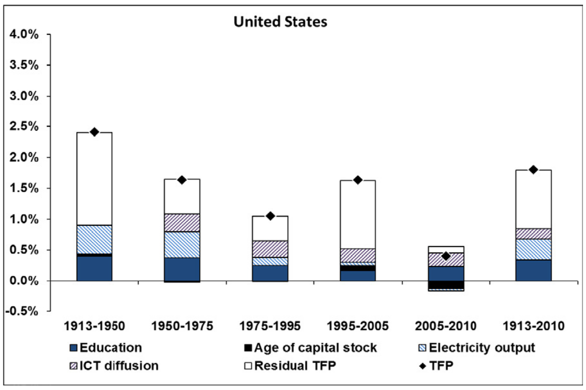
Sources: Bergeaud, Cette, Lecat (2016); Cette, Clerc and Bresson (2015)

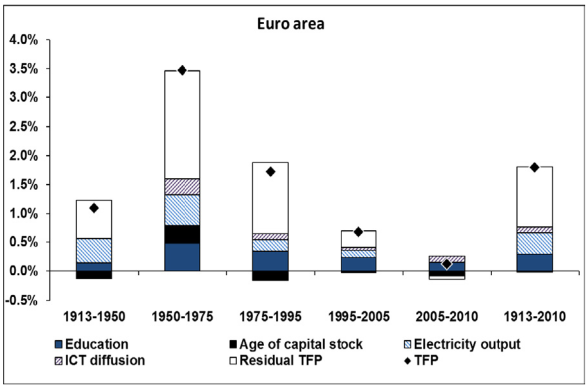
Our ignorance has been reduced but has not completely disappeared

Chart 3 breaks down average annual TFP growth for the period 1913-2010 and various sub-periods into the contributions from production factor quality (education and age of capital stock) and from the two technological factors (electricity output and ICT diffusion), and the residual component which cannot be explained by these variables. The share of TFP growth which can be explained over the period is 52% in the United States and 58% in the euro area. Education and electricity output are the main factors behind the explained portion of growth. However, the decline in the rate of TFP growth in the last sub-period (2005-10) compared with the previous sub-period (1995-2005) is primarily attributable to the decline in the TFP residual.

Chart 3: Growth in total factor productivity (TFP): contributions of factor quality and technology diffusion

Total economy - % and percentage points





Sources: Bergeaud, Cette, Lecat (2016), see www.longtermproductivity.com

The proposed decomposition thus explains a larger share of TFP growth over the long term. Nonetheless, a significant share remains unexplained. The ignorance described by Abramovitz (1956) has therefore been reduced but is still very much present.