3.
Human Capital and Growth: Another Reading of Graduate Unemployment

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Introduction

The field of employability studies is dominated by empirical research. Yet this chapter argues for the importance of returning to theory, particularly economic theory. Theory allows us to refocus and update the relationship between improving the levels of education and training of populations, especially university populations, and economic growth and development. The dominant theory has continually emphasised the role of human capital in the process of economic growth, to the point of making it the main source of this growth. This enthusiasm for the role of human capital has grown strongly since the advent, in the mid-1980s, of the theory of endogenous growth. However, empirical analyses have never been able to establish a clear relationship between the accumulation of human capital and growth (Easterly, 2001; Pritchett, 2006). In a remarkable paper, Hanushek (2013) writes:

> The role of improved schooling has been a central part of the development strategies of most countries and of international organizations, and the data show significant improvements in school attainment across the developing world in recent decades. The policy emphasis on schooling has mirrored the emphasis of research on the role of human capital in growth and development. Yet, this emphasis has also become controversial because expansion of school attainment has not guaranteed improved economic conditions. Moreover, there has been concern about the research base as questions have been raised about the interpretation of empirical growth analyses. It appears that both the policy questions and the research questions are closely related to the measurement of human capital with school attainment. (Hanushek, 2013: 204)

He notes that the empirical literature has changed course several times and increasingly agrees that this inability to conclude is the result of methodological and conceptual weaknesses, namely: (1) the problem of measuring human capital and the availability of empirical human capital data; (2) the problem of the sense of causality:

> An analytical concern is that the growth relationships discussed do not measure causal influences but rather reflect reverse causality, omitted variables, cultural differences, etc. This concern has been central to the interpretation of much of the previous work in empirical growth analysis. It is obvious that countries that are developing faster have the resources to invest in schools so that growth can lead to higher scores. However, the lack of relationships between countries as to the amount spent in schools and the observed test scores that were generally found provides evidence against this. (Hanushek, 2013: 210)

Finally (3), models' ignorance of the "quality" of formal education was cited to explain the inconclusive results of empirical research:

> The emphasis on human capital as a driver of economic growth for developing countries has led to undue attention being paid to levels of schooling. Developing countries have made considerable progress in closing the gap with developed countries in terms of school enrolment. But recent research has highlighted the importance of cognitive skills for economic growth. This result draws attention to issues of school quality, and in this area developing countries have been much less successful in closing the gaps with developed countries. (Hanushek, 2013: 210)

In this chapter we argue that when it comes to investing in human capital, there is an optimal level. This means that below this level (under-accumulation of human capital), an increase of the investment in human capital has a positive impact on growth, and beyond this threshold (over-accumulation of human capital), the impact on growth is null or negative! In particular, the overemployment of human capital, which is the case in some countries such as Tunisia, generates several negative consequences at the macroeconomic level, in addition to the misfortunes it creates for individuals who have invested and find themselves unemployed. We argue that this is one of the main explanations for the endemic unemployment of graduates.

In section one, we will present the model. In Section 2, we will examine optimality of employment of human capital. Section 3 will conclude by re-reading graduate unemployment. The chapter is partly based on our previous research in macroeconomic theory (Zaiem, 2018), while it summarises the essential results of ongoing research, without the mathematical developments (Nabli & Zaiem, Forthcoming 2026).

The Model

We will use an original model of the value creation process that poses the problem in terms of financing growth. Investment is considered in terms of investment in fixed capital and investment in circulating capital. The latter is made up of the acquisition of inputs, which is the main originality of the model.

The introduction of input modifies the economic problem, which becomes the following: an economy with capital K, and an amount of resources R, seeks to determine the "best" possible allocation (the allocation allowing the maximum of profit) of these resources between two alternative uses: the financing of capital accumulation (GFCF) and the acquisition of inputs. It will be a question of distributing resources between these two uses, and the decision parameter becomes the proportion of resources allocated to GFCF (denoted ζ for "Organic Composition of Investment (OCI)"), strictly between 0 and 1. The relationships describing the technology make it possible to deduce the volume of employment from this distribution of resources.

"Investment in human capital" is defined as the training of individuals (initial or continuing) within organizations dedicated to this role. This may involve vocational training or higher education institutions, depending on the case. We will assume that this training is carried out autonomously by the government. All decisions concerning this training (number of people trained, curricula, etc.) are the

prerogative of public authorities, which, of course, does not preclude the existence of consultation mechanisms with the productive sector or any other structure such as workers' organizations. The investment in human capital is financed by a tax on added value (output).

We will refer to "employment of human capital" as the hiring by companies of new workers who have benefited from training provided by institutions. It may also include the continuing training, by these same institutions, of a portion of their staff. Thus "Employment of human capital" refers to the demand side of human capital and "investment of human capital" to the offer side. We will measure the volume of human capital by the cost of training. Given the way in which investment in human capital is financed, this does not mean that companies pay for the training of the workforce they employ, since they pay a specific tax whether they hire trained labour or not.

In the model proposed by Lucas (1988), endogenous growth results from the accumulation of human capital. This is assumed to be proportional to the duration of training and the stock of human capital. Lucas (1988) makes human capital a factor in the same way as labour and capital, even if, considering the way in which it is introduced into the production function, it appears to be formally incorporated into work. The main limitation of this representation lies in the fact that it induces automatic positive impact of human capital on growth. Another limitation is the possibilities of substitution that this formulation introduces between the three autonomous factors: capital, labour and human capital. It is easy to see that some aspects of this substitution do not make sense.

As a result, and in line with our representation of the production process, we need to find a formalism that takes these limits into account and that reveals the role of human capital in the generation of added value: the effect of human capital on growth will not be modelled by the introduction (in any form) of this capital as a new argument in the production function, but by its introduction into the function representing the dynamics of fixed capital.

Our construction is based on the following premises:

The first premise is that, to influence productivity, technological change requires a need for investment in new equipment that incorporates this change:

> The striking assumption [in models like Lucas'] is that old and new capital equipment participate equally in technical progress. This conflicts with the casual observation that many if not most innovations need to be embodied in new kinds of durable equipment before they can be made effective. Improvements in technology affect output only to the extent that they are carried into practice either by net capital formation or by the replacement of old-fashioned equipment by the latest models … in contrast to Solow (1956, 1957), implementation is not free. It requires the purchase of new machines. (Greenwood & Jovanovich, 2001: 180)

This does not exclude:

> that some increases in productivity would take place even if capital per man remained constant over time, since there are always some innovations-improvements in factory lay-out and organization, for example-which enable production to be increased without additional investment. But beyond these the growth in productivity will depend on the rate of growth in the capital stock-clearly the more capital is increased, the more labour-saving technical improvements can be adopted, though

> there is likely to be some maximum beyond which the rate of growth in productivity could not be raised, however fast capital is being accumulated. (Kaldor, 1957: 596)

This leads to the second premise, that this investment in fixed capital induces a need for training to influence growth:

> Moreover, it requires new human capital, too, because workers and management must learn the new technology. This will take place either through experience or through training, or both. This type of technological progress is labelled here as investment specific; you must invest to realize the benefits from it. If this view is correct, growth accounting should allow for many types of physical and human capital, each specific at least in part to the technology that it embodies. (Greenwood & Jovanovich, 2001: 180)

The logic of the modelling is summarized in Figure 3.1 below:

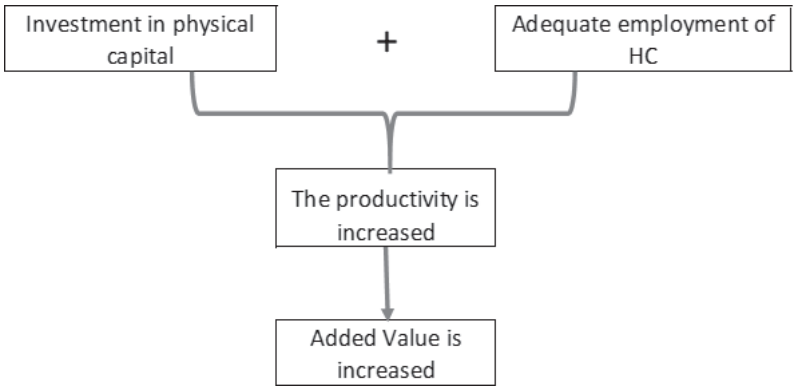

Figure 3.1. Embedded technological change and human capital

For the modelling of the effect of human capital, we operate in two stages. First, we introduce the concept of "efficient capital", defined as follows: the impact of technological change will be captured through the modification of the efficiency of fixed capital in which it is incorporated. The investment in fixed capital is increased by the introduction of an $e^{\propto}$factor, $\propto > 0$, $e^{\propto}$is greater than 1. In regard of the effectiveness, this means that one obtains $e^{\propto}$units (greater than 1) of capital with a unit of product (against a single unit previously), which also means that capital costs less, or is more effective at constant cost. $\propto$, as all the parameters and variables are specific to the concerned economy and generation of capital. Both the impact of the embodied technological change and its cost, vary from one generation to another (and therefore with t). We will call $\propto$ "Impact rate of technological change".

This is a way of translating within the framework the proposal of Kaldor, to "postulate a unique relation between the growth of capital and the growth of productivity, which integrates the influence of these two factors (capital and technological change)".

However, it is not enough to acquire equipment incorporating technological change to see productivity increase and output grow. Indeed, without the employment of adequate human capital, new equipment incorporating technological advances will not have the desired effect on labour productivity and

will not generate growth in output. We maintain that it makes little sense to speak of accumulation of human capital without associating it with technological change, it also doesn't make sense to speak of technological change without speaking of human capital. Generally, there is no impact of technological change without adequately using the required level of human capital, and conversely, there is no impact (or negligible impact) of employment of human capital if there is no investment in physical capital. All "partial" approaches are wrong.

The investment in human capital (as above defined) is financed by a tax on added value (output), which automatically results in an equivalent reduction of the resources available for investment. Thus, investment in human capital, mainly made necessary by the accumulation of fixed capital, is also at its expense. That is to say, the amount of investment in human capital is deducted from the amount of available resources, and results for the production sector in a reduction in the investment. In the model, this translates in a reduction of the "rate of impact of technological change" which will be equal to $(\propto - \omega)$, ω being the rate of reduction of the investment.

Technological change makes it possible to increase output for the same factors and inputs only if the cost of accumulating the required human capital is less than the benefit derived from this change incorporated in new investments. A research implication is that this provides an explanation for the difficulties encountered in empirical analyses of the impact of human capital on growth.

Optimality of employment of human capital

We will call the level of employment of human capital induced by the investment in fixed capital "Required level of employment of human capital" (another formulation would be: "Adequate level of use of human capital"). The actual level of employment of human capital is considered to be optimal if it is equal to the required one. It is then made in harmony with the accumulation of physical capital and the technological change it incorporates.

The concept of adequate (requisite/required) amount of employment of human capital is a consequence of the link between investment in fixed capital and employment of human capital. The "adequate" level is a standard specific to the concerned economy and generation of capital. It depends upon many factors, including: first, the nature of technological change and the significance of its impact. The greater the disruption to the processes that this change will bring, the higher the required amount of employment of human capital.

A second factor concerns the main characteristics of the training system, including quality, costs, and other factors. This impact of human capital employment on productivity and added value depends upon the adequacy of this employment to the required level. There are three possible situations: the adequacy: the "actual" employment of human capital is equal to "required"; the under-employment of human capital: the "actual" is less than the "required" employment of human capital; and the over-employment of human capital: the "actual" is higher than the "required" employment of human capital.

Thus, the terms "*adequacy*", "*under*-employment" and "*over-employment*" refer to actual employment in relation to the required employment, without reference to the amount of available human capital

(= investment in human capital), which is decided and realized by public authorities. Demand for human capital is decided by the production sector, but it can be due to a mismatch of the 'supply' of human capital.

The situation of underemployment of human capital may be caused by the fact that the investment in human capital is quantitatively insufficient in relation to what is required (shortage of supply of human capital). This can be due either to a lack of resources, which in our model come from a tax on output, or to more complex institutional problems such as the low capacity to make the necessary investments, or bad governance of the sector. It may also be caused by what is known as the "mismatch between training and employment". That is to say that investment is sufficient in quantitative terms but not in qualitative terms, since the output of training systems does not correspond to the characteristics sought by companies, and which are also – in our model – linked to the nature of investment in fixed capital.

Overemployment can of course occur, but only if the investment in human capital is sufficient, but unlikely. In fact, such a situation reflects the widespread, but incorrect idea that the employment of human capital is an asset and increases labour productivity and makes growth, regardless of any other consideration.

What happens when the employment of human capital is different from the required level? Let λ be the ratio of actual to required employment of human capital. In case of adequacy, $\lambda = 1$. The impact of employment of human capital on the output is represented by the Figure 3.2 below. In abscissa we have the value of λ, and in ordinate we have the corresponding value of the output (added value).

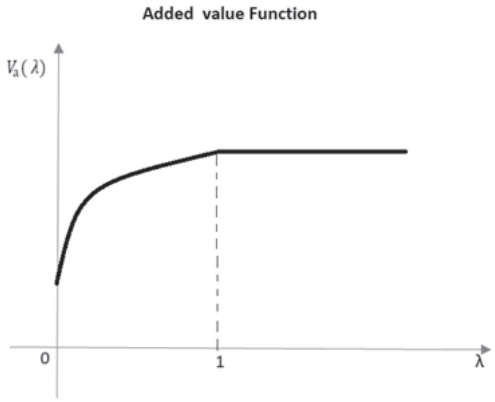

Figure 3.2. Relation between employment of human capital and the output

In case of under-employment of human capital $(\lambda < 1)$, we are in a situation where the level of the product is lower than the one with adequate accumulation of human capital $(\lambda = 1)$. The under-accumulation of human capital has a negative effect on the level of wealth created. Up to a certain threshold $(\lambda = 1)$, the increase of the employment of human capital has a positive effect on growth, and beyond this threshold, it has a null (and possibly negative) effect on growth. The underemployment of human capital is equivalent to a waste of fixed capital.

For $\lambda \geq 1$, we are in a situation where the level of the product is constant and equal to the one with adequate accumulation of human capital ($\lambda = 1$). The over-accumulation of human capital has no effect on the level of wealth created. The increase of the employment of human capital has a null (and possibly negative). The overemployment of human capital is equivalent to a waste of qualified workers.

In a forthcoming paper (Nabli & Zaiem, Forthcoming 2026), we tested the relationship between GDP and investment in higher education using an econometric model where the exogenous variable of interest is the ratio λ between actual investment in Tertiary Education (TE) and the required investment in TE defined above. Since the required investment is not observable, in conformity with our second premise (investment in fixed capital induces the need for training to influence growth) we used instead the ratio (P) between actual investment in TE and investment in fixed capital.

The theoretical model suggests a non-linear relationship between GDP/L and P (quadratic form on P) is the usual way to test for an optimal point or an inverted-U shape. If the coefficient of P is positive and the one of P^2 is negative and significant, this would be strong evidence for our hypothesis: the GDP/L increases as P increases up to a certain point (the turning point, or threshold), after which GDP_L starts to decrease.

We have tested this model using a Panel of 29 countries over 25 years (1994-2018). The estimation results confirm that capital stock per worker K/L is the primary and most stable driver of economic performance in our sample of 29 countries. The most compelling finding is the strong non-linear relationship (inverted U-shape) between the P ratio and GDP/L. The coefficient for (P) is positive and significant, indicating that increasing the ratio of investment in TE relative to investment initially boosts economic output. The coefficient of the quadratic term (P^2) is negative and also highly significant. This confirms the existence of a "turning point" or an optimal threshold.

Conclusion: Another reading of graduate unemployment

The theory of economic growth has established the investment in human capital as a permanent source of value creation, and this assertion is inscribed in the assumptions of growth models. Lucas' (1988) founding model makes human capital a factor of production by weighting work by the average level of qualification of workers. This means that the more investment is made in the training of workers, the more the product is increased, with no limit except that resulting from diminishing factor returns.

Our contribution is to demonstrate that there is an optimal level of investment in human capital. This means that in the event of underemployment of human capital in relation to the level required by the accumulation of fixed capital, there will not be a full benefit from this capital, and we could have had the same product with less investment in fixed capital. This wastes investment in fixed capital. On the other hand, if we are in a situation of overemployment of human capital in relation to the level required for the investment of fixed capital, we find ourselves in a situation of inefficiency in the sense that this amounts to wasting the resources devoted to training without any impact on product and growth. In the latter case, the surplus of employed qualifications results in the unemployment of the trained persons or in their employment in jobs that do not require the training provided. The inade-

quacy of employment of human capital is thus one of the explanations for graduate unemployment. It is like the very common question of the "mismatch between training and employment", but it also differs from it.

Let us call "skills employment rate of fixed capital investment" the need for human capital per unit of investment in fixed capital. This rate is likely to be much lower in developing countries than in advanced industrial countries. There are many reasons for this: If we look at fixed capital investment in our countries, we will probably find that the share of public investment in total investment is much higher. However, public investment is mainly made up of infrastructure that requires fewer qualifications to operate, and is standardized, therefore incorporating fewer technological innovations.

Private investment itself does not have the same "skills employment rate of fixed capital investment" (the P ratio used in the econometric analysis) because of the low degree of integration of value chains. The industrial fabric is made up of companies that are oriented towards the internal market and do not require high levels of skills. Companies that are oriented towards the external market operate in very narrow segments of the value chains and generally employ very few high-level skills because the design is at the client's level. The mismatch between training and employment would mean that we do not employ "the good" human capital, that is, the capital that is made necessary by the accumulation of physical capital. The overemployment of human capital, which is the case in some countries such as Tunisia generates several consequences at the macroeconomic level, in addition to the frustrations it creates for individuals who have invested, and do not find the expected return from this investment.

Graduate unemployment is a force to feed the race for new technologies, and for the accumulation of fixed capital that drives it. Graduates become the main vectors of the race for technology through the accumulation of fixed capital. Overinvestment in human capital creates and feeds a reservoir of skilled labour ready to meet the growing needs of the advanced industrial countries, from which they derive only benefits, while the countries of origin have financed – sometimes at the cost of massive debt – the costs of its accumulation.

The fact that graduate unemployment undoubtedly reflects the mismatch between the product of the training system and the needs generated by investment in fixed capital should not be interpreted as a call for an education system driven only by the labour market.

This is partly because our universities use curricula that are transposed from those of advanced industrial economies, while our industrial development is very different from that of these economies. This is a consequence of the conviction we have internalized that human capital is the engine of growth, it is accumulated not to meet a need (which we have identified as linked to the accumulation of physical capital) but because it would be the source of the creation of added value. It would be the driving force, when in fact it is an indispensable support for an engine that would be installed and that could not function without this human capital. Becoming aware of this leads us to review our conception of development and our vision of the training system.

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