Ensuring optimal developments of both investment and consumption in case of scarce labour

By
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> "On the basis of the pattern of labour-saving technical development, a model can be constructed that (for) the total consumption, as in reality withdrawn year after year from the totality of sectors, (allows to determine) an optimal investment pattern … under which the total consumption could not have been produced with a lower use of labour. This investment pattern of all sectors can be compared with the observed investment pattern and it can be determined whether the observed investments have lagged behind the optimal ones and whether and to what extent sectors have kept machines in use for longer than the optimal lifetime.
> On the other hand, the model makes it possible to determine whether and to what extent investments must increase in order to optimally meet total of consumer demand over successive years, i.e. to always produce a total of consumption with as little use of labour as possible, while using all supply of labour."
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> On Production, Consumption and the Emergence of Unemployment, February 1976

The writer of both the theses *On Absolute Value and the Value in Exchange of Commodities* and *Draft of Equilibrium* had in mind how to produce as efficiently as possible over time, given the technical development and the available labour supply. To this end, the first thesis focused on measuring technical development, where the proposed two methods of twofold valuation aimed to provide profound insight into the role of investments over the years. That efficient production is independent of wages and prices was the subject of the second thesis, although no explicit attention was paid to investments. Nevertheless, it seems obvious that efficient production with efficiently produced capital commodities will also be independent of wages and prices.

The article cited above starts with a simple example of a stationary economy in which a change in technical development leads to a sharp increase in the optimal investment size. Assuming that the real economy was characterized by a high degree of efficient production, the writer thought that such a change in technical development was behind the rise in unemployment at that time. However, his paper *Oligopolistic Competition and Economic Development* suggests that the market share of efficiently operating firms in the production of the manufacturing industry in the United States, Germany, France and the United Kingdom is recently still not higher than a share between 18 and 32 percent.

Below we first show how the optimal investment size can be determined by assuming that the actual production belongs to a stationary economy. Next, we emphasize that in a world in which not all firms produce efficiently, firms can emerge that do so. As a result, these firms gain market power over the less efficient producing firms who continue to use labour as long as it is profitable.

The main point of this article, however, concerns the phase in which the efficient producing firms have more or less outcompeted the less efficient ones. How should we then ensure that, in the event of major changes in technical development or major changes in the conditions imposed by the state that production and consumption must meet for sustainability reasons, a balanced development of investments and consumption would still be possible?

Optimal Investment

Your writer was inspired by Eugen von Böhm-Bawerk's analysis whereby the value of a labourer increases, but gradually to a lesser and lesser extent, as the production period increases. Given the available capital and the labourer's wage, he showed how the optimal length of the production period can be determined[1]. Similarly, your writer thought that within a stationary economy that uses machines that allow labour savings each year, an optimal lifetime of those machines can be determined so that a given quantity of production can be produced every year with as little labour as possible.

Table 1 which has been drawn up analogously to the tables of Böhm-Bawerk, will show this, but at the same time it also responds to a controversial analysis at the time that linked the emergence of unemployment in the Netherlands to an increase in real labour costs that led to an accelerated scrap of no longer profitable machinery[2]. Part A of table 1 gives a stylized picture of an economy that purchases a machine every year that enables labour savings of 4.8 percent compared to the previous machine. In addition, the machine breaks down more often as it gets older. This loss amounts to 4 percent annually. The capital output ratio remains unchanged over time at 1.45.

The size of investments and the wage rate in 1973 were chosen in such a way that the total of profitable production was 70 while the machines were no longer profitable after 26 years. In the study by the Central Planning Bureau, production in 1973 amounted to approximately 70 billion guilders, while investments amounted to approximately 10 billion.

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[1] E. von Böhm-Bawerk, *Kapital und Kapitalzins*, Zweite Abteilung: *Positieve Theorie des Kapitales*, Erster Band, Jena, Verlag von Gustav Fisher, 1921, p. 438-464.

[2] See H. den Hartog and H.S. Tjan, *Investeringen, lonen, prijzen en arbeidsplaatsen (Een jaargangenmodel met vaste coëfficiënten voor Nederland)*, Central Planning Bureau, Occasional Papers No2/1974. This study with the translated title *Investment, wages, prices and labour places (A vintage model with fixed coefficients for Netherlands)* was followed up in a more extensive study H. den Hartog, TH.C. van de Klundert and H.S. Tjan, *De structurele ontwikkeling van de werkgelegenheid in macro economisch perspectief (The structural development of employment in a macroeconomic perspective)*, in Werkloosheid: aard, omvang, structurele oorzaken en beleidsalternatieven. Preadviezen voor de Vereniging van de Staatshuishoudkunde, Martinus Nijhoff, The Hague, 1975. Hereinafter referred to as the studies of the Planning Bureau.

Table 1

Part A: Machines according to their year of installment

	installed machine capacity	*Involved production*	*involved labour placees*	*profit*
1973	*3.277*	*4.752*	*1.311*	*4.372*
1972	*3.114*	*4.515*	*1.377*	*4.115*
1971	*2.958*	*4.289*	*1.447*	*3.870*
1970	*2.810*	*4.075*	*1.519*	*3.634*
1969	*2.670*	*3.871*	*1.596*	*3.408*
1968	*2.536*	*3.677*	*1.677*	*3.191*
1967	*2.409*	*3.493*	*1.761*	*2.983*
1966	*2.289*	*3.319*	*1.850*	*2.782*
1965	*2.174*	*3.153*	*1.943*	*2.589*
1964	*2.066*	*2.995*	*2.041*	*2.403*
1963	*1.962*	*2.845*	*2.144*	*2.224*
1962	*1.864*	*2.703*	*2.252*	*2.050*
1961	*1.771*	*2.568*	*2.366*	*1.882*
1960	*1.682*	*2.440*	*2.485*	*1.719*
1959	*1.598*	*2.318*	*2.610*	*1.561*
1958	*1.518*	*2.202*	*2.742*	*1.407*
1957	*1.443*	*2.092*	*2.880*	*1.256*
1956	*1.370*	*1.987*	*3.025*	*1.110*
1955	*1.302*	*1.888*	*3.178*	*0.966*
1954	*1.237*	*1.793*	*3.338*	*0.825*
1953	*1.175*	*1.704*	*3.506*	*0.687*
1952	*1.116*	*1.618*	*3.683*	*0.550*
1951	*1.060*	*1.538*	*3.869*	*0.416*
1950	*1.007*	*1.461*	*4.064*	*0.282*
1949	*0.957*	*1.388*	*4.269*	*0.150*
1948	*0.909*	*1.318*	*4.484*	*0.018*
1947	*O.864*	*1.252*	*4.710*	*-0.114*
sum over 48-73	*48.276*	*70.000*	*67.417*	*50.450*

Part B: Stationairy economies according to their age of replacement of machinery

	Derived from part A						
age of replace-ment	*production A*	*labour places B*	*correction factor C*	*pro-duction =A*C*	*labour places =B*C*	*profit*	*total labour places*
1	*4.752*	*1.311*	*14.730*	*70*	*19.310*	*23.264*	*161.172*
2	*9.267*	*2.688*	*7.554*	*70*	*20.305*	*43.016*	*93.054*
3	*13.556*	*4.135*	*5.164*	*70*	*21.350*	*49.388*	*71.082*
4	*17.631*	*5.654*	*3.970*	*70*	*22.449*	*52.402*	*60.688*
5	*21.501*	*7.250*	*3.256*	*70*	*23.604*	*54.063*	*54.959*
6	*25.179*	*8.927*	*2.780*	*70*	*24.817*	*55.039*	*51.593*
7	*28.672*	*10.688*	*2.441*	*70*	*26.093*	*55.615*	*49.606*
8	*31.991*	*12.538*	*2.188*	*70*	*27.434*	*55.934*	*48.508*
9	*35.144*	*14.481*	*1.992*	*70*	*28.843*	*56.073*	*48.027*
10	*38.139*	*16.522*	*1.835*	*70*	*30.324*	***56.081***	***48.001***
11	*40.984*	*18.666*	*1.708*	*70*	*31.881*	*55.985*	*48.331*
12	*43.687*	*20.918*	*1.602*	*70*	*33.517*	*55.806*	*48.949*
13	*46.255*	*23.284*	*1.513*	*70*	*35.236*	*55.556*	*49.811*
14	*48.695*	*25.769*	*1.438*	*70*	*37.043*	*55.244*	*50.888*
15	*51.012*	*28.379*	*1.372*	*70*	*38.942*	*54.875*	*52.158*
16	*53.214*	*31.121*	*1.315*	*70*	*40.937*	*54.455*	*53.607*
17	*55.306*	*34.001*	*1.266*	*70*	*43.035*	*53.986*	*55.225*
18	*57.293*	*37.026*	*1.222*	*70*	*45.238*	*53.470*	*57.006*
19	*59.180*	*40.204*	*1.183*	*70*	*47.554*	*52.907*	*58.946*
20	*60.974*	*43.542*	*1.148*	*70*	*49.988*	*52.298*	*61.045*
21	*62.677*	*47.048*	*1.117*	*70*	*52.545*	*51.644*	*63.301*
22	*64.296*	*50.732*	*1.089*	*70*	*55.232*	*50.943*	*65.718*
23	*65.833*	*54.601*	*1.063*	*70*	*58.056*	*50.196*	*68.297*
24	*67.294*	*58.665*	*1.040*	*70*	*61.023*	*49.400*	*71.042*
25	*68.682*	*62.933*	*1.019*	*70*	*64.141*	*48.554*	*73.957*
26	*70.000*	*67.417*	*1.000*	*70*	*67.417*	*47.658*	*77.049*

Table 1 therefore assumes that the employment associated with the production of the machine in 1973 is equal to 1/7 of the number of profitable labour places which in part A amounts to 67.417, i.e. 9.631. At a wage rate of 0.29, the profit of the last profitable vintage is equal to (1.318-4.484*0.29=) 0.018. The total profit of the profitable vintages equals 50.45. After deduction of the investment costs (9.631*0.29=2.792), a profit remains equal to 47.658.

All totals for profitable production shown in part A are also reflected in part B of table 1: the last row in this part shows a stationary economy that replaces its machinery after 26 years for a given production of 70. This part also shows whether it pays to replace machines earlier. For the given production of 70 this does lead to higher investment costs. The first columns of part B are directly derived from part A: they show the sum of the involved production and labour places at an increasing age at which machines are replaced. These columns make it possible to determine a correction factor that should be used to increases the production of each stationary economy to 70. The profit of each economy can then be determined by subtracting from the production value 70 both the wage rate times the number of labour places and also the wage rate times not only the labour associated with the production of a machine, but also times the calculated correction factor.

The table shows that the highest profit is achieved in the stationary economy that replaces machines after 10 years. The last column of part B shows that the total labour required (that is, the labour required to operate the machines and the labour required to produce the machines to be replaced) at the same time reaches a minimum level. It is evident that this level remains unchanged with changes in the production price and wages.

It is important to compare this stationary economy that produces most efficiently with the stationary economy in which machines are hold in operation as long as they provide a positive profit. From the stationary economy in the last row in part B of table 1 (that gives a stylized picture of the Dutch economy as analysed in the in footnote 2 mentioned studies of the Planning Bureau) we see that a production value of 70 billion guilders with 10 billion in investments requires a labour volume of 77. However, an efficient production of 70 requires an increase in investments to 18.35, while the total required labour decreases to 48[3].

Part B of table 1 makes it very likely that an increase in real labour costs will lead to contraction processes in which machines that become less profitable are more likely to be taken out of use. But will a policy aimed at wage moderation be able to do more than slow down contraction processes? Can the path to more efficient production processes be reversed so that old machines that have become profitable again are kept in use for longer? To answer such questions, I would like to refer to the already mentioned paper *Oligopolistic Competition and Economic Development* that addresses the danger of structural unemployment. This paper shows that efficiently producing firms, through their market power, may prevent that unemployment can be effectively combated with wage moderation. As a civil servant, your writer has helped shift the emphasis to investment promotion.

[3] The article *On Production, Consumption and the Emergence of Unemployment* places great emphasis on changes in technical development that result in a shortening of the optimal lifetime of machinery. It shows how unemployment can arise if there is a shortage of room for investment. For the simplified economy of table 1, however, a doubling of the labour saving technical development from 2.4 to 4.8 percent would only lead to a shortening of the optimal lifetime from 11 to 10 years. The level of investments should then have to increase by 7.5 percent.

This policy surrounding the WIR, Wet Investerings Rekening (Investment Account Act), has succumbed to its great success.

In addition, I would also like to stress how complex reality can be. Technical development not always implies steadily increasing labour savings, it may also result in drastic changes that enable new production processes that, due to their efficiency, will sooner or later overtake old production processes. It is important for a society to know in a timely manner where new efficient production processes are emerging, even if they arise abroad. It may then be more preferable to bring in a foreign firm so that domestic firms can also start working with these new production processes, rather than allowing those foreign firms to start from abroad a devastating competition with domestic firms. But good industrial policy must also take into account Ricardo's principle of comparative advantage, which means that at some point it may be attractive to move parts of the industry abroad. Such outsourcing can also lead to structural unemployment.

There are various causes that can lead to structural unemployment, especially in countries where many firms operate that keep machines in use as long as they provide profit. Structural unemployment can then arise from within due to the actions of more efficiently producing firms that through their market power enforce contraction processes among the less efficient firms. But efficient firms in other countries can also cause these contraction processes. It is often thought that depreciation helps to withstand competition from abroad. But the market power of efficient firms in countries with a relatively appreciating currency is often so great that they easily remain competitive in countries with a depreciating currency. Vulnerable countries would therefore do well to check whether they have some branches of industry that produce efficiently and could expand their production through exports. In addition, it should be emphasized that where labour is not scarce and does not pose a bottleneck to expanding investments, stimulating consumption can also help combat unemployment.

In general, to avoid structural unemployment, an effective industrial policy is desirable that, in accordance with Ricardo's first principle, with a proper measurement of technical change promotes efficient production, especially where it also contributes to comparative advantage in foreign trade.

But the quote with which this article begins does not address unemployment policy, it wonders how policy should respond to technical developments in times of scarce labour. The article *On Production, Consumption and the Emergence of Unemployment* states that it is important to determine policy in such a way that, regardless of the direction in which technical development is moving, actual development can continue to be linked as closely as possible to an optimal development of production and consumption, while promoting investments that are sufficient to produce optimally, that is to say efficiently, so that the total of consumption also optimally meets demand.

To make this policy possible, the article proposes to annually describe a range of production possibilities in the future per industry, given the production techniques that have become available, whereby each possibility is provided with the required investment and necessary supplies from other industries. Because the actual development must always take place within this range of production possibilities, the range will gain in accuracy over time. This makes it possible, among other things, to identify bottlenecks in a timely manner. For example, new efficient machines may become available for various industries, but they will all be electrically powered instead of oil or gas. An important question then arises whether the energy sector can provide the required increase in electricity. Another question is whether market forces alone can be relied upon to solve these types of bottlenecks efficiently.

With knowledge of the extent to which technical development in the recent past has led to more efficient production, and with a view of the production possibilities in the near future, an effective industrial policy can be pursued that is not subordinate to technical development but, on the contrary, responds to it to achieve the most balanced possible development of production and consumption, under which full employment is and remains achievable at all times: that was the belief expressed in the 1976 article. Full employment, while the total consumption is produced with as little labour as possible. The article also contains an appendix discussing how environmental policies can promote the balanced development of production and consumption.

Optimal investment in an even broader perspective

To show which factors can influence the development of production, consumption and investment, the paper *Marshallian Production evokes Schumpeterian Production* gives the example of two cities long ago that were separated by a fast-flowing river that hardly made mutual traffic and trade possible. Both cities were more or less self-sufficient until the technology became available to build a bridge over that river. What will happen then? What will the firms do that can benefit from the abundant mineral resources on one side of the river, while on the other side there is plenty of fertile agricultural land available? On both sides of the river there will be firms that will see new opportunities for expansion. Others fear competition from the other side.

But the bridge that is considered technically possible has not yet been built. Given the uncertainty as to whether and when construction will succeed, firms on both sides of the river will be cautious with their investments. Their reluctance could even create unemployment. This gives the authorities of both cities room to actually invest in the bridge, supported by the firms that expect to benefit from it. And yes, as soon as it becomes clear when the bridge will be completed, the investment activity of firms on both sides of the river will increase sharply.

This image of earlier times may serve as a metaphor for the bridge that the world at present must build to a truly sustainable economy that no longer cultivates the earth predatorily. It is clear that we have to build that bridge, but what that bridge should look like is anything but clear. But let us first look to consumers who in many countries, whether or not helped by incentives, are taking good steps by going to drive electric and generating energy themselves with solar panels. So there are firms that meet that consumer demand and also provide wind energy. Many consumers are already willing to make the necessary transition possible.

But firms also have to take steps. As the metaphor suggests, relying on market forces in a world full of competitors does not mean that firms can be trusted to build an easily passable bridge by mutual agreement. However, a wait-and-see attitude on the part of firms, as reflected in stagnating investments, may underline that governments must and can take control. But in order to be able to take control effectively, in-depth conversations with firms, for example working in the steel industry, about how and at what pace they can efficiently switch to more sustainable production processes are of great importance. Moreover, the willingness of firms to cooperate with governments may depend greatly on the extent to which their relative competitiveness is guaranteed. Without knowledge of how transitions can be technically realized and without necessary guarantees, goals can be formulated, but without clarity about the paths that firms must and can take, the attainability of goals is often little more than wishful thinking.

In order to gain a better picture of possible transition paths, it would be advisable to examine in an international context per branch of industry how the production processes used there can efficiently make way for future-proof processes. Where the transition can be achieved in different ways – for example, one method uses electricity while the other uses hydrogen – international pilots could be agreed to determine whether one method is more efficient than the other. The results of the pilots, including the production technology used, could then be shared with all firms in the industry worldwide in order to agree on a joint transition.

For the steel industry, such an approach could mean that competition between steel firms during the transition period is not only neutralized, but also that the less efficient steel firms are enabled to reach the level of the most efficient firms during the transition period. It then becomes attractive for the most efficient steel firms to keep the transition period as short as possible. It makes sense to apply this international approach primarily and as quickly as possible to the most polluting and climate-threatening industries. For some more diversified branches of industry such as petroleum refining and chemicals, the approach could be limited to characteristic components such as distillation columns. On the other hand, it will be clear that binding international agreements are difficult to agree with many branches of industry in which many firms are active. For these industries, international recommendations would suffice on how firms could shape the transition to sustainable production processes as efficiently as possible.

It is of great importance for the participating countries to see whether and to what extent the agreed or recommended transition can be achieved within the available production capacity. It may be that the available labour is too limited and that labour would therefore have to be withdrawn from other sectors to make the transition possible. Free market forces in which consumers do not want to give up the consumption they want could then stand in the way of a timely transition. A solution must be found for this dilemma, either by temporizing the transition or by additionally rewarding the labour involved in the transition in some way.

These are complex issues. One would hope that these can be solved by the unused production capacity provided by the wait-and-see attitude of firms before clarity arises about the transition measures to be taken.

An example of how this dilemma can be solved may be offered by the healthcare sector. This sector is also experiencing major technological developments that make it possible for people to continue living healthily for longer. Moreover, in many countries healthcare is financed separately. This can lead to people being willing to pay more for additional expenses that benefit everyone.

But to start with, it is also important to determine which healthcare systems, including firms involved in financing healthcare and firms that not only make and develop medicines, but also medical equipment, are most efficient. This means that the desired care, including the desired attention, is provided with use of as little labour as possible.

Are these systems that are largely based on market forces, where every procedure, treatment or hour worked in a hospital must be accounted for to the financing institutions, or systems that are characterized by a high degree of trust in the nursing staff? How do the systems differ in terms of administrative burden and stress that is reflected in absenteeism due to illness? Insight into the different systems is important not only to determine the most efficient system, but also to gain an eye for which system the consumer is most prepared to pay the associated costs. Because many countries depend on supplies from abroad for the use of medicines and medical equipment, it is worth considering applying Ricardo's first principle to an economy consisting only of firms involved in healthcare without regard to the countries in which these companies are located. To investigate differences in efficiency, the twofold valuation method can also be applied to such a cross-border sector.

Moreover, within a country or group of countries, the twofold valuation method can also be used to view each hospital as a separate economy in which departments supply goods and services to each other. The production of each hospital (the number of cured patients, distinguished by the nature of their illness) can then be linked to the labour that contributed to the care. It can then be determined whether one hospital makes relatively more use of blood tests or other laboratory tests than in other hospitals. It can also become clear whether new medical equipment contributes to higher efficiency. The way in which mutual supplies within a hospital are valued may differ from hospital to hospital. The twofold valuation is insensitive to this: it helps always to determine whether there have been changes in production circumstances that have led to greater efficiency.