TIME FOR GROWTH: The big impact of public mechanical clocks on Europe's economic development 1200-1800

Public mechanical clocks, which were first introduced in European cities in the late thirteenth century, were one of the most important innovations in history. According to research by Lars Boerner and Battista Severgnini, to be presented at the annual congress of the European Economic Association in Geneva in August 2016, they had a big impact on growth in the places that were early adopters of the new technology.

Their study finds significant growth effects based on the diffusion rate of mechanical clocks. The findings support the view that 'general purpose technologies' can have a strong impact on economic growth. But it takes time for such fundamental innovations to have an effect because the technology must be culturally and socially accepted and applied in related economic activities.

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This research investigates the impact of the early adoption of high-technology machines on long-run growth. The study investigates the positive and significant role played by public mechanical clocks, one of the most important innovations in history, on the development of European cities during the period 1200-1800. The findings shed light on the paradoxes of the impact of big ideas on wealth in the long run (Gordon, 2016).

Various studies have discussed the possible benefits and drawbacks of the role of high-tech innovation on firms’ and nations’ economic success. On the one hand, a well-established literature of various scholars (for example, Ricardo, 1821; Leontief, 1983; Samuelson, 1988) has claimed that the impact is negative because advanced machines lower wages, which in turn reduce population and income growth.

On the other hand, in the last 20 years, which coincide with the introduction of new innovations in information technology (IT), new research has found a more differentiated picture of this relationship. In a 1987 article published in the New York Times, Robert Solow described a ‘productivity paradox’ (also known as Solow paradox) that highlights that the American productivity slowdown in the 1970s coincides with the adoption of computers (‘You can see the computer age everywhere but in the productivity statistics’).

But other scholars have found the advantage and the positive effects of the spread of computers on society: for example, Bresnahan et al (2002) underline the positive role of high-tech capital and the complementarity with skills and innovations at the firm level.

To find an answer to questions concerning the relationship between technology and economic performances, case studies based on the introduction of innovative machines can be useful. In an early reply to Solow, the economist and economic historian Paul David (1990) suggested resolving the Solow paradox from a historical perspective. Examining the innovation of the dynamo in the late nineteenth century, he argues that it simply takes time until the use of such a ‘general purpose technology’ (GPT) results in higher economic growth rates.
Crafts (2002) among other scholars took up this line of argument and compared the impact of different GPTs, such as electricity and computers, on long-run economic growth. He finds comparably strong evidence for the effect of IT, but admits that there are problems in measuring and comparing such effects adequately.

This new study attempts to shed light on the productivity paradox from a new perspective. The authors study the impact of one of the most important technologies ever invented in history – the public mechanical clock – on economic growth. This technology was first introduced in Europe at the end of the thirteenth century and it spread across Europe during the following two centuries. Mechanical clocks have been identified as one of the greatest GPTs of the last millennium.

The importance of mechanical clocks has been discussed by several scholars in different fields. Economic historians such as David Landes (1983) and Joel Mokyr (1992) have claimed that the clock had a strong impact on productivity: it enabled increases in organisational skills in terms of coordination and division of labour and the monitoring of production processes.

Other scholars also find evidence for the improvement of various coordination activities in pre-modern towns such as market times, administrative meetings of the town governments, and school and university lecturing time. Social historians such as Thompson (1967) highlight that the mechanical clock changed the work culture and increased work discipline.

Le Goff (1982) claims that the introduction of the public mechanical clock was a turning point for the Western society. It helped create a new epoch, ‘the time of the merchants’, because it enabled business people to frame and measure all types of economic activities in a timely manner.

Other economic historians with a greater focus on the transition to modernity argue that the clock had a profound impact on the processes of the Industrial Revolution. Finally, more generally, prominent social scientists such as Marx (1863), Weber (1905) and Sombart (1921) claim that clocks had a fundamental impact on the evolution of capitalism and rationality of societies.

To test the impact of clocks on economic growth, this study runs an empirical growth regression. In particular, the authors use the change of population size in European cities from 1200-1800 as a proxy to study pre-modern economic growth. As a main explanatory variable, they collect information on the construction of public mechanical clocks in all these cities. They identify a group of early adopting cities from the first adopters in 1283 until 1450.

They find that earlier adopters, compared with other cities, display significant growth differences in the range of 30 percentage points for the period of 1500-1700. These results indicate that public clocks as a GPT indeed localised spillover effects on various economic and economy-supporting activities and led to higher city growth rates. This approach explains economic growth from a micro perspective.

As an extension and alternative approach, the researchers study countries’ GDP growth rates. This makes it possible to estimate comparative growth effects between countries and create a macroeconomic perspective. The main explanatory variable is
the adoption rate of public mechanical clocks measured by the population rate of a country.

Again, the researchers find significant growth effects based on the diffusion rate of mechanical clocks on economic growth. These results support the point of view that GPTs indeed have a strong impact on economic growth. But it takes time for such fundamental new technological innovations to have an effect because the technology must be culturally and socially accepted and applied in related economic activities.

To control for potential endogeneity problems between the cause (technological change) and consequence (economic growth), the authors use an instrumental variable approach in their empirical investigation. This means that they use the main explanatory variable with different instruments that correlate with the implementation of clocks, but not with economic growth. They use the distance from the first adopters and the geographical areas affected by different appearances of solar eclipses as an instrument for the implementation of clocks.

Historians have convincingly shown that the creation of astrolabes, which were the predecessors (and technological basis) of the mechanical clocks were triggered by solar eclipses. The study uses these insights and the geographical data provided by NASA of solar eclipses from 800 until the end of the thirteenth century. Thus the empirical strategy is based on a two-stage procedure, where the researchers measure in a first stage the probability of the implementation of the clock, and in a second stage the growth rate with the help of the instrument created in the first stage.

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‘Time for Growth’ by Lars Boerner (London School of Economics) and Battista Severgnini (Copenhagen Business School)

References


