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Allyn Young on Macroeconomic Increasing Returns**

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Solovian and New Growth Theory from the Perspective of Allyn Young on Macroeconomic Increasing Returns

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Abstract

This paper evaluates, from an Allyn Youngian perspective, the neoclassical Solow model of growth and the associated empirical estimates of the sources of growth based on it. It attempts to clarify Young's particular concept of generalised or macroeconomic "increasing returns" to show the limitations of a model of growth based on an assumption that the aggregate production function is characterised by constant returns to scale but "augmented" by exogenous technical progress. Young's concept of endogenous, self-sustaining growth is also shown to differ in important respects (including in its policy implications) from modern endogenous growth theory.

Keywords: Solow model; aggregate production function; Allyn Young; endogenous growth theory; macroeconomic increasing returns.

JEL Classifications: B22, B31, O30, O40, O47

There is no problem where there has been more loose thinking than in this of increasing returns... Large production, not large scale production, permits increasing returns (Allyn Young 1990:54).

Robert Solow's two seminal papers (1956, 1957) induced a burgeoning literature on "endogenous" growth theory. His theoretical and empirical work was based on a constant-returns-to-scale neoclassical aggregate production function that harked back to Charles Cobb and Paul Douglas (1928) who tested J B Clark's marginal productivity theory of distribution. Solow's model is expounded in companion papers, so here it is necessary only to remind that his work was a reaction against the "knife-edge" instability of the Harrod-Domar model by invoking a general linear homogeneous production function with flexible factor prices and factor proportions to maintain full employment. The theory predicted a tendency to a steady state of zero growth in per worker terms unless the production function is augmented by technical progress. "Labour-augmenting" innovations could maintain the output-capital ratio and constant factor shares. In his empirical 1957 paper he found that the Cobb-Douglas functional form fitted aggregate United States data (on growth of output per worker regressed against capital per worker) as well or better than any of the other forms with which he experimented.

The Cobb-Douglas paper appeared in the same year as Allyn Young's (1928) on increasing returns. Earlier, Young had also elaborated the marginal productivity theory of distribution in some detail as a co-author of the second (1908) edition of Richard T Ely's *Outlines of Economics*. However, he had always been careful to differentiate static equilibrium theory and the individual profit-maximizing entrepreneur from the dynamics of the aggregate growth process through which are

set the product and factor prices to which the entrepreneur adjusts.¹ Marginal productivity theory helps explain income distribution but not the determinants of marginal utility and productivity. The latter depend on conditions that affect demand and supply elasticities of products – hence of the factors – as incomes increase through time.²

It is thus unlikely that Young would have embraced the Cobb-Douglas-Solow production function with its unidirectional dependence of aggregate output on factor inputs and technology. In Young's theory of the circular flow, his concept of "increasing returns" is macroeconomic, arising from growth itself and hence dependent as much on demand as on supply, though Young emphasised that in the overall sense demand is the reciprocal of supply. Combined with the varying elasticities of supply of land, labour and capital goods, factor prices and market opportunities are determined and entrepreneurs adjust accordingly. In the process, the Marshallian "representative firm" – and industries too – tend constantly to lose their identity and become increasingly specialised, employing increasingly specialised methods, hence becoming increasingly productive. This interplay questions how far output growth can be explained in Solovian fashion by the measured growth of capital and labour inputs weighted by their income shares if incomes mainly reflect relative scarcities which in turn depend on growth of GDP.³

¹ J B Clark (1899: vi) himself wrote that his theory "tries completely to isolate the static forces that act in distribution from the dynamic forces."

² In 1908 Young discussed the relation between the "annual product" (inclusive of capital goods) and the "social dividend" (sale of final goods and services), showing "the importance of the greater productivity of indirect, time using methods of production for the theory of interest" (in Mehrling and Sandilands, 1999:73). This was an early exposition of what Young's student Frank Knight would later call the "wheel of wealth" or the circular flow of income mediated through time by the rate of interest. Young stressed the relation between product and factor demand, showing that rewards "imputed" to factors are not the same as their contributions.

³ In Ely et al (1908:324-35), Young criticises Clark for fudging this circularity problem in respect of capital.

It is clear from his chapters on value theory in the various editions of *Outlines*, in lectures at the London School of Economics 1927-29 as recorded by Nicholas Kaldor (Young 1990), and in correspondence with Frank Knight throughout the 1920s, that there were distinct limitations to the Marshallian concept of normal price for understanding secular growth. As detailed in Sandilands (2000), Young spoke of the “togetherness” of economic phenomena so that the conventional Marshallian apparatus of supply and demand and Clark’s marginal productivity theory could not be integrated to give the social picture or explain why growth tends to be self-sustaining rather than self-exhausting (as in Solow’s model).

Also showing the development of his thinking is Young’s (1913) critique of A. C. Pigou on social cost. Pigou had insisted that if expansion of a competitive industry with “decreasing returns“ (rising supply curve) drives up factor prices for other industries, then this “external diseconomy” raises the social above the private cost, thus justifying a tax. Vice versa for competitive “increasing returns” industries if lower factor prices due to a larger industry are not offset by the rising expenses of each firm as it expands. Young criticised Pigou for confusing transfer payments as real costs, and for failing to distinguish the independent effects of a larger firm size from those connected with an enlarged industry. He concluded that he could scarcely imagine a case where increasing returns, *in Pigou’s sense*, could coexist with competition. Furthermore, it would be practically impossible to identify increasing and decreasing returns industries and then to internalise these misconceived Pigouvian externalities with taxes or subsidies.

But Young did not deny the significance of *Marshallian* external economies, as is clear from his 1928 presidential address.⁴ However, his untimely death (March 1929) prevented him from developing the growth theory expounded there; and with the onset of the Great Depression interest in long-run growth waned in favour of depression economics until Roy Harrod and Evsey Domar renewed interest but along different lines from Young's. Meantime, the cost controversy associated with others' interpretations of Pigou and the Marshallian representative firm was oriented toward the nature of the firm itself rather than the way the representative firm might evolve in the overall growth process. Young (1928:527) himself warned that he did not propose to discuss those "alluring" but narrower questions, and that the supply and demand apparatus being developed for that purpose "may stand in the way of a clear view of the more general or elementary aspects of the phenomena of increasing returns". Soon the imperfect and monopolistic competition theories of the firm in equilibrium would also distract attention from Young's disequilibrium view of monopolistic competition.

Instead, Solow (1956 and 1957) came to dominate growth theory and related empirical work, following his finding that nearly 90 percent of the growth of labour productivity could not be explained by growth of capital per worker. The "residual" was an unexplained measure of labour-augmenting technical progress. The two main strands to subsequent work were, first, redefinition and measurement of factors with a distinction between skilled and unskilled labour and inclusion of human with physical capital; and second, special attention to the nature of "knowledge" and research and development expenditures. Most of this research has retained the neoclassical growth framework, but with the new variables placed comfortably within it. Thus instead of

⁴ Peter Newman (1987) misinterpreted Young's criticism of Pigou, suggesting that he later regretted his claim that cases of increasing returns in competitive industries must be rare. But there is no inconsistency. Young rejected Pigou's notion of external economies, but (subject to caveats) not Marshall's.

growth of aggregate output being driven only by inputs of capital and labour, it is also driven more explicitly by *effective* labour, with human capital increased through the knowledge that comes from education, training and learning by doing.

A Youngian evaluation of attempts to endogenize Solow's "residual"

The distinctive feature of knowledge in the wealth of nations (to echo the title of David Warsh's [2006] enthusiastic "story of economic discovery" of modern endogenous growth theory, with Paul Romer heading a star cast) is that it is "non-rivalrous" and only partially and temporarily excludable by learning costs and patent protection. In the medium and long run, pure and applied scientific advances are widely learned and copied. These features are modelled to allow resources devoted to R&D – now seen as an explicit explanatory driver of growth – to depend on expected internal net benefits, but also emphasising the external benefits of new knowledge.⁵ It is believed this explains why capital deepening is not subject to diminishing returns, thus converting the production function into one exhibiting increasing returns consistent with Young's seminal, but rather "mushy" (as characterised by Krugman 1993) non-mathematical treatment of the subject.⁶

⁵ Philippe Aghion and Peter Howitt (1998:79) call imitators' dissipation of innovators' profits a "Schumpeterian business-stealing effect" that discourages innovation and lends support for monopoly and protectionism. By contrast, Young stressed the positive role of competition to maximise the pecuniary external economies inherent in the free market mechanism (see Chandra and Sandilands 2006, and parallel ideas in Baumol 2002).

⁶ Warsh (2006:91) also deprecates Young as a rather fuzzy "literary" economist who (unlike Frank Ramsay on savings and optimal growth) "eschewed mathematics altogether". Yet Irving Fisher acclaimed him "decidedly the best mathematician among living American economists" (see Earl Hamilton in Sandilands 1999:469). Observe too the math in the appendix to Young (1928:540-42), mentioned in Young's letter to Frank Knight, 11 August 1928, showing it was prepared in advance of his September presidential address. Commenting on the Knight's theory of price, he wrote: "Where I don't follow you, of course, is in respect of increasing returns... The economies which show themselves in increasing returns are the economies of *large* production, not of large-scale production. I have just sent a mathematical note on this matter to the printer."

But does this modern theory really coincide with Young's emphasis on the size of the overall market in his treatment of knowledge, induced innovation, externalities and the factor rewards? A major difference is that neoclassical theories are based on a mainly input-driven, supply-side view of the growth process. New kinds of inputs may be introduced but in their production functions causation runs unidirectionally from inputs to outputs. This is true even of Marvin Frankel's (1962) model, based on Solow but with a "development modifier" that makes enterprise production functions depend on the *aggregate* capital stock per worker. Aghion and Howitt (1998) see this as an early but neglected endogenous growth model in tune with Romer (1986) where social returns on capital (the vehicle for accumulation of knowledge, especially when including human capital) so exceed private returns as to yield an AK production function (see also Sandilands 2000). But Frankel still retains a Solovian framework in which growth is driven by capital without explaining what drives capital.

This is less true of Kenneth Arrow's (1962) model where learning-by-doing depends on the cumulative production experience. However, Alberto Ales and Edward Glaeser (1999) test whether learning-by-doing is as important as Young's stress on growth of market size. They find that insofar as scope for learning-by-doing is greater in advanced products in which rich countries specialise, it is less important than growth of markets in explaining why poor countries have most to gain from trade liberalisation for they, with their narrower range of products, are more specialised. But the significance of specialisation for Young is not so much potential economies of scale from a small number of products, but rather the economies from a larger number of specialised firms producing and using a larger number of specialised products. Actually the range of firms and products expanded most in poorer countries such as

China and India that grew most rapidly after opening up trade. This is in line with Yongsheng Zhang and Xueyan Zhao (2004) – following the extensive work of Xiaokai Yang (2003) on Youngian economics – that showed a declining average size of firm as growth proceeded in countries such as Mexico and South Korea.⁷

Young saw the supply and effectiveness of inputs as driven by aggregate *derived* demand or the force of overall market demand for goods and services whose size is in turn affected by the degree of competition and mobility in product and factor markets. However, when Young emphasises demand it is in the special sense of real *aggregate reciprocal demand* (abstracting from fluctuations arising from monetary disturbances⁸). Thus

the capacity to buy depends upon capacity to produce. In an inclusive view, considering the market not as an outlet for the products of a particular industry, and therefore external to that industry, but as the outlet for goods in general, the size of the market is determined and defined by the volume of production” (1928:533).

Consequently the Marshallian apparatus of sectoral supply and demand curves cannot adequately illumine the growth process. Young acknowledged Marshall’s “fruitful distinction between the internal productive economies which a particular firm is able to secure as the growth of the market permits it to enlarge the scale of its operations and the economies external to the individual firm which show themselves only in changes of the organization of the industry as a whole” (527), but he thought

⁷ Marshall (1920:318) believed an increase in the size of the industry will generally increase the size of the representative firm, and wrote: “The *law of increasing returns* may be worded thus: An increase of labour and capital leads generally to improved organization which increases the efficiency of the work of labour and capital.” Young might complain that this is a supply-side “law” that misses the crucial role of demand, and that increased specialisation often means smaller firms.

⁸ Some necessary qualifications, allowing for monetary disturbances and malinvestments, are found in Young (1928a:145) to indicate that despite a powerful underlying, self-reinforcing secular trend, there may be cyclical interruptions: “There is a sense in which supply and demand, seen in the aggregate, are merely different aspects of a single situation. It is for this reason that some of the older economists held that general overproduction is impossible – a theorem which, though not really erroneous, has proved to be misleading.” Young’s cycle theory is similar to Ralph Hawtrey’s monetary theory: see Laidler 1993.

Marshall underplayed the qualitative changes in the external field. The internal economies of the representative firm “dissolve into the internal and external economies of the more highly specialized undertakings which are its successors, and are supplemented by new economies.” Further:

Insofar as it is an adjustment to a new situation created by the growth of the market for the final products of industry the division of labour among industries is a vehicle of increasing returns. It is more than a change of form incidental to the full securing of the advantages of capitalistic methods of production – although it is largely that – for it has some advantages of its own which are independent of changes in productive technique (538).

Young thereby extended Smith’s famous aphorism that the division of labour is limited by the size of the market – in turn limited by the degree of competition. Today, “we mean by the division of labour something much broader in scope than that splitting up of occupations and development of specialized crafts which Adam Smith mostly had in mind” (Young 1928:529). Instead it shows up as increasingly specialized firms and industries, using more roundabout methods and producing increasingly differentiated consumer and capital goods. Emphasis is on economics of specialisation rather than economies of scale. Thus

the principal economies which manifest themselves in increasing returns... are largely identical with the economies of the division of labour in its most important modern forms. In fact, these economies lie under our eyes, but we may miss them if we try to make of *large-scale* production (in the sense of production by large firms or large industries), as contrasted with *large* production, any more than an incident in the general process by which increasing returns are secured (*ibid.*:531).

Here, importantly, “large production” means not only large real (reciprocal) demand or size of market for an industry in which the single firm operates, but also the size of the whole economy in which the single industry operates, and indeed of the size of the effective world economy to which a country has access. With a larger market in Young’s inclusive sense of “an aggregate of productive activities, *tied together by trade*” (1928:533, emphasis added), an “increasingly intricate nexus of

specialized undertakings has inserted itself between the producer of raw materials and the consumer of the final product” (*ibid.*:538). Both the scale and nature of firms and industries in a growing economy are determined not only, and not mainly, by their own sales but rather by sales of the industry or economy to which they are ancillary.

In a “Marshall-Young-Romer” model, Romer (1989) attempts to formalize the significance of this “increasingly intricate nexus of undertakings”. He posits that the greater the number of intermediate inputs the greater the productivity of given resources. Here the constraint on specialization is the fixed cost (giving rise to a U-shaped average cost curve) of each addition to the list of intermediate inputs produced by specialist firms. If each specialist is a monopolist, it faces downward-sloping demand and excess profits that entice additional specialist firms. This reduces demand for each of the specialists (all assumed to have similar costs) until equilibrium is established with excess profits eliminated and price equal to average cost above the minimum on the U-shaped curve. This, then, is a model incorporating Chamberlinian monopolistic competition, so Euler’s theorem cannot apply: conventional factor inputs receive less than their marginal products and the excess compensates producers for the fixed costs of specialist goods that generate increasing returns. The larger the resources devoted to specialization (constrained by the discounted present value of expected benefits), the greater these returns.

Monopolistic competition is a feature common to many endogenous growth models (and of new trade theory too: for example, Krugman 1990), but according to Earl Hamilton (in Sandilands 1999:469) “every worthwhile idea in E.H. Chamberlin’s subsequent work on imperfect competition had been clearly expounded by Allyn Young in class long before Chamberlin put pen to paper.” However, Young’s LSE lectures (Young 1990) indicate that the number of specialist firms (whether producing

intermediate inputs or more varied consumer goods) is ultimately constrained by the growth of the market which determines how many resources it is worth devoting to this. In elaborating his theory of increasing returns, he stressed that “all costs are prime [i.e., variable] costs if you take the right period of time” (*ibid.*:49), and “underproduction is a feature of a state of growth. Plant cannot grow by infinitesimals; the [ever-changing] representative firm generally has more power than is necessary for immediate needs. It shows progress rather than depression and is evidently, in the long run, productive and economical or it would not be done” (48). Thus “surplus productive capacity is a normal and necessary condition of economic progress” (54), and increasing returns are consistent with intense competition. Monopolistic competition is inherent in Young’s view of competition as a process in growth, intrinsically tied to qualitative changes to the increasingly specialized representative firm.

In Romer (1994) the focus moves away from specialization as the source of growth and instead stresses the nonrivalrous nature of knowledge “goods”. He asserts: “If there are no nonrival goods, there are no increasing returns” (15). In Young, however, what is important is not knowledge as such but knowledge in use. Here he again differs from Romer in his emphasis on the importance of market size – and its growth – in making it economic to adapt and use existing as well as new knowledge that hitherto was known but uneconomic. It is not ignorance that prevents less developed countries from using tractors instead of oxen. But even developed countries forego the latest technology until it pays. New inputs, both of the conventional and unconventional (ideas) kind, become as much the result as the cause of economic growth. Thus the powerful concluding lines of Young’s (1928) presidential address:

The division of labour depends upon the extent of the market, but the extent of the market also depends upon the division of labour. In this circumstance lies the

possibility of economic progress, *apart from the progress which comes as a result of the new knowledge* which men are able to gain, whether in the pursuit of their economic or of their noneconomic interests (539-40; italics added).

Although in explaining this cumulative process Young (1928) wrote that Marshallian curve analysis “may divert attention to incidental or partial aspects of a process that ought to be seen as a whole” (533), nevertheless one might learn something from it if one enquires

into the operations of reciprocal demand when the commodities are produced competitively under conditions of increasing returns and when the demand for each product is elastic, in the special sense that a small increase in its supply will be attended by an increase in the amounts of other commodities which can be had in exchange for it. Under such conditions an increase in the supply of one commodity *is* an increase in the demand for other commodities, and it must be supposed that every increase in demand will evoke an increase in supply. The rate at which any one industry grows is conditioned by the rate at which other industries grow, but since the elasticities of demand and of supply will differ for different products, some industries will grow faster than others. Even with a stationary population and in the absence of new discoveries in pure or applied science there are no limits to the process of expansion except the limits beyond which demand is not elastic and returns do not increase (*ibid.*:534).

However, even in the reciprocal relationship between an inelastic-demand sector such as agriculture and the rest of the economy, producers of such commodities “often share in the advantages of the increase of the general scale of production in related industries, and so far as they do productive resources are released for other uses” (*ibid.*:535). Thus agricultural costs may fall partly through innovations (including, but not only, through “general purpose technologies” such as computers) in fields such as steel, engines and petrochemicals that only partly relate to the size of agriculture (just as the cost of steel etc is reduced, directly or indirectly, by a fall in agricultural costs). And so long as wants are insatiable, the overall income elasticity of demand for all goods is unity (again abstracting from exogenous interruptions to secular growth).

If Youngian “macroeconomic” (Lauchlin Currie 1997) or “generalized” (James Buchanan and Yong J. Yoon 1999; Buchanan 2008) increasing returns, associated with a growing “aggregate of productive activities tied together by trade”, arise from this increasingly complex nexus of specialized undertakings, the benefits involve increased transactions costs. Xiaokai Yang and Jeff Borland (1991), and Yang (2003) emphasize that with Youngian fragmentation of production, a new role emerges for co-ordination services such as transport and communications as well as research and advertising. However, Young (1928) himself wrote:

One who likes to conceive of all economic processes in terms of tendencies towards an equilibrium might even maintain that increasing returns, so far as they depend upon the economies of indirect methods of production and the size of the market, are offset and negated by their costs... This would amount to saying that no real economic progress could come through the operation of forces engendered *within* the economic system – a conclusion repugnant to common sense... The appropriate conception is that of a *moving* equilibrium, and... the costs which (under increasing returns) grow less rapidly than the product are not the “costs” which figure in an “equilibrium of costs and advantages” (535).

These increasing returns are also reaped by service sectors as the market grows. For example, all sectors require transport but how far each sector enjoys a reduction in these costs depends, paradoxically, on others’ increased use of it. Thus are costs associated with the securing of increasing returns differentiated from those involved in a conventional “equilibrium of costs and advantages”. With increasing returns there is no equilibrium except a moving equilibrium of technical and organizational change that is cumulative, self-sustaining *and endogenous to the size of the overall real market* – a demand-driven rather than an input-driven theory of growth.⁹

⁹ See Nicholas Kaldor (1972) and Young’s (1990:45) statement (cited by Kaldor) that “seeking for equilibrium under increasing returns is as good as looking for a mare’s nest.” Young had a profound influence on Kaldor (see Thirlwall 1987) and may have inspired Kaldor’s “technical progress function” in which the growth of labour productivity is a positive function of the growth of capital per worker that embodies technical progress ($\dot{q} = a$

However, the rate is subject to various obstacles, natural (such as inelastic demand for a major sector like agriculture) or man-made, and these may be relaxed or exacerbated by exogenous events or policies. The latter would include not only better monetary management, but also attacks on institutional obstacles to competition and mobility (notably those inhibiting movement out of sectors such as agriculture that face low demand elasticity but substantial increases in labour productivity).¹⁰

Regarding Marshall's statement that an industry's long-run supply schedule may fall "given time for the organisation of industry", Young (1990:47-8) wrote:

But that is exactly the problem: how much time?... The 'period of time' is relative to costs, and the costs are relative to the period of time... A long-period supply curve is meaningless apart from the particular length of time considered: the curve is relative to the rate at which increasing returns exist. On the other side you cannot postulate a constant demand curve for a good over a long period. It would shift as a result of the very forces which are shifting the supply curve. We need a theory of an equilibrium rate of progress. Probably the optimum rate of progress which will keep the supply curve close up to the demand curve.¹¹

These reciprocal curves depend on their interrelated elasticities, which helps clarify an otherwise elusive statement in Young (1928:534n.):

+ $b \dot{k}$). With $0 < b' < 1$, the two growth rates converge toward a *sustainable* equilibrium rate of productivity growth. In addition, the constant term may shift up over time due to exogenous technical change or learning-by-doing – as with Erik Lundberg's "Horndal effect" mentioned by Mauro Boianovsky (2008). But Kaldor thought that increasing returns are confined to manufacturing and debated this with Currie (in Sandilands 1990:296-303). Youngian specialisation also enhances productivity via "disembodied" organisational changes requiring little extra capital.

Another Swedish connection to Young is told by Bertil Ohlin in Sandilands (1999:473). Ohlin relates that Young "impressed me immensely [at Harvard in 1922-23]... He knew and understood his subject better than anyone else I have met. I tested him by means of a question about the "Wicksell effect", i.e., the special aspects of the marginal productivity of capital which at that time was practically unknown in most countries outside of Scandinavia. He immediately gave a fine account in a five minute speech before the students."

¹⁰ Stressed by Currie (1981, 1997) in his "leading-sector" theory of development (cf. Ramesh Chandra 2006). Institutional reform in urban housing finance and the exchange-rate regime could liberate latent demand (in Young's reciprocal sense) for sectors whose expansion had hitherto been artificially repressed (thus repressing the rest of the economy too).

¹¹ At the conference Professor Solow asked if increasing returns exhibit diminishing returns in moving, for example, from aircraft to airframes to engines to rotor blades produced by increasingly specialised firms. The above paragraphs show it depends on the time frame, the secular direction of the structure of demand, and the degree of competition and mobility.

If the circumstance that commodity a is produced under conditions of increasing returns is taken into account as a factor in the elasticity of demand for b in terms of a , elasticity of demand and elasticity of supply may be looked upon as different ways of expressing a single functional relation.

However, consider an inelastic-demand sector such as agriculture. For the long period, its downwardly shifting short-period cost schedules will appear as a downward-sloping supply schedule that nearly coincides with its demand schedule. Even if its cost reductions (increasing returns) are similar to those in other industries, both its long-period demand and supply schedules will be more steeply sloped (less elastic) than for products with elastic demand. For the supply schedules, this may seem paradoxical. But long-run industry supply is derived from a series of shifting cost schedules for the firms (farms) in a competitive industry while demand conditions will dictate how many firms remain in the industry. With inelastic demand that number will fall – and will fall faster the greater the exodus of labor from agriculture into sectors with higher elasticity of demand..

Factor shares and the labour-saving bias of technical progress

Another outgrowth of Solovian growth theory concerned the factor bias to the technical progress than accompanies growth. Samuelson (1965, 1966), highlighted by Stiglitz (2006:237), addressed the issue whether a rise in the wage rate (which occurs in both the Young and Solow theories as productivity advances) is likely to induce a labour-saving bias to innovation, following William Fellner (1961) and Charles Kennedy (1964).¹²

¹² Samuelson (1966) was a rejoinder to Kennedy on “induced Harrod-neutral technical change” that keeps relative factor shares constant. If the capital-labour ratio rises, labour-saving innovation prevents capital’s share from falling, thus also maintaining a relatively constant return on capital – one of Kaldor’s famous “stylized facts”. Kaldor’s LSE lecture notes reveal that Young (1990:99), following Cassel, also stressed this. Solow (1994:49) notes that the assumption of constant returns to capital makes *increasing returns to scale* “inevitable”, along with the modeling of monopolistic competition. But Young’s increasingly

Samuelson and Stiglitz deny any *a priori* reason for such a bias, for a higher wage rate need not increase unit wage costs when capital deepening raises productivity, so there is no incentive to bias marginal R&D expenditures in the labour-saving direction. But if technical progress were Hicks-neutral (with neither a labour-saving nor capital-saving bias) capital deepening would raise capital's share progressively. In view of the historically observed labour-saving bias, Samuelson suggests a natural tendency for innovative effort simply to follow the (successful) labour-saving trend. And the actual labour-saving bias explains the relative constancy of labour's share despite capital deepening and rising wage rates.

An alternative explanation could be asymmetry in the response to a rise in the economy's "going wage" by relatively labour-intensive industries compared with more capital-intensive ones. Labour-intensive sectors whose labour productivity is below average do face rising unit wage costs, and thus face greatest pressure to make labour-saving adjustments. Nevertheless, they are still likely to suffer a decline in their domestic and international comparative advantages (a kind of Balassa-Samuelson effect upon their relative costs). The squeeze on these sectors releases resources for expansion of capital-intensive sectors where labour's productivity is higher. Thus the economy's measured average labour productivity will increase without there necessarily having been any *further* labour-saving innovations in the expanding sectors. All that has happened is that labour will have shifted to sectors with higher labour productivity.

This is consistent with Young's stress on the way an expanding market makes it pay to introduce the more roundabout or indirect uses of labour that most powerfully raise productivity and lower costs. If lower costs are passed on through

specialized monopolistically competitive firms that are the vehicle of his "*increasing returns*" are not necessarily exploiting "returns to scale" from being larger than their predecessors.

competition in lower prices or higher money wages, market demand increases further. This provides, endogenously, the incentive and the resources to continue investing and innovating (whether in a predominantly labour-saving direction or not). So long as capital accumulation keeps the return on new investment more or less constant, it means that despite or because of growing labour scarcity (which implies growing labour productivity¹³) the purchasing power of wages can keep rising without depressing investment incentives. The wage rate (but not necessarily the wages share) will rise relative to the return on physical capital.

These ratios (and absolute returns) are, to repeat, ultimately simply a matter of (derived) supply and demand. As Young (1990:25) put it: “The values of the factors merely reflect the value which consumers attach to final products of such factors.” Constantly on guard against the fallacy of composition, he also wrote:

Fundamentally, there is no difference between productivity and scarcity. Scarcity is meaningless except in relation to human desires; so is productivity. This does not mean that you can create a product by creating scarcity...

An objection has been raised that it is “value”, not “product” that counts. But one does not produce value; the market values what one produces... Wages are paid for the value of what the workman produces. There must be some balancing of the factors of production. One should not fix one’s eye too narrowly on the way the individual entrepreneur apportions his expenses. One cannot apply an additive process and find a picture of the whole economy. The older economists thought on the grand scale. Take this notion of the universality of diminishing returns, of diminishing productivity. The individual entrepreneur is relatively disadvantaged if he oversupplies himself with one factor. Following Von Thünen, modern economists, assuming land and machinery are given, draw decreasing productivity curves to labour. But what significance does this have? To what extent is this diminishing productivity a matter of the individual firm? Would integration give a good social picture?

In other words, capital deepening and the shape and productivity of the isoquants associated with a move across an aggregate Cobb-Douglas production function, are being driven by both the past growth of output and the expected increase

¹³ In value terms, giving rise to increased output being *imputed* to labour in higher wages even though the cause of rising labour productivity/scarcity lies elsewhere; see below.

and pattern of demand that increasing incomes induce. This favours labour-intensive or capital-intensive goods and services according to differing elasticities of demand and relative product prices – in turn determined by relative elasticities of factor supplies in response to the demands.¹⁴

But many inherently labour-intensive services have high income elasticity of demand. Partly this is because of the nature of services like education and health.¹⁵ Partly it is because Youngian increasing returns involve a thickening of the trade and exchange nexus (as stressed by Yang 2003) that requires labour-intensive services such as transport and communications, as well as training and research. Significantly, although their costs per unit also fall with labour-saving innovation, as a share of GDP they tend to rise because of their income-elastic demand. Thus the derived demand for labour may increase on account of demand-side forces even if there is an induced labour-saving innovation bias. The growth of services has been greatest in the more advanced countries where most of the world's inventive activity occurs. This provides another Youngian demand-side explanation for relatively constant factor shares and return to investment. Single-product or “corn” models of growth (including Solow's¹⁶) cannot explain this.

¹⁴ Young's (1928:540-42) appendix explains the italicised *problem* of breaking free of a conventional equilibrium of costs and benefits to secure an equilibrium rate of *potential* increasing returns. He invokes a special isoquant and indifference map, with different (reciprocal) sectoral supply and demand elasticities. Then: “To diminish the amount of the one commodity which must be sacrificed for a given increment of the other, some of the labour hitherto devoted to its production must be used indirectly, so that the increase of the annual output of the one lags behind the curtailing of the output of the other.”

¹⁵ But Japan has made great advances with robots (as well as computers) to replace humans in these fields. (On “machine slavery”, Young [in Mehrling and Sandilands (1999:243)]) wrote: “One way, perhaps the most important way, out of the admitted evils of the machine system is through the more thorough utilization of the possibilities of that system.”)

¹⁶ However, cf. Solow (1958) on constancy of relative shares. He considers sectoral differences in the elasticity of substitution as factor price ratios change, but not the bias of technical progress or sectoral differences in demand elasticities. See also his conference speech in this volume.

Incidentally, a growth model that explicitly separates the fixed supply of classical Land (claiming classical Ricardian rents) from the elastic supply of capital (claiming interest), would argue for a bias toward land-saving innovations. Without these, the “free” gifts of Nature command higher transfer payments to whomsoever can claim property rights over them. Similarly, separating skilled and unskilled labour, a growing relative demand for skills may induce a bias in favour of skill-saving innovation.

Ultimately, to repeat, factor incomes are not so much the result of the value of their *contributions* to the growth of GDP. Rather they are what the market *attributes* or *imputes* to them through the forces of supply and demand. Thus, when searching for the sources of growth, Samuelson (1980:502) surely misleads policy when he writes, on the basis of the Solow model, that “a 1% increase in labour increases output by 3 times as much as a 1% increase in capital, if the exponent on L is 0.75.”

This could induce misplaced complacency toward population growth and rapid immigration. It is macroeconomic supply and demand as well as physical productivity that determines factor payments and shares. Factors must have scarcity as well as productivity if firms are to pay them well. The market distributes the fruits of economic progress accordingly, in the form of pecuniary external benefits, with factors paid not for what they contribute but rather on how far competition and mobility reduce prices and induce factors to move to where they are most valued. Pecuniary externalities are thus inherent in a successful market system, not a sign of its failure. Failure comes from monopoly¹⁷ and protectionist elements, including excessively strong patents – which Young (1990:52) opposed. For, to repeat, it is not knowledge per se that matters but the freedom to apply knowledge as and when it

¹⁷ As distinct from *monopolistic competition*, insofar as this is central to increasing specialization and differentiation inherent in the phenomenon of increasing returns.

pays, which depends on the fastest possible growth of market size and specialisation – not upon the largest size of the firm or industry as stressed by neo-Schumpeterian and neoclassical endogenous growth theories.

Conclusion

Ultimately then (as Currie 1997 insisted) the main sources of growth are competition, mobility, and growth itself. But perhaps the contrast with recent neoclassical theorising may best be inferred from Young's own conclusion to an essay entitled "The sources of wealth":

Science teaches how to harness nature, and to use her powers for our own needs. For a short time, the advance of scientific knowledge may be "capitalized" in the form of valuable technical secrets, or in patent rights, but, in the long run, scientific knowledge, of whatever sort, becomes diffused. We pay no rent, interest or royalty to science as such. We merely have to pay for the technical equipment, for the capital, which is required if we are to make effective use of our accumulated fund of scientific knowledge. Appraised by his real contributions to wealth and welfare, not in dollars and cents, the scientist may easily outrank the millionaire or the captain of industry. His contributions to society's capital are, in general, free. For that reason, they do not fall under the ordinary laws of supply and demand. There is no limitation of supply; there is no question of a larger or a smaller number of increments of supply. The scientist's contribution is, or becomes, a free good. Just because it is diffused and free, its *apparent* utility to society may be less. Ordinary capital, in order to have value, must have both utility (productivity) and scarcity. The scientist's contribution has productivity without scarcity (Young 1929:237).

In short, *attributions* (payments) to factors under increasing returns have only tenuous links with *contributions* to growth. Young's vision was thus an extension of "one of the most illuminating and fruitful generalisations which can be found anywhere in the whole literature of economics" (1928: 529), namely Smith's dictum that the division of labour is limited by the size (and, one must add, the freeness) of the market. While modern growth theory focuses on the microeconomic foundations of neoclassical growth theory by noting how entrepreneurs allocate resources to innovation according to a profit-maximizing balancing of private costs and benefits

that may also yield external benefits, Young's more classical approach stresses the macro foundations of microeconomics. The dynamic creative function of markets induces productivity-enhancing specialization and roundabout methods that yield self-sustaining macroeconomic increasing returns to which entrepreneurs respond in ways that defeat the otherwise self-exhausting accumulation process. Young's approach converts the economics of scarcity and diminishing returns into the economics of opportunity and increasing returns.

References

- Ades, Alberto F. and Edward L. Glaeser. 1999. Evidence on Growth, Increasing Returns, and the Extent of the Market. *Quarterly Journal of Economics* August:1025-45.
- Aghion, Philippe. and Peter Howitt. 1998. *Endogenous Growth Theory*, Cambridge, MA: The MIT Press.
- Arrow, Kenneth J. 1962. The Economic Implications of Learning by Doing. *Review of Economic Studies* XXIX:155-73.
- Baumol, William J. 2002. *The Free-Market Innovation Machine*. Princeton: Princeton University Press.
- Boianovsky, Mauro. 2008. *Some Swedish Stepping Stones in Growth Economics*. Mimeo, Duke University conference.
- Buchanan, James M. and Yong J. Yoon. 1999. Generalized Increasing Returns, Euler's Theorem and Competitive Equilibrium, *History of Political Economy* 31.3:511-523.
- Buchanan, J.M. 2008. Let Us Understand Adam Smith. *Journal of the History of Economic Thought* 30.1:21-28.
- Chandra, Ramesh. 2006. Currie's "Leading Sector" Strategy of Growth: An appraisal. *Journal of Development Studies* 42.3:490-508.
- and Sandilands, Roger J. 2006. The Role of Pecuniary External Economies and Economies of Scale in the Theory of Increasing Returns. *Review of Political Economy* 18.2:193-208.
- Clark J. B. 1899. *The Distribution of Wealth*. New York: Macmillan.

- Cobb, Charles and Paul Douglas. 1928. A Theory of Production. *American Economic Review* supplement (March):139-65.
- Currie, Lauchlin. 1981. Allyn Young and the Development of Growth Theory. *Journal of Economic Studies* 8.1:52-60.
- 1997. Implications of an Endogenous Theory of Growth in Allyn Young's Macroeconomic Concept of Increasing Returns. *History of Political Economy* 29(Fall):414-443.
- Ely, Richard T., Thomas S. Adams, Max O. Lorenz, and Allyn A. Young. 1908. *Outlines of Economics*. New York: Macmillan.
- Fellner, William J. 1961, Two Propositions in the Theory of Induced Innovations. *Economic Journal* LXXI(June):305-308.
- Frankel, M. (1962), The Production Function in Allocation and Growth: A Synthesis. *American Economic Review* 52.5:955-1022.
- Kaldor, Nicholas. 1972. The Irrelevance of Equilibrium Economics. *Economic Journal* 82:1237-55.
- Kennedy, Charles. 1964. Induced Bias in Innovation and the Theory of Distribution, *Economic Journal* LXXI:514-47.
- Krugman, Paul. 1990. *Rethinking International Trade*. Cambridge, MA: The MIT Press.
- 1993. Toward a Counter-Counterrevolution in Development Theory. *Annual Conference on Development Economics 1992*. Washington, DC: The World Bank: 15-38.
- Laidler, David. 1993. Hawtrey, Harvard and the Origins of the Chicago Tradition. *Journal of Political Economy* 101 (December): 1068-1103.
- Lewis, Arthur. 1954. Economic Development with Unlimited Supplies of Labour. *Manchester School* 22(May):139-91.
- Marshall, Alfred. 1920. *Principles of Economics*. London: Macmillan.
- Mehrling, Perry G. and Roger J. Sandilands, eds. 1999. *Money and Growth: Selected papers of Allyn Abbott Young*. London and New York: Routledge.
- Newman, Peter. 1987. Allyn Abbott Young. In *New Palgrave Dictionary of Economics*, New York: Palgrave Macmillan. V.4:937-40.
- Romer, Paul M. 1989. Capital Accumulation in the Theory of Long-Run Growth. In *Modern Business Cycle Theory* edited by Robert J. Barro. Cambridge, MA: Harvard University Press: 52-127.

- 1994. The Origins of Endogenous Growth. *Journal of Economic Perspectives* 8.1:3-22.
- Samuelson, Paul A. 1965. A theory of Induced Innovation on Kennedy-von Weisäcker Lines. *Review of Economics and Statistics* 47.4:343-56.
- 1966. Rejoinder. *Review of Economics and Statistics* 48.4:444-48.
- 1980. *Economics*. 11th ed. New York: McGraw-Hill.
- Sandilands, Roger J. 1990. *The Life and Political Economy of Lauchlin Currie: New Dealer, Presidential Adviser and Development Economist*. Durham, N.C.: Duke University Press.
- 1999. New Evidence on Allyn Young's Style and Influence as a Teacher. *Journal of Economic Studies* 26.6:453-79.
- 2000. Perspectives on Allyn Young in Theories of Endogenous Growth. *Journal of the History of Economic Thought* 22.3:309-28.
- Solow, Robert M. 1956. A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics* 70(February):65-94.
- 1957, Technical Change and the Aggregate Production Function. *Review of Economics and Statistics* 39(August):311-320.
- 1958. A Sceptical Note on the Constancy of Relative Shares. *American Economic Review* 48(September):618-31.
- 1994. Perspectives on Growth Theory. *Journal of Economic Perspectives* 8.1:45-54.
- Stiglitz, Joseph E. 2006. Samuelson and the Factor Bias of Technological Change. In *Samuelsonian Economics and the Twenty-First Century*, edited by Michael Szenberg et al. Oxford: Oxford University Press: 235-251.
- Thirlwall, Anthony P. 1987. *Nicholas Kaldor*. New York: New York University Press.
- Warsh, David. 2006. *Knowledge and the Wealth of Nations: A story of economic discovery*. New York & London: W.W. Norton.
- Yang Xiaokai and Jeff Borland 1991. A Microeconomic Mechanism for Economic Growth. *Journal of Political Economy* 99.3:460-82.
- Yang, Xiaokai. 2003. *Economic Development and the Division of Labour*. Oxford: Blackwell.
- Young, Allyn A. 1913. Pigou's Wealth and Welfare. *Quarterly Journal of Economics* 27.4: 672-86.

----- 1928. Increasing Returns and Economic Progress. *Economic Journal* 38(December):527-542.

----- 1928a. Supply and Demand. From *Encyclopaedia Britannica*, in Mehrling and Sandilands 1999: 143-46.

----- 1929. The Sources of Wealth. From *The Book of Popular Science*, in Mehrling and Sandilands 1999: 231-38.

----- 1990, Nicholas Kaldor's notes on Allyn Young's LSE lectures, 1927-29. *Journal of Economic Studies* 17.3/4:18-114.

Zhang, Yongsheng and Xueyan Zhao. 2004. Testing the Scale Effect Predicted by the Fujita-Krugman Urbanization Model. *Journal of Economic Behaviour and Organization* 55.2:207-22.