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**Article**

## Resource productivity and economic wealth

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**KOMMENTAR****Resource productivity and  
economic wealth****A theoretical criticism of Europe 2020 growth policy****Erich Hödl****1. Economic growth, capital intensity and European growth policy**

Criticism of continued high economic growth comes mainly from ecologists, but also economists are aware, that a growing transformation of nature into man-made real capital may reduce the profit rate. Ricardo (1877, p. 356) and also Keynes (1967, p. 325) were definitely for high capital accumulation to augment economic welfare and to alleviate from work. In fact, consumption has enormously grown, but permanent substitution of labour by capital has augmented capital intensity, so that growth efficiency for both consumption and employment has declined. More importantly, continued capital-intensifying high economic growth causes irreversible destructions of nature. Under conditions of a market economy economic growth cannot be abolished, but reduced and fundamentally modified by lower capital intensity. As natural resources account for nearly half of total capital inputs, augmenting resource productivity is the main strategy to make economic growth both ecologically and economically more viable. Then, for a desired level of final consumption economic growth can be reduced, because modified economic growth allows a higher consumption quota and creates more employment. Prevailing growth strategies aim at higher capital intensity and higher growth rates, so that industrial countries have to compensate lacking home demand by export surpluses and accelerate financial investments without augmenting real economic welfare. By higher resource productivity economic growth can be reduced in favour of (a) higher home consumption and (b) higher real capital exports instead of growing export surpluses.

Europe 2020 has split its strategy for a socio-ecological market economy into three priorities for a smart, sustainable and inclusive growth. Smart growth should be enhanced by innovation and a digital economy, sustainable growth by higher resource efficiency and industrial policy and inclusive growth by higher qualification.<sup>1</sup> Already the naming indicates the primary target of higher economic growth and as far as resource efficiency will rise it is certainly an important step to protect nature. But its interrelations with the two other growth priorities and initiatives, es-

pecially competitiveness, demonstrate, that higher resource efficiency is primarily meant to reduce production costs for a renewed start for higher European economic growth.<sup>2</sup> This is confirmed by the overall strategy to augment economic growth by higher labour productivity.<sup>3</sup> Like several theoretical treatments<sup>4</sup> European economic policy considers higher labour productivity by means of higher capital intensity as the main driver for higher growth, but neglects pressures of high capital intensity on the profit rate. Whereas raising resource efficiency will reduce these pressures, smart growth will be capital-augmenting, because it aims at higher competitiveness by higher labour productivity. Reinforced innovation is expected to be output-augmenting instead of capital-reducing and the effects of higher resource efficiency are overruled by the strive for higher economic growth, which in sum will still be capital augmenting. Inclusive growth, by higher qualification will marginally contribute to employment efficiency and both higher employment and consumption are regarded to depend on high economic growth. Europe 2020 is captured by high growth thinking based on substitution of labour by capital and high capital intensity. As Europe 2020 is the result of short-run political pressures, it is only a very moderate step towards „a vision of Europe’s social market economy for the 21st century“.<sup>5</sup>

## 2. Capital wealth, resource productivity and economic welfare

In a market economy high economic growth cannot any more be considered as the adequate approach to solve ecological and economic questions. On the contrary, economic policy has to turn to the productive system and to develop a new factor combination with less capital inputs for a desired level of economic welfare. In general terms, capital productivity has to be augmented by a capital-saving technical progress. If we define all man-made capital equipments by  $K_R$  and natural capital inputs by  $K_N$ , productive capital is  $K = K_R + K_N$  and the reduction of  $K_N$  has for ecological reasons priority and augments overall capital productivity ( $Y/K$ ). High capital intensity ( $K/A$ ) can be reduced by less inputs of  $K_N$  and we will show, that lower capital intensity gives room for higher consumption and more employment without augmenting economic growth. But during a transition period a reduction of capital intensity will accelerate globalisation much less by export surpluses than by real capital exports.

Economic growth policies have largely neglected the longer term profit squeeze of capital-intensifying economic growth. By integrating neoclassical and postkeynesian growth theories into a general model of capital accumulation we can derive the pressures on the profit rate and identify higher resource productivity as crucial for high economic welfare without high economic growth. Defining the growth rate of working population  $n$ , the growth rate of labour productivity  $t$ , the rate of capital accumulation  $g$ , the profit rate  $r$ , the wage rate  $l$ , the propensities to save  $s_p$  and  $s_l$  and the capital productivity  $m$ , we can write  $n + t = g = s_p \cdot r + s_l \cdot l \cdot m$ .<sup>6</sup> Starting from a constant working population ( $n = 0$ ), the accumulation rate  $g$  depends exclusively on the growth rate of labour productivity ( $t = g$ ) and for given propensities to save the needed savings are assured by the income distribution ( $r, l$ ) and capital productivity  $m$ . For income distribution between profits  $P$  and wages  $L$  ( $Y = P + L$ )

total saving are  $S = s_p \cdot P + s_l \cdot L$  and aggregate saving behaviour is  $s = S/Y$ . For any accumulation rate holds  $s = t/m$  and a relative augmentation of labour productivity augments savings and capital accumulation. In contrast, a relative rise of capital productivity reduces economic growth. Therefore, augmenting resource productivity is decisive for augmenting economic welfare without high economic growth. Under the assumption, that prices describes quantities correctly and factor remunerations correspond to their productivities lower capital intensity will result in a higher wage-profit relation ( $L/P$ ), but without reducing the profit rate ( $r = P/K$ ) on the reduced capital stock.

Europe 2020 Strategy's target of higher resource efficiency will contribute to reduce the capital stock, but the primary target is still higher labour productivity. Referring to the general accumulation model from  $g = s \cdot m$  and  $s = t/m$  follows  $g = (t/m) \cdot m$ , then capital productivity  $m$  cancels out and capital accumulation is equal to labour productivity ( $g = t$ ). This is exactly the policy approach of the European Union,<sup>7</sup> which suggests, that the economy is only governed by labour.<sup>8</sup> But, if we interpret the same equation  $g = s \cdot m$  with respect to capital productivity  $m = g/s$ , then augmenting capital productivity needs a higher accumulation rate  $g$  and/or a reduced savings rate  $s$ . As  $s = t/m$  a higher growth of labour productivity than of capital productivity needs higher savings, which leads to higher economic growth. But for all economic growth paths, were the growth rate of labour productivity is higher than that of capital productivity the profit rate declines.<sup>9</sup> Therefore, European economic growth policy runs both into economic and ecological difficulties and higher resource efficiency can avoid them. Formerly, the single market was supposed to result in capital-saving economies of scale,<sup>10</sup> but lacking successes led to wage reductions. Europe 2020 proposes a reinforcement of the innovation system, but beyond higher resource efficiency all measures are meant to augment labour productivity and by this augment economic growth.

Capital-intensifying higher economic growth will certainly augment capital wealth ( $K$ ), but much less economic welfare ( $C$ ). The ultimate target of economic activities is not capital accumulation, but final consumption and growing capital intensity reduces the „consumption productivity of capital“ ( $C/K$ ). Longer term economic developments generated structural changes of capital allocation, which partly reduced capital intensity of real production. The service sector, public economic activities and the informal sector may diminish macroeconomic capital intensity. However, widespread environmental destructions in industrial countries demonstrate that these changes of capital accumulation cannot prevent them. Continued capital-intensifying economic growth enhances also financial investments and export surpluses. European economic policy intends primarily higher export surpluses, for which production remains in Europe and both ecological problems and capital intensity grow. A neoclassical substitution of natural capital by man-made capital<sup>11</sup> has narrow restrictions. If the price sum of productive capital with prices  $r$  for  $K_R$  and  $q$  for  $K_N$  is after substitution higher than before ( $K' = K'_R \cdot r + K'_N \cdot q > K$ ) the profit rate will fall and most probably also worsen the ecological situation. Therefore, a change of technical progress from a capital-augmenting to a labour-augmenting has to be considered.

### 3. Technical progress, innovation and income distribution

A transition into a low growth path, necessary for protecting nature rests on a higher capital productivity for which the key is higher resource productivity. To begin with, we introduce first exogenously higher capital productivity and exclude price substitution, which would always result in a return back to high capital intensity. By looking only on consistencies we will then discuss the implications for employment and income distribution. By referring to the equation  $g = s_p \cdot r + s_l \cdot l \cdot m$  six steps can be enumerated, which assure a desired level of consumption and augments employment and wages without high economic growth. For a low accumulation rate  $g$ : (1) the profit rate  $r = P/K$  can be kept constant by lower capital inputs ( $K$ ) and for a given output  $Y$  the wage rate  $l = L/A$  will augment, (2) as  $s_p > s_l$  savings will reduce and the consumption-investment relation ( $C/I$ ) will augment. (3) lower capital intensity ( $K/A$ ) will reduce labour productivity  $t$  ( $t = f(K/A)$ ) and for a given output  $Y$  also the quantity of labour  $A$  will rise, (4) as labour intensity ( $A/K$ ) has risen, the demand for the higher consumption quota ( $C/Y$ ) is assured, (5) the consumption productivity of capital ( $C/K$ ) has augmented and (6) for a desired level of consumption ( $C$ ) the accumulation rate remains at the previous low level.

Evidently, this contradicts traditional theories of technical progress. Post-keynesians argue that every technical progress is labour-saving.<sup>12</sup> This is not surprising, because in an economy with a positive surplus and even in cases where it is not fully invested ( $I < S$ ) growing capital intensity must by definition crowd-out labour and be labour-saving. The same applies also for the neoclassical theory of price substitution, where rising capital productivity would augment capital intensity and vice versa, but in the long-run growth is always capital-augmenting. Both theoretical strands have their foundations on Ricardo, that more capital augments economic welfare. Growth theories strive always for higher growth by higher capital intensity and this applies also for the new growth theory. Referring again to the general accumulation model ( $s = t/m$ ) higher qualification will augment labour productivity ( $t' > t$ ) and more innovation will augment capital productivity ( $m' > m$ ). Here too, if labour productivity rises more than capital productivity, savings augment ( $s' = t'/m' > s$ ) and for  $I = S$  economic growth rises. But if the growth rate of capital productivity is higher than that of labour productivity, the rates of savings, accumulation and economic growth will decline in favour of higher consumption and employment. The latter case corresponds to the above sketched labour-augmenting technical progress, where the basic assumption is that lower capital inputs are compensated by higher labour inputs and not by price relations, but by technological imperatives. In any case, a transition to higher labour intensity needs an innovation system, which can be most effectively initiated by higher resource productivity. Higher resource efficiency in Europe 2020 is a step towards it. We will argue, that an innovation system as part of the knowledge economy is bound to a higher quantity of labour inputs and if labour is remunerated according to its contribution to production the wage quota ( $L/Y$ ) will rise.

In former discussions of logical alternatives of technical progress most models consider higher capital productivity as „manna from heaven“ without cost. On the contrary, it needs not only economic resources, but primarily higher labour inputs.

Higher qualification and its transfer into innovation are bound to new knowledge, which ultimately can only be produced by human beings. In an innovation-driven economy the new knowledge will be partly stored in private firms and property rights may augment capital intensity, but production of tacit and explicit knowledge takes place in the „knowledge industry“ with high labour intensity and only product innovation may need high capital intensity. In an innovation-driven economy, labour gains of importance and higher labour productivity depends less on capital intensity, than on qualification. Both in current production<sup>13</sup> and in R&D qualification has become a limiting factor and wages are not solely a residuum. If we distinguish between simple and qualified work<sup>14</sup> the total quantity of labour inputs may have risen and only the labour-saving effect of prevailing high capital intensity reduces the employment efficiency of economic growth. If the high innovative capacity of the knowledge economy would be applied for augmenting resource productivity, capital intensity could be reduced and more employment would be created. More labour would be needed<sup>15</sup> and wages would not fall. Contrary to a mechanistic price substitution „intelligent production“ (grids, networks etc.) will spare natural capital for which higher labour inputs are a precondition. Europe 2020 has specified a comprehensive European innovation system, which includes growingly R&D for higher resource efficiency, but the general orientation toward higher labour productivity by higher capital intensity prevents an effective transition to lower growth.

High economic growth with growing capital intensity entails also redistribution. If we distinguish between quantities and prices and quantitative labour intensity has risen, this does not imply that in terms of prices, i.e. the wage-profit relation must rise. Neoclassics and Postkeynesians agree that the volume of profits depends on the price volume of investments ( $P = (I)$ ) and higher capital intensity in terms of prices augments the profit quota also in cases where the physical labour intensity has risen. In fact, the wage quota has diminished considerably during the last decades. As production is mainly determined by physical quantities and income distribution depends on social relations (J. St. Mill) income distribution may have decoupled from the system of quantities. Rough estimations of deflated factor productivities can hardly explain income distribution. During the last five decades deflated labour productivity grew about threefold of productive capital productivity, which would have declined, if resource productivity would not have marginally risen. Even if the income shares ( $P/L$ ) would have remained constant large explanatory gaps exist, possibly due to the enormous accumulation of unproductive financial capital.

#### **4. Economic growth, economic welfare and globalisation**

Higher resource productivity can contribute to a reduction of distributional tensions by a higher consumption quota, but the decoupling of prices and quantities will still remain and higher surpluses in terms of prices enhances economic growth. Therefore, economic growth in industrial countries can be reduced by real capital exports and not by export surpluses. Higher resource productivity allows a higher consumption quota in industrial countries and lower capital intensity makes

capital free for developing countries. Uncontrolled financial markets have led to fore-running financial globalisation<sup>16</sup> and real direct investments are relatively behind, because until now economic growth in industrial countries could be kept high. Cost pressures of low resource productivity were levelled-off by low wages and raising prices. Although high capital intensity is still considered to augment global competitiveness,<sup>17</sup> competitiveness can also be augmented by lower natural capital costs, which allow higher wages and raises European welfare. To avoid questionable higher global trade<sup>18</sup> lower economic growth in industrial countries and resource-saving will protect nature also in developing countries and allow there higher consumption and to create more labour demand.

Market economies have always to grow to the extent to which a surplus of the productive sector is needed to motivate for real investments. Changes of the structure of consumption have an important influence, but ultimately reallocations in the productive sector decide about the level and content of economic growth. If capital intensity is reduced by higher resource productivity, the consumption productivity of capital can be augmented and for a desired level of consumption less natural capital and economic growth is needed. To turn the economy to a lower growth, not labour productivity, but resource productivity has to be augmented. An adequate innovation system will reduce overall capital intensity and create more employment and protect nature. Therefore, less natural capital is needed for a desired level of economic welfare and economic growth can be reduced. Prosperity is possible without growth.<sup>19</sup> In contrast to the traditional theory that a longer system of production („Produktionsumwege“, Böhm-Bawerk [1909]) augments economic welfare, a smaller transformation system from nature to final consumption is advantageous both for nature and the economy.

## Endnotes

- <sup>1</sup> European Commission (2010) 8.
- <sup>2</sup> Hödl (2011) 13.
- <sup>3</sup> European Commission (2003) 6.
- <sup>4</sup> Weizsäcker (1999) 57; Sinn (2003) 96.
- <sup>5</sup> European Commission (2010) 8.
- <sup>6</sup> Harris (1978) 97.
- <sup>7</sup> European Commission (2003) 7.
- <sup>8</sup> Keynes (1973) 7.
- <sup>9</sup> Hödl (2009).
- <sup>10</sup> Cecchini (1988) 121.
- <sup>11</sup> European Commission (2000) 19.
- <sup>12</sup> Pasinetti (1983) 206.
- <sup>13</sup> Picot et.al. (2004) 451.
- <sup>14</sup> Keynes (1973) 41.
- <sup>15</sup> Miegel (2011) 186.
- <sup>16</sup> Skidelski (2010) 25.
- <sup>17</sup> Sinn (2004) 69.
- <sup>18</sup> Keynes (1931).
- <sup>19</sup> Jackson (2011).



## Abstract

High economic growth in industrialised countries is questioned by growing ecological limits and the consumption-reducing effect of rising capital intensity of economic growth. Referring to the Europe 2020 Strategy it is shown by modern economic growth theory, that a vigorous rise of resource productivity by a resource-saving innovation system can assure high economic welfare without high economic growth. In the knowledge economy higher resource productivity will augment employment and wages without reducing the profit rate on the reduced capital stock. By augmenting resource and capital productivity more than labour productivity the productive system as the transformation instrument between nature and consumption can become smaller and depending on the desired level of consumption in industrial countries real capital exports to developing countries can augment.

## Zusammenfassung

Ein hohes Wirtschaftswachstum in den Industrieländern wird durch die zunehmenden ökologischen Begrenzungen und den konsumreduzierenden Effekt einer hohen Kapitalintensität des Wachstums in Frage gestellt. Bezüglich der Strategie Europa 2020 lässt sich unter Anwendung der modernen Wachstumstheorie zeigen, dass eine energische Steigerung der Ressourcenproduktivität mit Hilfe eines natursparenden Innovationssystems eine hohe wirtschaftliche Wohlfahrt ohne hohes Wirtschaftswachstum ermöglicht. In einer Wissensgesellschaft erhöht eine steigende Ressourcenproduktivität die Beschäftigung und die Löhne ohne dass die Kapitalrentabilität des dann verringerten Kapitalstocks gedrückt wird. Wenn die Ressourcen- bzw. Kapitalproduktivität stärker steigt als die Arbeitsproduktivität wird das gesamtwirtschaftliche Produktionssystem, das lediglich ein Transformationsinstrument zwischen der Natur und dem Konsum ist, anteilig kleiner. Und in Abhängigkeit vom Konsumniveau in den Industrieländern wird der Transfer von Realkapital in die Entwicklungsländer zunehmen.

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