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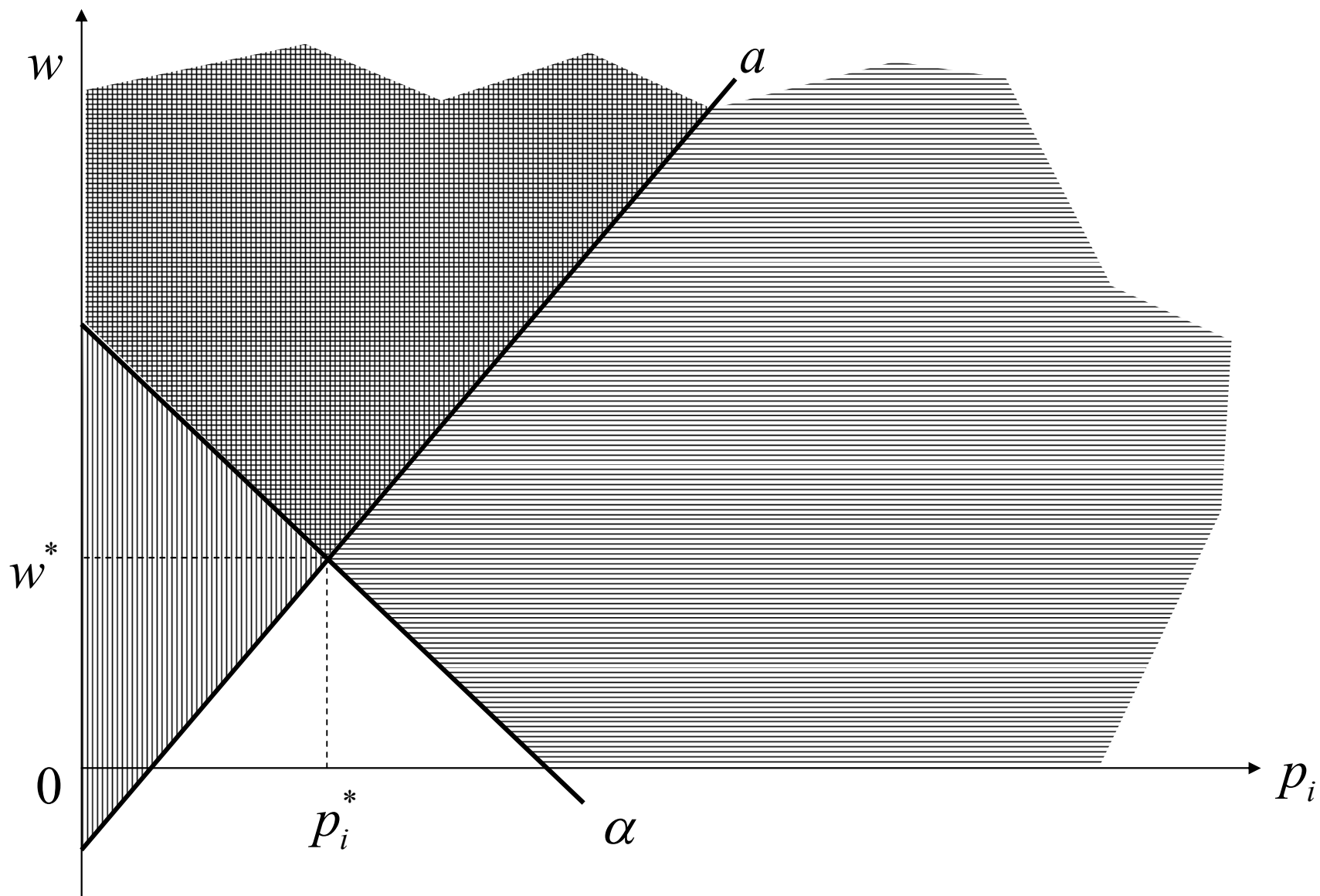


Fig. 1

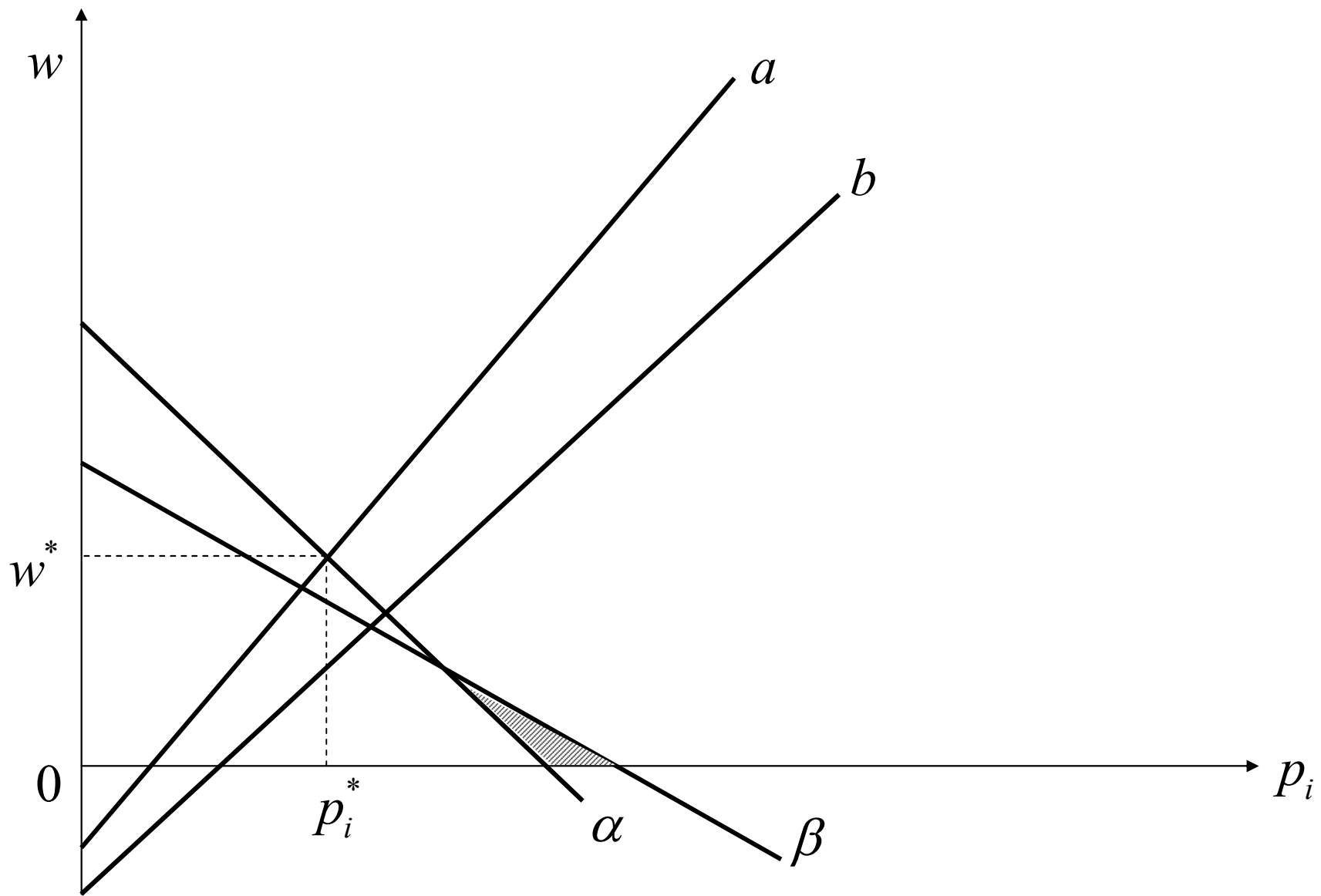


Fig. 2

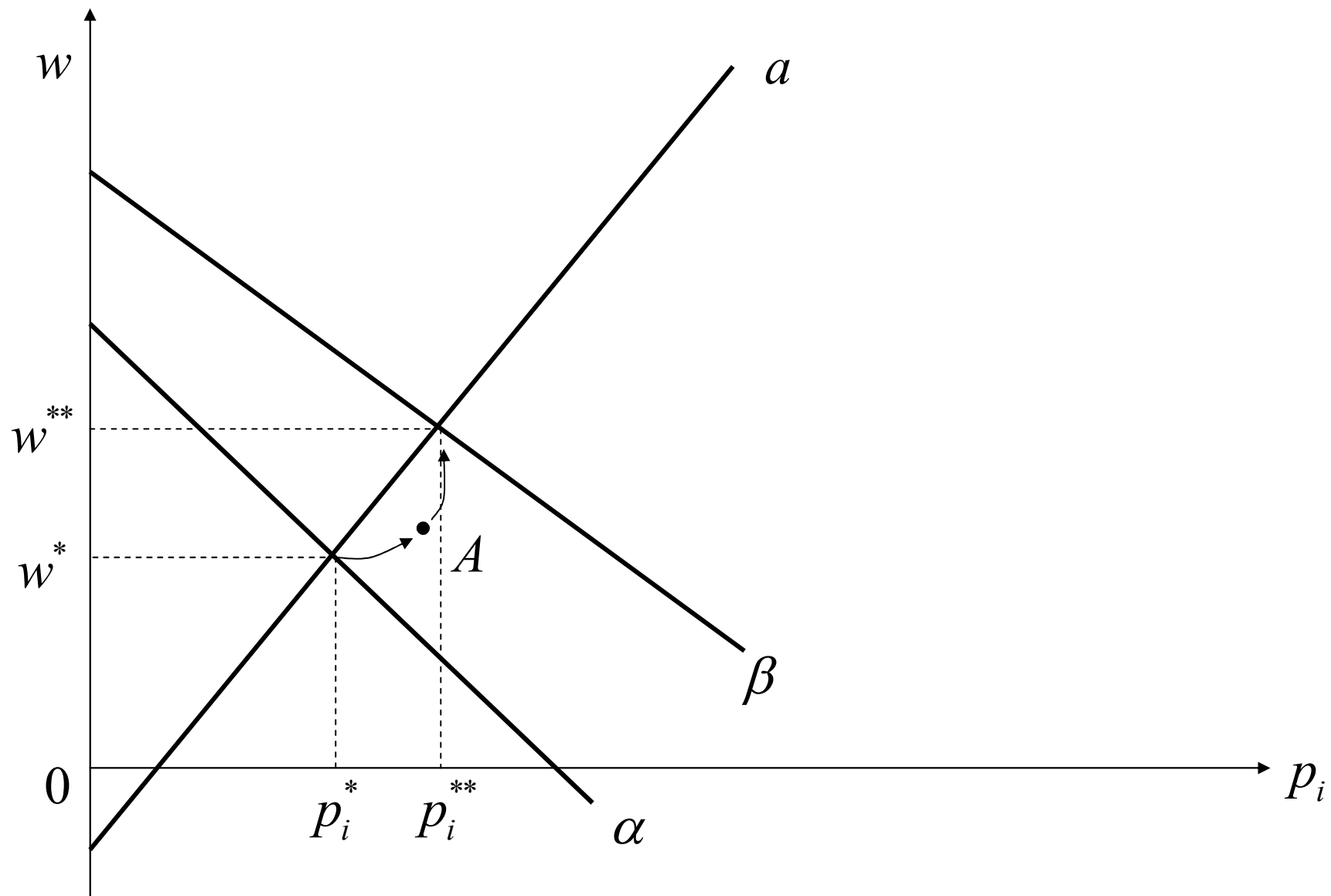


Fig. 3

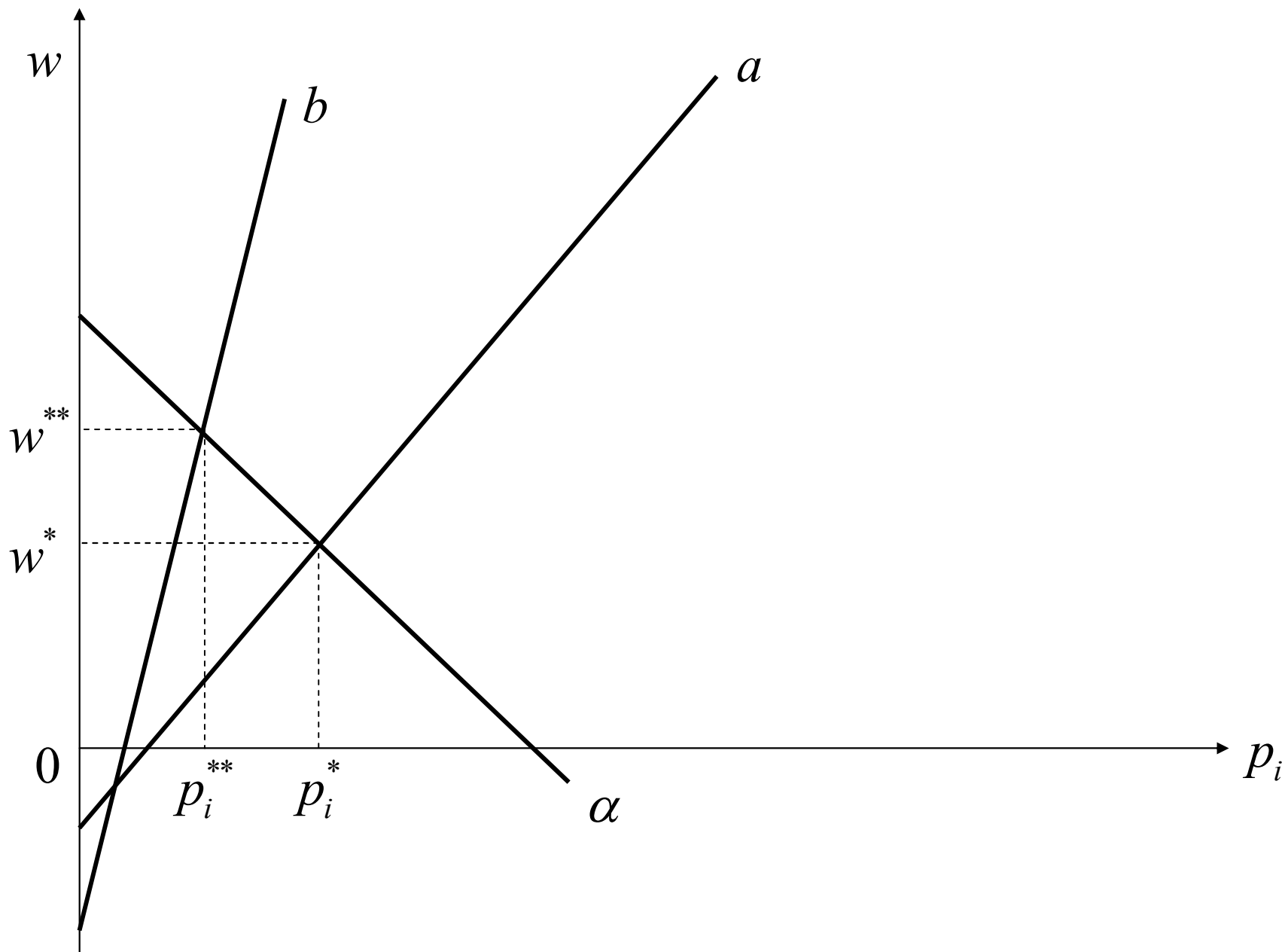


Fig. 4

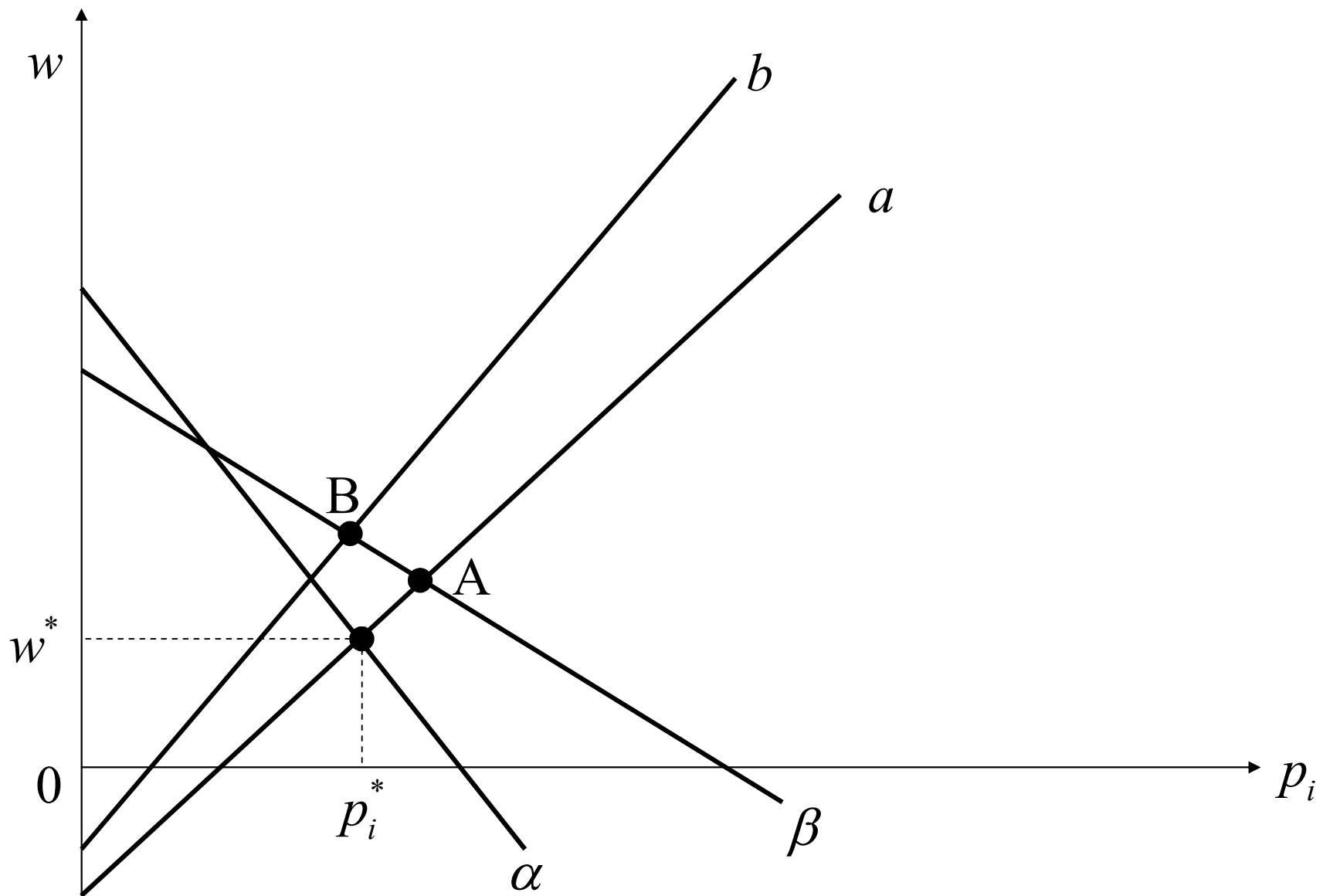


Fig. 5

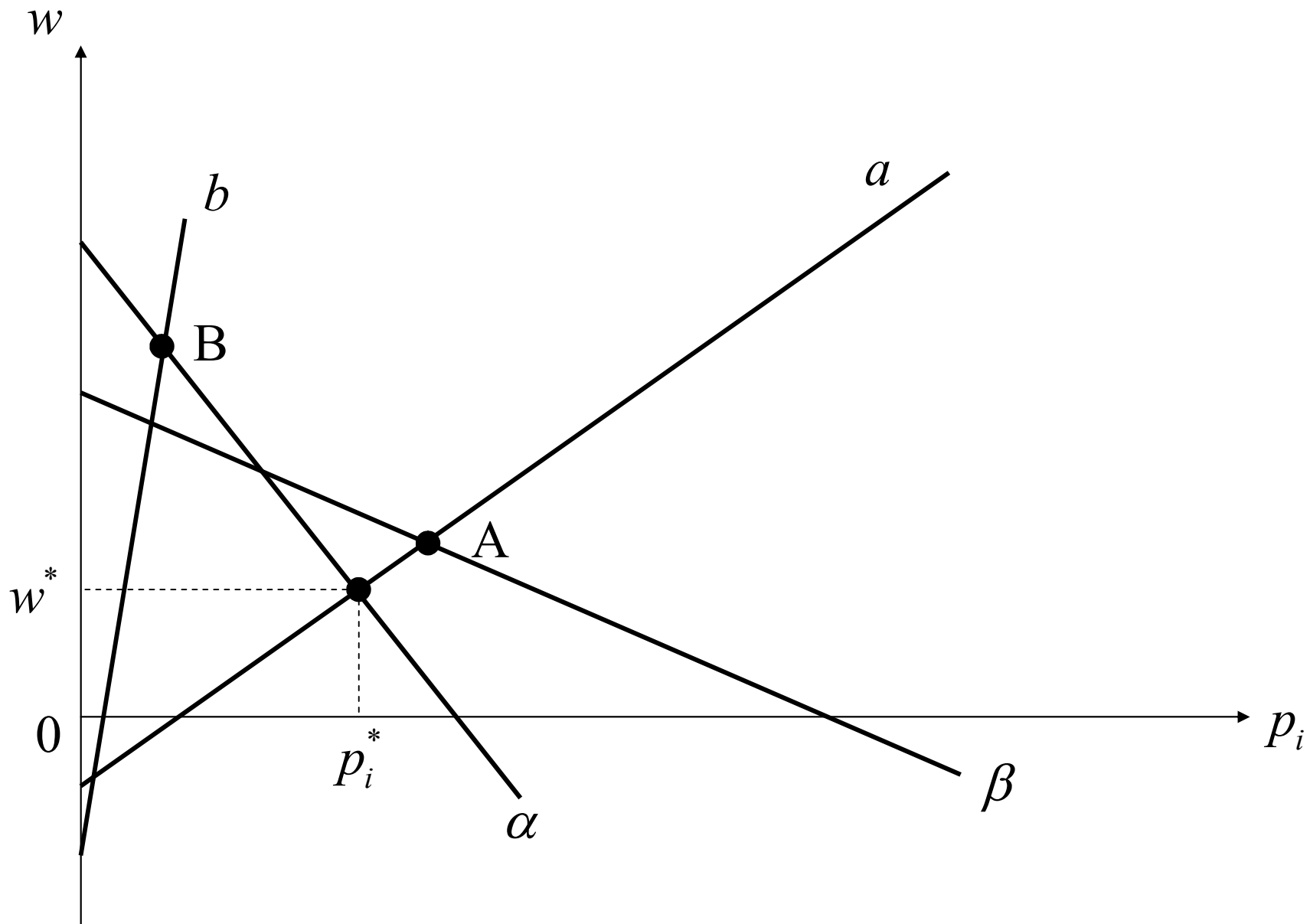


Fig. 6

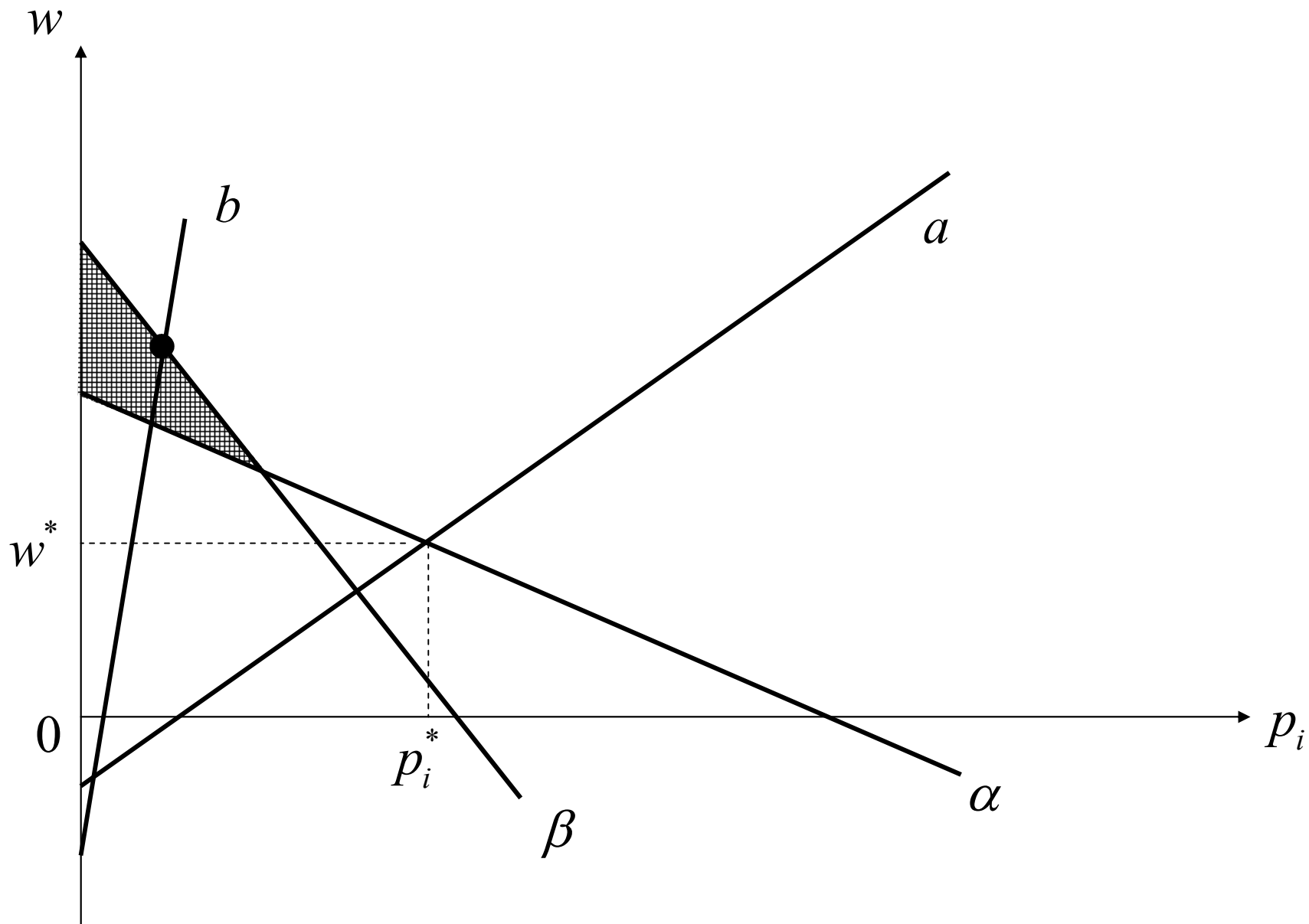


Fig. 7

Innovations and Profits

Schumpeter and the Classical Heritage

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Abstract

The paper discusses the problem of innovations and profits from a Schumpeterian perspective using the analytical tools of modern classical economics. The concept of “circular flow” is formalised and Schumpeter’s zero-profits assumption investigated. Next a typology of process innovations is discussed using a simple two-sector framework. In Schumpeter profits are transitional phenomena. In the conditions contemplated, increases in labor productivity will lead to rising real wages. The argument is generalized to product-cum-process innovations in systems with joint production where a bad that is costly to dispose of is transformed into a good that can be marketed profitably.

JEL classification: B12; B31; D33; E23; O1; O31; O33

Keywords: Classical economics; Competition; Inventions; Innovations; Profits; Schumpeter; Technical progress; Unintended consequences; Wages; Waste disposal

1. Introduction

Joseph Alois Schumpeter was a most attentive student of the history of economic analysis. He was brought up in the Austrian tradition of doing economics which typically consisted in first studying meticulously the received doctrines and their historical roots in the particular field under consideration, followed by an elaboration of the author’s own view on the matter. A particularly impressive case in point is Eugen von Böhm-Bawerk’s two-volume *Kapital und Kapitalzins* (Böhm-Bawerk, [1885, 1889] 1959). While the first volume is devoted to a critical account of earlier and contemporary theories of capital and interest, in the second volume Böhm-Bawerk develops his own “positive” theory. Schumpeter had studied with Friedrich von Wieser, Eugen von Philippovitch and Eugen von Böhm-Bawerk in Vienna and had acquired an intimate knowledge of their contributions. However, he hardly ever simply

adopted an idea without adapting it to the specific purpose at hand. And he was not reluctant to oppose doctrines advocated by his former teachers when he felt they were flawed. He thought that the answer Böhm-Bawerk (and other Austrians) had given to the most heatedly debated question of the time – Why are there profits, are they due to “exploitation”, as the socialist critics of capitalism maintained, and what determines their magnitude? – was at best incomplete if not outright wrong. Böhm-Bawerk, Schumpeter implied, had not really grasped the nature of capitalism.

Did the contributions of other authors fare better? Léon Walras’s general equilibrium theory the young Schumpeter (1908) had praised as the *Magna carta* of economics, but as time went by his admiration for the Lausanne economist’s achievements shrunk. Ironically, he kept him in high esteem essentially for allegedly having analysed an economic system, the so-called “circular flow”, in which the *differentia specifica* of capitalism, profits and interest are absent. The classical economists are given slightly better marks. The only author who, according to Schumpeter, deserves to be credited with having grasped at least elements of the capitalist mode of production and its inherent dynamism was Karl Marx. The latter figures prominently in Schumpeter’s interpretative and constructive work even and occasionally especially when there are no direct references to him.

This paper takes a fresh look at Schumpeter’s theory of economic development and corrects some of the received views on it. It does so against the background of the modern formulation of the classical theory of value and distribution (Sraffa 1960).¹ In this way the specificity of Schumpeter’s explanation of profits can be brought to the fore and the relationship between his analysis and that of the classical economists clarified. While Schumpeter was close to the latter in many respects, in his theory of economic development he retained the position of methodological individualism and explained economic change not as the outcome of systemic pressures on agents due to competition, conceived as rivalry, but as the consequence of the volitions and actions of a particular group of men and women, “entrepreneurs”.

¹ Schumpeter and Sraffa were in contact with each other and Schumpeter variously expressed the high opinion he had of his younger Italian colleague. For example, Sraffa’s papers (1925, 1926) Schumpeter (1954, p. 1047, fn. 54) called a “brilliantly original performance”.

2. Schumpeter on the classical authors and Marx

In *Theorie der wirtschaftlichen Entwicklung* Schumpeter identifies Léon Walras as the main representative of the “static point of view”. Interestingly, he attributes an essentially static perspective also to his Austrian peers (Schumpeter 1912, p. 100; the book was actually published already in 1911). Adam Smith is credited with having undertaken probing steps into the as yet uncharted territory of economic dynamics, which, alas, did not get him very far because of a lack of imagination and analytical rigour. Whenever Smith talks of economic progress he is said not to explain it in terms of the economic process itself (i.e., *endogenously*). In the English version of his *magnum opus* Schumpeter (1934, p. 60) insists boldly that “economic theory in the traditional sense contributes next to nothing” to an explanation of the all-important phenomenon of economic and social development. There is a single exception worth mentioning: “Only Marx ... has tried to deal with the development of economic life by means of economic theory ... and always does his attention focus on the aim to understand the development of economic life as such and not only of its circular flow” (1912, p. 98; my translation). Unfortunately, the reader is told neither wherein precisely Marx’s merits lie, nor how Schumpeter’s own approach compares with Marx’s. The situation does not change much in subsequent editions of the book, yet in all of them Marx is praised for his respective achievements. Schumpeter (1934, p. 60 n) actually writes about his own novel conception of the economic process, that it “overcomes a series of fundamental difficulties and thus justifies the new statement of the problem.” Interestingly he adds (p. 60 n): “This statement of the problem is more nearly parallel to that of Marx. For according to him there is an *internal* economic development and no mere adaptation of economic life to changing data.” Then follows the remarkable adjunct: “But my structure covers only a small part of his ground.” Schumpeter was not exactly known for his modesty, but here, at least, he displays a fair amount of it.

3. The classical view of innovations and competition

Schumpeter’s assessment of the classical economists’ achievements, or rather lack thereof, regarding the explanation of socio-economic change is difficult to sustain. His approach to the problem at hand is in some respects much closer to their analyses than he and many of his

followers would admit. Adam Smith (1776), for example, depicted such change consistently as endogenous; think of his discussion of the fall of the Roman empire. Such diverse commentators as Ronald Coase (1976) and Richard Nelson (2005) therefore dubbed him one of the first “evolutionary” economists. Here it suffices to draw attention to two closely interrelated aspects of Smith’s analysis. The first concerns the tendency for the rate of profits to uniformity despite ongoing technological change, the second the establishment of what nowadays are called research and development activities as an integral part of an ever deeper division of social labor. According to Smith, modern society is characterized by continuous innovations. He emphasized the uncertainty associated with the introduction of new goods and new techniques and insisted that due to competition there will be a long-run tendency towards a uniform rate of return on the capital invested across all sectors of the economy:

The establishment of any new manufacture, of any new branch of commerce, or of any new practice in agriculture, is always a speculation, from which the projector promises himself extraordinary profits. These profits sometimes are very great, and sometimes, more frequently, perhaps, they are quite otherwise; but in general they bear no regular proportion to those of the other old trades in the neighbourhood. If the project succeeds, they are commonly at first very high. When the trade or practice becomes thoroughly established and well known, the competition reduces them to the level of other trades. (Smith 1776, *WN*, I.x.b.43)

The tendency towards a uniform rate of profits in competitive conditions was seen to result from the mobility of capital (and labor) and the ensuing process of “gravitation” of “market” prices to their “natural” levels. Schumpeter essentially endorsed this view (see below).

Smith stressed that improved machinery is not only due to what Nathan Rosenberg was to call “learning by using,” but is often the result of research and development:

All the improvements in machinery ... have by no means been the inventions of those who had occasion to use the machines. Many improvements have been made by the ingenuity of the makers of the machines, when to make them became the business of a peculiar trade; and some by that of those who are called philosophers or men of speculation, whose trade it is, not to do anything, but to observe every thing; and who, upon that account, are often capable of *combining together the powers of the most distant and dissimilar objects*. In the progress of society, philosophy or speculation

becomes, like every other employment, the principal or sole trade and occupation of a particular class of citizens. (*WN*, I.i.9; emphasis added)

The combinatoric metaphor as an abstract description of the innovation process is thus already (or also) to be found in Smith. The idea that the existing particles of knowledge can be newly combined in order to generate new particles of economically useful knowledge recurs in Schumpeter's concept of "new combinations" (see below). It underlies also Martin Weitzman's recent concept of "recombinant growth" (Weitzman, 1998).

David Ricardo fully subscribed to this view of Smith's. He wrote: "He, indeed, who made the discovery of the [new] machine, or who first usefully applied it, would enjoy an additional advantage, by making great profits for a time," but, he added, "in proportion as the machine came into general use, the price of the commodity produced, would, from the effects of competition, sink to its cost of production" ([1817] 1951, p. 387). As a consequence, profitability would again tend to equality. Ricardo also had a clear understanding of the fact that, in general, new technical knowledge cannot for long periods of time be monopolized; typically, it sooner or later becomes a "general good" (p. 386) that is non-excludable and non-rival. It is the process of *diffusion* and *imitation* of a new method of production, enforced by competition, that renders what at first was a purely private good a public one.

A discussion of Marx's contribution is beyond the scope of this paper. We rather focus on a remarkable difference between the views of the classical economists and especially Marx on the one hand and Schumpeter on the other as regards the main source of innovations and economic change. Marx stressed that a capitalist who introduces a new and superior method of production can sell the commodities "above their individual, but under their social value ... This augmentation of surplus-value is pocketed by him"; therefore there is *always* "a motive for each individual capitalist to cheapen his commodities, by increasing the productiveness of labour" (Marx 1967, p. 317). For fear of one of the rivals gaining a competitive advantage that endangers his or her existence, to innovate is not something left to the individual capitalist's option, but is an existential must, enforced by competition. Modifying a famous dictum of Marx, we might say: "Innovate, innovate! This is Moses and the prophets." A systemic characteristic is responsible for the permanent revolution of the types and qualities of goods produced, of the methods of production used and of the ways in which firms and markets are organized. The "coercive law of competition," of which Marx spoke, compels producers incessantly to introduce new methods in order to escape their competitors in given

markets or new types or qualities of goods in order to escape them in newly established markets.² Competition means rivalry, and in it only the successful innovator will survive. Innovations are not the result of a particular inclination of a group of people characterized by exceptional capabilities; they are rather the result of a behavior of agents shaped and enforced by competitive pressures. Exceptional skills and capabilities are commonly advantageous in the battle of survival; they are not, however, the prime mover of development.³ The impulse comes from the institutional characteristics of the capitalist economy and translates itself into the aspirations and actions of people. In the struggle with their “inimical brothers”, their competitors, capitalists are compelled to innovate on penalty of their own ruin. The competitive capitalist economic system, one might say without too great a stretch of the imagination, “breeds” a particular brand of leaders, entrepreneurs.⁴ One might also put it in the following way: the entrepreneurial impulse may be seen as an expression of evolved human behavior that pre-dates capitalist innovation, and thus is a necessary but not sufficient condition for the specific kind of innovative activity under consideration.⁵

² See also Smith who insisted that “universal competition ... forces every body to have recourse to [good management] for the sake of self-defence” (I.xi.b.5).

³ Adam Smith stressed, “The difference of natural talents in different men is, in reality, much less than we are aware of; and ... is not upon many occasions so much the cause, as the effect of the division of labour. The difference between the most dissimilar characters ... seems to arise not so much from nature, as from habit, custom, and education” (I.ii.4). Smith’s view gets some support, for example, from Howe (1999) who argues that geniuses do not form a breed apart but are first and foremost the result of a unique set of circumstances and opportunities.

⁴ In this context it is perhaps worth recalling that according to some economic historians the usury rule helped to nourish a spirit of entrepreneurship by discriminating against certain legal forms in which financial transactions were clothed. In particular, instead of arranging for a loan the provider and user of a loan might form a partnership, which would put the burden of entrepreneurship also on the financier.

⁵ I am grateful to one of the referees for suggesting to distinguish between necessary and sufficient conditions for the innovation process.

Schumpeter's view reflects his "methodological individualism", a term he coined (Schumpeter 1908). He, too, is concerned with explaining *endogenous* economic and social change. However, in his view it is not so much a systemic cause that keeps generating change from within the economic system; it is rather the existence of "a second type of economic action". In addition to the genotype of "hedonic" or "static" men and women there is the genotype of "energetic" or "dynamic" ones, which is much smaller in number and constitutes an "elite". The latter genotype is said to be the "*agens*" of economic development. Given this postulate, it is unclear how there could ever be a situation, such as the circular flow, in which the genetic predisposition of the leaders does not make itself felt. As Kuznets (1940; see also Rieter 1985) remarked drily with regard to Schumpeter's concept of long waves (1939), the whole story boils down to the assumption that Schumpeter's heroes (and heroines), entrepreneurs, are getting tired about every fifty years.

Among the best known elements of Schumpeter's doctrine of economic change is his list of five types of "new combinations":

- (1) The introduction of a new good ... or of a new quality of a good.
- (2) The introduction of a new method of production ... which need by no means be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity commercially.
- (3) The opening of a new market, that is a market into which the particular branch of manufacture of the country in question has not previously entered ...
- (4) The conquest of a new source of supply of raw materials or half-manufactured goods ...
- (5) The carrying out of the new organisation of any industry, like the creation of a monopoly position (for example through trustification) or the breaking up of a monopoly position. (1934, p. 66)

The five cases referred to are to be found already in the earlier, especially German, literature, (see Streissler 1994). The role of the entrepreneur, seen as leader, was emphasized, for example, by Schumpeter's teacher Wieser, and the importance of swarms of imitators for propagating the initial innovative impulse was stressed by several authors. Marx's account of the way capitalism develops comprises practically all the items contained in Schumpeter's list and considers innovation as a major weapon in the competitive struggle (1972, pp. 285-90). Social change, Marx insisted, was both an instrument and a consequence of that struggle.

We now turn to Schumpeter's concept of "circular flow", the starting and end point of his

analysis of change. The “law of motion” of modern society, as Schumpeter saw it, unfolds in leaps and bounds. Economic development takes place in the transitory phase leading from one circular flow to another one until the system has fully absorbed the innovative shock.

4. Schumpeter’s concept of “circular flow”

Commentators have variously pointed out historical predecessors of Schumpeter’s concept of circular flow, in particular François Quesnay’s *Tableau Économique* and Karl Marx’s scheme of simple reproduction. The concept was at odds with Böhm-Bawerk’s view of production as a linear process of final duration starting from original factor services and maturing in consumption goods. It rather followed Wieser’s input-output view of social production (1884, p. 50).⁶ The concept of a self-reproducing economic system was a powerful tool of analysis from William Petty to Marx. However, before Schumpeter the concept was hardly ever meant to refer to an actual and recurrent state of the economy. The system experienced was subject to continuous change in size and form from within. In earlier authors the concept was rather an analytical device designed to render precise one of their main analytical concepts: that of the “difficulty of production” of a commodity. This in turn contained the key to the most basic version of the concept of value in these authors.

The simplest case conceivable of a circular flow is an economy that is just able to reproduce what has been used up in the course of production (see Sraffa 1960, chap. I). This economy produces for the sustenance of its population but does not generate a “social surplus”. The system of price equations corresponding to such an economy are linear and homogeneous and therefore only relative prices can be determined. Further, only $n - 1$ of the n equations are independent of one another. This is enough to determine $n - 1$ relative prices. The important finding is that the given socio-technical relations of production and productive consumption rigidly fix relative values. These values depend exclusively on necessities of production. They are the only ones that allow the replication of the initial distribution of resources and thus of the circular flow.

⁶ Schumpeter generally followed more in the footsteps of Wieser than Böhm-Bawerk. He disputed, for example, Böhm-Bawerk’s postulation of a positive rate of time preference independently of the socio-economic environment. Against this Wieser had already objected that such a rate is an implication and not a cause of a positive rate of interest.

Schumpeter did not restrict the concept of circular flow to systems without a surplus, but subsumed under it *all* systems except those in which there are profits and interest. A slightly more general expression of Schumpeter's concept starts directly from Walras's *Elements*, in Schumpeter's view the modern *locus classicus* of the concept of circular flow. Equations (4) in § 203 of Walras (1954, p. 240) are here presented using matrix notation:

$$\mathbf{P} = \mathbf{C}\mathbf{q} + \mathbf{L}\mathbf{w} + \mathbf{A}\mathbf{y} \quad (1)$$

where \mathbf{P} is the vector of prices of outputs, \mathbf{C} the matrix of land input coefficients (of the operated methods of production), \mathbf{q} the vector of prices of land services (rent rates), \mathbf{L} the matrix of labor input coefficients, \mathbf{w} the vector of wage rates, \mathbf{A} the matrix of capital input coefficients, and \mathbf{y} the vector of prices of the services of capital goods. If, following Ricardo, we take account only of the technology used at the margin (extensive or intensive) and assume that there is only one quality of labor and only circulating capital, we obtain

$$\mathbf{P} = \mathbf{w}\mathbf{l} + \mathbf{A}\mathbf{P}, \quad (2)$$

which is a system of n equations in $n + 1$ unknowns, where n is the number of products, some (or all) of which could be capital goods (\mathbf{l} is the vector of direct labor inputs). Expressing prices in terms of units of "labour commanded" (Adam Smith), that is $\mathbf{p} = \mathbf{P}/\mathbf{w}$, gives

$$\mathbf{p} = \mathbf{l} + \mathbf{A}\mathbf{p} \quad (3)$$

or

$$(\mathbf{I} - \mathbf{A})\mathbf{p} = \mathbf{l} \quad (4)$$

where \mathbf{I} is the $n \times n$ identity matrix. On the assumption that the inverse of matrix $(\mathbf{I} - \mathbf{A})$ exists, we can solve for \mathbf{p} :

$$\mathbf{p} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{l} = \mathbf{l} + \mathbf{A}\mathbf{l} + \mathbf{A}^2\mathbf{l} + \mathbf{A}^3\mathbf{l} + \dots \quad (5)$$

In the conditions under consideration relative prices are proportional to relative quantities of labor bestowed directly and indirectly upon the various commodities. Schumpeter (1934, p. 17) was well aware of this: "We can resolve all goods into 'labor ...' in the sense that we can conceive all goods as bundles of the services of labor ..." He concluded, "Hence, in an exchange economy ... the prices of all products must, under free competition, be equal to the prices of the services of labor ... embodied in them" (p. 30). The resulting system of relative values, he surmised, may be compared to the "genealogy of a mountain of experience"; the

values are the “rational consequences of the given conditions in the surrounding world” (p. 40).

In this paper I will not enter into a critical discussion of Schumpeter’s widely disputed view that in a stationary economy profits (and interest) are of necessity zero (see, therefore, Kurz 2005, pp. 42-53). I rather adopt his zero-profits premise regarding stationary conditions and focus attention on its implications in terms of a simple model with two commodities (Kurz and Salvadori 1995, chap. 3). The attention focuses on process innovations, but it will be unavoidable to touch also upon other types of innovations. The two-sector framework allows for a relatively rich typology of cases of inventions and innovations.

5. A two-sector example

The two commodities are called “corn” and “iron”, produced in “agriculture” and “industry”, respectively. There are constant returns to scale throughout the economy. We start from a given circular flow characterised, *inter alia*, by the employment of one process (or method) to produce corn and one process to produce iron. Table 1 summarizes the technical features of the two processes. Accordingly, a_{gf} ($f, g = c, i$) units of commodity f and l_g units of labor are needed to produce one unit of commodity g ; obviously, $a_{gf} \geq 0$ ($f, g = c, i$).

Table 1

	material inputs		labor	outputs	
	corn	iron		corn	iron
corn process	a_{cc}	a_{ci}	l_c	→ 1	–
iron process	a_{ic}	a_{ii}	l_i	→ –	1

For the most part of the argument both products are taken to be *basic products*; that is, each enters directly or indirectly into the production of all commodities (Sraffa, 1960, p. 8). This is the case if and only if

$$a_{ci}a_{ic} > 0. \quad (6)$$

With the product of the two coefficients being positive, each coefficient is strictly positive.

Corn is taken to be the only consumption good. The minimum consumption per unit of labor employed, or subsistence level of consumption, c_s , is given from the outside. The economy is

said to be *viable* if there are feasible activity levels of the two processes, q_c and q_i , such that

$$q_c \geq q_c a_{cc} + q_i a_{ic} + (q_c l_c + q_i l_i) c_s \quad (7a)$$

$$q_i \geq q_c a_{ci} + q_i a_{ii} \quad (7b)$$

$$q_c \geq 0, \quad q_i \geq 0, \quad q_c + q_i > 0. \quad (7c)$$

It will be assumed throughout that conditions (7) are met. The actual remuneration per unit of labor in terms of the consumption good, w , therefore satisfies the condition

$$w \geq c_s. \quad (8)$$

Schumpeter assumed *free competition* with regard to the circular flow, which presupposes the absence of significant barriers to entry in and exit from any given market. Let p_i be the price of one unit of iron in terms of corn; then the system of unit price equations is given by

$$a_{cc} + a_{ci} p_i + w l_c = 1 \quad (9a)$$

$$a_{ic} + a_{ii} p_i + w l_i = p_i \quad (9b)$$

with w and p_i as the unknowns.⁷ We may now illustrate this constellation by plotting each of the equations (9) in a (p_i, w) plane as in Figure 1. Note that the decreasing straight line α corresponds to the corn producing process, whereas the increasing one β corresponds to the iron producing process. The intersection between the two gives the wage rate w^* and the price of iron p_i^* ruling in the economy. (By assumption (8) $w^* \geq c_s$.)

Fig. 1

Next we define the concepts of “extra profits” and “extra costs”. Assume that a new method of producing corn (or iron) is made available.⁸ Producers will assess it against the background of the prices and wage rate ruling in the actual circular flow, w^* and p_i^* . While in the classical economists’ view stationarity of the economy did not *per se* imply the absence of

⁷ We know from the preceding section that with a zero rate of profits the price of iron in terms of corn, p_i , is equal to the ratio of the amounts of labor “embodied” respectively in one unit of iron and one unit of corn, that is, the ratio of labor values.

⁸ We will not discuss the generation of new technical devices in R&D departments of firms, as they are analysed, for example, in contributions to endogenous growth theory.

profits (see, e.g., Ricardo, *Works*, vol. I, p. 120, and Kurz and Salvadori 2006), things are different in Schumpeter. Consequently he referred to profits rather than extra profits, but the meaning is essentially the same: *above normal profits*. We shall henceforth use Schumpeter's concept.

Assume there is a new process, h , to produce corn described by the triplet $(a_{cc}^{(h)}, a_{ci}^{(h)}, l_c^{(h)})$, and/or a new process, k , to produce iron described by the triplet $(a_{ic}^{(k)}, a_{ii}^{(k)}, l_i^{(k)})$. (In accordance with our assumption that both commodities are, and will remain, basics, $a_{ci}^{(h)} > 0$, $a_{ic}^{(k)} > 0$, each h and each k .) With w^* and p_i^* as the ruling wage rate and iron price, processes $(a_{cc}^{(h)}, a_{ci}^{(h)}, l_c^{(h)})$ and $(a_{ic}^{(k)}, a_{ii}^{(k)}, l_i^{(k)})$ are said *to be able (not to be able) to pay profits* if

$$a_{cc}^{(h)} + a_{ci}^{(h)} p_i^* + w^* l_c^{(h)} < 1 \quad (\geq 1) \quad (10a)$$

$$a_{ic}^{(k)} + a_{ii}^{(k)} p_i^* + w^* l_i^{(k)} < p_i^* \quad (\geq p_i^*) \quad (10b)$$

and they are said *to incur (not to incur) extra costs* if

$$a_{cc}^{(h)} + a_{ci}^{(h)} p_i^* + w^* l_c^{(h)} > 1 \quad (\leq 1) \quad (11a)$$

$$a_{ic}^{(k)} + a_{ii}^{(k)} p_i^* + w^* l_i^{(k)} > p_i^* \quad (\leq p_i^*) \quad (11b)$$

respectively. The shaded area above the straight line giving the corn (iron) process in Fig. 1 concerns pairs of w and p_i for which the process exhibits extra costs. Similarly, the area below the straight line giving a process concerns levels of w and p_i at which the process exhibits profits. Since any corn (iron) process can be represented by a decreasing (increasing) line, we can *a fortiori* ascertain immediately the profit and extra cost areas relative to the process.

A new process that pays profits will be adopted. We may schematically describe what can be expected to happen as a consequence of its introduction and diffusion. (For a discussion of adjustment processes in the kind of model under consideration, see also Burgstaller 1994.) If the process invention is protected by a patent, prices and the wage rate are unchanged and the profits the innovator gets have the character of a differential rent. If the patent allows imitators to employ the new method, or if there is no patent, profit-seeking agents from the same or from the other industry will invest in the new method. This involves a change in output proportions, with the commodity in whose production the innovation has taken place becoming relatively abundant. As a consequence, its price relative to that of the other

commodity can be expected to fall. In classical political economy the adjustment process under consideration is referred to as the “gravitation” of “market” prices to their (new) “natural” levels.⁹ On the premise that the producers of the other commodity do not benefit from the change in prices, the wage rate increases along the straight line related to the process used by this industry, the rent of the innovators will gradually diminish and the producers in the industry, in which the innovation has taken place, who are not imitating will incur losses. Sooner rather than later they risk being driven out of the market. Schumpeter’s zero-profits condition in fact involves an extremely rapid transition to a new technique, whereas from a classical point of view the transition can be expected to be more sluggish because “static firms”, to use Schumpeter’s notion, survive longer.¹⁰ Via the channels indicated, the new method will gradually be generalized throughout the economic system and replace the old one.

Schumpeterian profits (as the extra profits of the classical economists) are a *transitional phenomenon* to be traced back to cost differentials between different methods of production used simultaneously. They are not due to the “scarcity” of capital, as marginal productivity theory maintains. What was perhaps not clear from the beginning but is now put into sharp relief is that Schumpeter’s zero-profits condition with regard to successive circular flows of the economy implies that in the last instance (and in the absence of scarce natural resources) the benefits of innovations go exclusively to workers in terms of higher real wages; it is a magnificent dynamics reflected in ever improving income levels of the population at large.

⁹ We may express this also using the concept of commodity rate of interest Sraffa (1932) introduced in his criticism of Hayek (1931). The market will expect that the supply of the commodity in which an innovation has taken place will increase relative to the supply of the other commodity. Accordingly the forward price will be below the spot price in the case of the former and above it in the case of the latter. This means that the commodity rate on the former will be higher than on the latter. In competitive conditions, this divergence of rates is but another aspect of the divergence of actual prices from new long-period prices and prompts the transition to the new circular flow.

¹⁰ In private correspondence, Donald Winch referred to the criticisms of Ricardo for believing in “instantaneous” adjustments of the stock market kind. Ricardo realised that this is not characteristic of industries with large capital investments, but also regarded the length of the adjustment process as due to the ignorance and irrationality of agents.

6. Inventions and innovations: a typology of cases

We may now illustrate in the (p_i, w) -plane various (classical and) Schumpeterian ideas. The point of reference is always the original circular flow characterised by $w = w^*$ and $p_i = p_i^*$. We begin with a discussion of inventions that will not become innovations.

(a) *Invention, but no innovation*

In Figure 2 it is assumed that there has been a process invention in agriculture that gives rise to the new straight line β . While the process incorporates new technical knowledge, cost-minimizing producers will not adopt it because at the ruling wage rate and price of iron the method exhibits extra costs. A similar case of an invention in the iron industry that does not become an innovation is given by the new method represented by the straight line b .

Fig. 2

New knowledge is therefore not *eo ipso* making its way into the economic system. Whether it does generally depends not only on how the new method compares with the one to which it is an alternative, but also on the method(s) of production employed in the other industries of the economy. The reason is that the methods *actually* in use determine the wage rate and the price(s) and *via* these variables decide whether a new method is cost-minimizing or not.

The two cases of inventions depicted in Fig. 2 differ in the following respect. While method b is inferior to method a for all non-negative levels of w and p_i , method β is inferior to method α only to the left of the point where the two straight lines corresponding to the two methods intersect, whereas to the right of this point it is superior (see the shaded area). The point of intersection gives the pair (p_i, w) at which both methods exhibit the same unit costs and are thus equiprofitable.¹¹

(b) *Innovation in agriculture*

¹¹ If the alternative methods in each industry were to be compared with one another at a non-zero level of the rate of profits, the ranking of the methods can be different. Hence, whether an invention will become an innovation, depends on income distribution. See Kurz and Salvadori (1995).

Figure 3 illustrates the case in which there is an innovation in agriculture. At the ruling levels of w and p_i , w^* and p_i^* , the new process β yields profits. Subtract from the unit costs associated with the old method, $a_{cc}^\alpha + a_{ci}^\alpha p_i^* + w^* l_c^\alpha$, the unit costs associated with the new one, $a_{cc}^\beta + a_{ci}^\beta p_i^* + w^* l_c^\beta$, in order to obtain profits per unit of output, π ,

$$\begin{aligned}\pi &= a_{cc}^\alpha + a_{ci}^\alpha p_i^* + w^* l_c^\alpha - a_{cc}^\beta + a_{ci}^\beta p_i^* + w^* l_c^\beta = \\ &= (a_{cc}^\alpha - a_{cc}^\beta) + (a_{ci}^\alpha - a_{ci}^\beta) p_i^* + (l_c^\alpha - l_c^\beta) w^* > 0.\end{aligned}$$

Fig. 3

Fig. 3 informs us also about the new *attractor* towards which the system can be expected to tend. It is given by the intersection of the line representing the new process in agriculture β with that of the old process in industry a . The wage rate will then be equal to w^{**} and the price of iron equal to p_i^{**} . Clearly,

$$w^{**} > w^* \quad \text{and} \quad p_i^{**} > p_i^*.$$

The price of iron will rise relative to that of corn because corn is produced at lower unit costs. In some absolute terms also iron will be produced at lower unit costs: the amounts of labor needed directly and indirectly in order to produce one unit of corn or one unit of iron will both be smaller. This result puts again in sharp relief Schumpeter's zero-profits assumption, which implies that in order for an invention to become an innovation it *must* reduce labor costs. This is not necessarily so in the case in which there is a positive rate of profits; a new method may be reducing unit cost even though it need not reduce the amount of labor embodied in the commodity. A consideration of this subset of possible cases is implicitly ruled out by Schumpeter. The kind of process innovations he allows for are invariably *labor saving*.

The diagram also reveals that as the wage rate and the price of iron tend to rise, producers still using the agricultural method α are progressively facing greater and greater losses and eventually will either have to adopt the new method or go out of business. In our schematic representation of the adjustment process caused by an innovation in Section 5 we have assumed for simplicity that producers in the industry in which no innovation takes place do not benefit from the wage and price dynamics triggered by the innovation. We may now briefly turn to the case in which this is not so. If the wage rate happens to increase along a curve that is *below* the straight line depicting the process of the iron industry but intersects the latter at the two long-period points, then producers in the iron industry benefit from the

innovation in agriculture. In Figure 3 the curve leading from the old to the new circular flow *via* point A illustrates the case under consideration. (Note that point A is necessarily below straight lines β and a and above the horizontal line going through w^* .) At the levels of w and p_i corresponding to point A, the following can be said: (a) innovator(s) introducing agricultural method β (and imitators following on their heels) reap profits per unit of output that (for the lower wage level) are larger than in the case in which the adjustment process of the wage rate were to follow the straight line of the iron process, (b) producers sticking to the obsolete method face losses that are smaller than in the alternative case, and (c) producers in the iron industry are temporarily getting some profits. Finally, it should be noted that the case discussed involves what Schumpeter in *Capitalism, Socialism and Democracy* dubbed “creative destruction”. Producers who have invested their capital in the old and now superseded method α suffer from the changes that take place.

(c) *Innovation in industry*

Figure 4 illustrates the parallel case of an innovation in the production of iron. In competitive conditions p_i is bound to fall, but w will invariably rise.

Fig. 4

(d) *Innovations in both sectors*

Figure 5 illustrates the case in which there is first an innovation in agriculture (method β). The resulting new circular flow is given by point A. Subsequently there is an innovation in industry (method b), which leads to the circular flow given by point B in which methods β and b have replaced methods α and a . Depending on the two kinds of innovations, the price of iron in terms of corn will in the resulting state of the system be larger or smaller, or in the extreme remain the same, while the real wage rate will again be higher.

Fig. 5

(e) *Return of a process that had already been superseded*

Figure 6 illustrates the case in which a method is first superseded by a new method in the *same* sector, but then returns after a process innovation has taken place in *another* sector of the economy. This suggests once again that in studying technical change one ought to look at the economic system as a whole; a partial analysis will generally not do. In Fig. 6 due to an invention in agriculture method α is first replaced by method β , leading to the new circular flow indicated by point A. However, due to a subsequent invention in industry (method b) the

intermittently obsolete agricultural method α comes back again. This is a case of a historical return of a method in one sector induced by a technical change in another sector. In the resulting system given by point B methods α and b co-exist.

Fig. 6

This possibility is of some interest because it provides a different argument for the case that a firm investing in a new process, and thus the plant and equipment in which it is embodied, may go bankrupt because of further innovations that render the firm's capital obsolete. In Schumpeter and the relevant literature this case is typically traced back to secondary innovations in the *same* sector that improve upon the invention and remove teething troubles of new machinery, and so on. However, the newly adopted process β might be rendered obsolete by what is happening in *some other* sector(s) of the economy. In systems with a sophisticated division of labor, things that happen in one place may have a decisive impact on what happens elsewhere. To Adam Smith a great range of social activity has the characteristic that men in pursuing their own objectives frequently contribute to outcomes that they neither intended nor foresaw. In the example of Fig. 6 the innovator in the iron industry is only keen to make profits, but the change his or her actions entail goes far beyond this narrow motive. First, competitors in the same industry are forced to switch from method a to method b . Secondly, mediated by the distributional and price effects this change triggers, producers in the other industry are forced to abandon the recently introduced method β and return to method α . *What begins as a small, even insignificant change may end in revolutionizing the entire economic system and compel producers at large to engage in decisions and actions they never planned or anticipated.* This is how the coercive law of competition propels the economy incessantly to transform itself both quantitatively and qualitatively.

(f) *Induced innovation*

In the literature on technical change it has variously been pointed out that in order for an invention in one sector finally to become an innovation, it is frequently necessary that there is a complementary innovation in another sector. Such a case is illustrated in Figure 7. The new method β in sector one will at first not be adopted by cost-minimizing producers because it would not be profitable to do so. However, an innovation in sector two such as the one depicted by method b triggers variations in w and p_i , eventually rendering method β , which was previously inferior to method α , superior to it. As Fig. 7 also indicates, this is typically not the case immediately upon the introduction of method b , but takes time. Indeed, use of

method α would for some time still be on the safe side. It is only after the pair (p_i, w) has entered the shaded area in the diagram that the switch to method β becomes imperative.

Fig. 7

7. A more general framework

The two-product framework adopted limits the variety of cases that can be covered. However, the framework can easily be generalized. A few indications must suffice.

1. Basics and non-basics

It is possible that an innovation in the same or in another sector changes the character of a commodity: it may render a basic product nonbasic, and *vice versa*. The horse, once a basic, has become nonbasic, whereas the computer once a nonbasic now is a basic. Since whether a commodity is a basic or a nonbasic affects the qualitative behaviour of the system, this possibility is obviously of great theoretical and practical importance.

2. Joint production

With joint production an entirely new set of possibilities emerges. Here only one empirically important phenomenon will be illustrated. With multiple-product processes of production there is no presumption that all products will be goods, that is, things capable of satisfying human needs and wants. Some may be “bads”, or “discommodities” (W. S. Jevons), that have to be removed because otherwise they might harm humans and other creatures (e.g. nuclear waste). The attention will thus have to focus on *systems of production-cum-disposal*. As stressed by authors from Karl Marx to Alfred Marshall, the existence of bads whose disposal is costly provides a powerful incentive to firms to explore the useful properties of things. A successful invention transforms a bad, whose removal is costly, into a good, whose marketing is profitable. This is a particular case of *product innovation*. It may, but need not, be associated with a *process-cum-product elimination*, because the transformation of a bad into a good may render the disposal process obsolete and with it all specific inputs employed in it.

A simple example can illustrate the case. (See also the analysis of costly disposal in Kurz 2006.) In Figure 8 it is assumed that originally there is only the joint products process \mathbf{y} that produces per unit of labor employed the net amounts y_1 and y_2 of two products, where the latter is taken to be a bad that is costly to dispose of. Per unit of labor employed z_2 units of the bad can be disposed of by means of the disposal process \mathbf{z}_2 . Hence, by combining the production and the disposal process the net output frontier per unit of labor employed is given

by RQ. If the entire amount of the bad produced was to be disposed of, the net output of the good, product 1, would be equal to 0Q per unit of labor. Assume now that a new single-product process of production has been invented that allows one to produce a new product, product 3, obviously a good, by means of product 2 and labor. Here we have a combined *process* and *product invention* before us. The new process \mathbf{q} , again normalized in such a way that one unit of labor is employed, transforms x_2 units of product 2 into y_3 units of product 3. Since the invention renders possible the conversion of at least a part of the amount generated of the former bad into a good, it can be expected to become an innovation. In the case in which the entire amount of the former bad, product 2, is used as an input in the new process \mathbf{q} , the disposal process \mathbf{z}_2 need not be activated at all and the net outputs per unit of labor of the two goods are given by T. In T process \mathbf{y} is activated at level 0G, while process \mathbf{q} is activated at level 0H. The total amounts produced of the two commodities are y_1^* and y_3^* . This compares rather favorably with the net output point Q in the original situation. In case only some of product 2 can be used, the disposal process \mathbf{z}_2 has to be operated in order to get rid of the residual waste. TQ is the locus of all combinations of quantities of goods 1 and 3 that can be generated per unit of labor. While in Q only processes \mathbf{y} and \mathbf{z}_2 and in T only processes \mathbf{y} and \mathbf{q} will be operated, between Q and T all three processes will be operated. The reader is invited to draw the implications with regard to the prices of the three products ruling in each of the different situations.¹²

One of the lessons the example teaches us is that there is generally no *a priori* distinction between goods and bads. Whether a product belongs to one class or the other depends not only on the needs and wants of people but also on the available methods of production. What in one system of production-cum-disposal is a bad, might in another one be a good.

3. Fixed capital

With durable instruments of production one aspect that has been referred to in the above in a cavalier way can be argued more convincingly: the fact that innovations may, and often will, render possibly expensive investments in plant and equipment in which older techniques are embodied obsolete. This is an important aspect of the phenomenon of creative destruction Schumpeter emphasized. In Marx we read about the “moral obsolescence” of fixed capital.

¹² As is well known from linear theory, the price vector is orthogonal to the net output frontier in the relevant point.

(For a discussion of obsolete used machines in a general framework, see Kurz and Salvadori 1995, chapter 12, section 2). Together with the fixed capital typically also some specific skills (“human capital”) of the workforce become redundant.

4. Natural resources

With scarce natural resources the assumption of constant returns has to be abandoned. Relative prices can be expected to change with a change in the relative amounts produced of the different commodities and the corresponding change of income distribution. Such changes in income distribution and relative prices generally affect the costliness of different methods of production and thus may induce technical changes. This possibility has found its perhaps most succinct expression in Ricardo’s famous dictum: “Machinery and labour are in constant competition, and the former can frequently not be employed until labour [that is, the money wage] rises.” (*Works*, vol. I, p. 395; see also Gehrke 2003) Improved machinery, which at first could not be employed because it would not have been profitable to do so, might eventually be employed. The reason Ricardo gives is that as capital accumulates and population grows, money wages will have to rise in order to keep real wages constant due to diminishing returns in agriculture. This increase in money wages may, however, render the employment of machinery profitable.

Exhaustible resources that are effectively exhausted necessitate technical change, as do renewable resources that are actually depleted. Before a resource will be exhausted or depleted there will typically be switches in the methods of production used induced by changing relative prices and wages (see Kurz and Salvadori 1995, chapter 12, and 2001).

5. Externalities

Production (as well as consumption) activities typically engender positive or negative externalities. These affect directly the conditions of production of single producers, entire industries or the economic system as a whole; indirectly they affect relative prices and income distribution. They can thus be expected to have an impact on the costliness of alternative methods of production and thus induce technical change.

8. Concluding remarks

The paper has discussed Schumpeter’s view on innovations and profits against the background of the analyses of the classical economists and Marx. It is argued that there are remarkable similarities between the two views in terms of the overall outlook on the problem

of economic change and also in terms of the mechanisms at work. Schumpeter, like his predecessors, emphasized that technical progress is not of a uniform kind over time. Different forms can be expected to engender different effects and adjustment processes. There is therefore no reason to presume that a steady-state analysis can adequately portray the path the economy takes over time. He entertained the view that economic development follows a pattern of leaps and bounds that begins and ends with a circular flow. This process is triggered by inventions, some of which become innovations. In the course of the diffusion process the new methods of production are generalized throughout the system as a whole, thereby establishing a new set of relative prices and gradually eroding the (extra) profits reaped by the innovators and the first generation of followers, while late adopters run the risk of being driven out of the market. The system gravitates to a new circular flow, because competition compels firms to imitate. Schumpeter's zero-profits postulate regarding the circular flow implies that static firms rapidly face losses and thus bankruptcy.¹³ There is reason to think that the postulate overestimates the speed at which the system absorbs innovative shocks. The paper then discusses various possible cases of innovations, the creative destructions they entail and their long-term impact on wages and relative prices. With transitory profits being competed away, and setting aside scarce natural resources, in the long run innovations entail rising wages.

There are also noteworthy differences between the views of the classical economists and Marx on the one hand and Schumpeter on the other. While the classical authors and Marx identify a systemic feature of the capitalist economy, competition, as responsible for the system's innovative drive, Schumpeter places the weight of the argument instead more on the existence of a particular genotype, "dynamic" and "energetic" people, or "entrepreneurs". While in the classical perspective people with particular talents and skills play an important role in the process, they are not its driving force: they might be considered a necessary but not sufficient condition. The differentiation of society in different ranks of people is by and large the outcome of a socially reproductive process, of the social division of labor, and not so much, as in Schumpeter, a reflection of the special initial physical, psychic and mental endowments of a particular group of people. In the classical authors the most important force

¹³ Obviously, even with a normal rate of profits that is positive, as in classical analysis, firms with a rate below the interest rate face bankruptcy.

at work, competition, is systemic; it shapes people's aspirations, decisions and actions. Schumpeter does not deny the importance of competition, conceived as rivalry, but appears to reverse the order according to which systemic and individual factors, explaining the phenomenon of socio-economic change, enter the stage and attributes different weights to them. The prime mover in his portrayal of economic dynamism is the entrepreneur, whereas competition sets in motion a mechanism that translates individual actions in social outcomes. In the classical view that mechanism is in motion all the time and cannot be expected to peter out. Competition compels agents to innovate and imitate. Which kinds of innovation will take place, and when, is historically contingent upon, among many other things, complementary inventions in the same or in other industries, the distribution of talents and skills among the members of society, the development of these talents and skills in education processes, and so on, yet whatever the historical contingencies defining a particular situation may be, the profit motive, competitive pressures and the institutionalization of research and development will engender innovative activities all the time. There is simply no such thing as a state of affairs in which the forces of change are dormant.

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