

MOT1421
Economic Foundations
Week Four (November 2020)

November 30, 2020

TECHNOLOGICAL CHANGE
SELF-TEST: ANSWERS

The self-assessment consists of 10 Questions.
Each Question has a weight of 1. Your maximum score therefore is 10.
A score of 6 means that you have successfully passed the test.
The self-assessment is self-scoring.

Question 1

Incremental product innovation concerns a series of small improvements made to a company's existing products or services. Generally, these low-cost improvements help further differentiate a company from the competition while building on current offerings.

Radical product innovation refers to the introduction of a radically new product or service designed to replace an existing one. In the same way in which cars eventually replaced horse-drawn carriages, radical innovations dramatically alter the consumer landscape as well as the business model of firms.

Question 2

The **technology-push model of innovation** consists of the following three stages: scientific research is done in universities (stage 1: basic research) and in large industrial corporations (stage 2: applied research with direct commercial applications in mind; and stage 3: RD&D, directed toward incremental product and process innovation). Innovation therefore is driven or pushed by basic research & engineering.

In the **demand-pull model of innovation**, economic activity influences innovative effort. Firms tend to put their innovative investment into areas where

demand is growing, so that they can recoup their costs and reap greater returns on their investment. Demand plays a leading role in determining both the direction and magnitude of inventive activity. The larger an actual or potential market is, the more inventive activity will be directed toward it, because the profitability of invention rises with market size, all else equal.

Question 3

“Innovation is thus just a case in which perfect competition does not yield the best outcome.” Explain why this is so.

In PERFECT COMPETITION, equilibrium means that $P = MC = AC$; there are no supernormal profits for firms. However, to innovate, firms need to invest (in R&D); innovations are lumpy (indivisible) and large, and risky. When $P = AC$, firms are unlikely to earn enough profits to internally finance the required investment effort. In addition, if the PERFECT market is transparent and information is free (a public good), then investing in innovation (= new knowledge) is not rational for firms, since they will not be able to recoup the investment. They cannot exclude competing firms from imitating, and using the innovative knowledge. PERFECT Competition may be good for achieving static efficiency, but it fails in generating dynamic efficiency.

Question 4

In the growth-accounting model, TFP growth \hat{a} is calculated as a residual:

$$\hat{a} = \hat{\lambda} - (1 - \alpha) \times \hat{k}$$

To calculate TFP growth, we must first calculate labour productivity growth $\hat{\lambda}$ and capital-intensity growth \hat{k} . Labour productivity growth is equal to the difference between output and the growth of labour input, $1.5\% - 0.45\% = 1.05\%$ per year. Capital intensity growth is equal to the difference between capital stock growth and the growth of labour input: $2.4\% - 0.45\% = 1.95\%$ per year. We know that $\alpha = 0.55$. Hence, we get:

$$\hat{a} = \hat{\lambda} - (1 - \alpha) \times \hat{k} = 1.05\% - 0.45 \times 1.95\% = 0.1725\%$$

The annual average rate of TFP growth during 1990-2017 is 0.17%.

Question 5

Two limitations or problems concerning the notion of TFP growth are the following:

1. The production function analysis assumes that production is technically efficient. This neglects the fact that in reality, the diffusion of new technology takes time and costs money. Firms may not (yet) be on the isoquant, and when they move toward the isoquant, their productivity rises without any technological progress actually occurring.
2. Any mistake in measuring labour productivity and/or capital intensity will affect the residual and hence our estimate of TFP growth. Using the growth-accounting approach, we cannot check whether there are mistakes in our measurements.

Question 6

Schumpeter argues that economic progress is driven by continuous innovation and technological progress – leading to new goods, new production processes, new markets, etc. Radical innovation upsets the status quo, as ‘existing’ markets, firms and industries will be ‘destroyed’ by the growth of novel markets. Creative destruction is an inherent feature of capitalism – which will always feature declining (sun-set) industries and rising (sun-rise) industries – and a necessary condition for economic progress. For Schumpeter, ‘creative destruction’ leads to dynamic efficiency, as innovation reduces costs and prices and creates new/better technologies and products.

Question 7

[Bounded rationality](#) is meant to express the fact that people cannot constantly optimise their decisions as they are supposed to do in the neoclassical model of consumption and production. There are two reasons for this. First, we do not have the mental capacity to continuously perform non-linear constrained utility and/or profit maximisation exercises. Second, even if we could do this, it would cost a lot of time, effort and money to collect all necessary information which we need to do the optimisation; doing so is not rational. Hence, what we do is we restrict (or bound) our information search as well as our “decision-making”

by following useful, practical rules of thumb; we are perfectly willing to change these rules of thumb once we learn that there are better alternatives available.

Question 8

Tacit knowledge (as opposed to formal, codified or explicit knowledge) is the kind of knowledge that is difficult to transfer to another person by means of writing it down or verbalizing it. Tacit knowledge has been described as "know-how" – as opposed to "know-what" (facts). The key to acquiring tacit knowledge is experience. Without some form of shared experience, it is extremely difficult for people to share each other's thinking processes.

Tacit knowledge is important to process innovation: people who do the actual work and have working experience in a factory or a firm, know best at which stages of the production process improvements can be made. Tapping into this (tacit) knowledge pool has been a major source of process innovations in firms.

Question 9

Technological lock-in refers to the situation in which users continue to use a particular technology (say the QWERTY keyboard in PCs) which is known to be inferior (in terms of productivity) to existing alternative technologies. Users do not switch to the new – more efficient – technology, because they have 'invested' in the old inferior technology (in the form of training, accumulating experience) or because the new technology requires a major overhaul of not just the old technology, but also of connected technologies, networks, institutions etc. The transition to renewable (wind/solar) energy technologies is a case in point: it is not just building wind mills or solar farms, but a larger transformation of the energy/electricity system is required.

Question 10

The selection mechanism in an evolutionary market model works through competition. The 'fittest' firm will outcompete the other firms and gain market share. This process become cumulative if the larger market share enables the leading firm to become even more 'fit'. In this case, the market will converge to a monopoly. The critical notion is 'fitness': in the example of Chapter 16 in the book, 'fitness' is defined in terms of the profit margin, and not in terms of

efficiency (= the lowest average cost of production). If a firm manages to increase its profit margin, for instance by successful product differentiation (e.g. Apple iPhones), this firm will become more 'fit' and gain market share, even if it has higher average cost of production than other firms in the market.

End of self-test Week 4