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Joseph A. Schumpeter and Schumpeterian Paradigm on the Dynamics of Capitalism: Entrepreneur, Innovation, Growth, and Trade

Summary: Joseph A. Schumpeter suggested two models about the evolution process of capitalist societies. The article aims to specify the essential roles of these models in discussions about the modern firm theories and the development of integrated economic growth and international trade theory. In this context, this article aims to evaluate these developments and point out their role in bridging the gap between micro-economics and macroeconomics. The Schumpeterian framework, as a bridge, provides us a very productive base to discuss the connections among entrepreneurs, firms, innovation, economic growth, and international trade.

Keywords: Joseph A. Schumpeter, Schumpeterian growth and trade models, Capabilities/evolutionary approach in firm theory, Entrepreneurship and technological innovation.

JEL: B310, D21, E140, O310.

Joseph A. Schumpeter (1883-1959) considered that the primary subject matter of economics is to explain the economic change (or evolution) process of capitalist societies. He suggested two models for this research theme*:* In the first model addressed in *The Economic Theory of Development* (1934), he emphasized the importance of the role played by entrepreneurs in the economic change process of capitalist societies. In the second model covered in *Capitalism, Socialism and Democracy* (1943), he asserted that innovation and innovative competition between large corporations are the main elements of the dynamics of capitalism.

The article aims to specify the essential roles these models played in three crucial developments in economic theory since the beginning of the last quarter of the 20th century and construct the connection with each other. In this context, the central thesis of this study can be expressed as follows: First, while Schumpeter's pioneering views provided a basis for the studies on the improvement and consolidation of the entrepreneur and firm theories in the mainstream microeconomics, they also led to developing a unique theoretical framework for analyzing the connection between entrepreneur and behaviors of firms (Evolutionary/Capabilities Approach). Second, the same thing is

also true in macroeconomics. On the one hand, his stimulating ideas contributed to the development of neoclassical and new Schumpeterian growth theories and their relation to international trade. On the other hand, those also led to a different framework for discussing the relationship between technological innovation, economic growth, and international trade (Neo-Schumpeterian/Evolutionary Growth Theory). Third, Schumpeter's methodological suggestion of compartmentalizing economic analysis as micro-meso-macro presents an original solution to the duality problem of mainstream economics, as micro-macro. In a nutshell, Schumpeter's views and the Schumpeterian paradigm built upon them contain elements of a strong and idiosyncratic alternative to mainstream neoclassical economics.

The study consists of four sections. The link between method and scope in Schumpeter's economic thought is mentioned in the first section. The relationship between Schumpeter's (1934, 1943) views about entrepreneurs and firm behaviors and studies aimed at improving the Evolutionary Firm Theory since the 1980s is discussed in the second section. In the third section, the Neo-Classical (or New-Schumpeterian) and Neo-Schumpeterian (Evolutionary) growth and international trade theories focused on the interrelationships between technological innovation, growth, and international trade are discussed by underlining the connection them with Schumpeter's views. Finally, the article concludes with a short assessment of the Schumpeterian Paradigm as an alternative to mainstream economics.

1. On the Methodology and Scope in Schumpeter's Economic Thought

The primary subject matter of Schumpeter's studies in economics is closely related to his methodological views (for a detailed review of Schumpeter's methodology, see Turan Yay 2021). The views of two economists who studied Schumpeter's methodological views confirm this hypothesis. However, their views are opposite to each other: According to Yuichi Shionoya (2004), Schumpeter builds on the idea of "universal science", which was discussed in the original German version of Joseph A. Schumpeter (1934) but removed from its English version throughout his entire set of works, and it makes up the primary subject matter of his economic views: the central theme of Schumpeter's academic work is defined as the "evolution of mind and society".

On the other hand, Kesting emphasizes methodological changes and interruptions in Schumpeter's works, which are significant for understanding the corpus of Schumpeter's works. According to Peter Kesting (2007, p. 388), "*Schumpeter's* work can be interpreted as an intensive struggle for an adequate understanding of economic change".

Here we may say that the primary aim of Schumpeter's works is to make an economic analysis of the evolution of society and economic change and that he addressed this issue in various contexts throughout his career. Schumpeter started his academic career at the beginning of the 20th century as a member of the Austrian School of Economics based at the University of Vienna. In this period, the Austrian School of Economics was the lead partner of two crucial battles of ideas in economics. First was the ongoing Calculation Debate with Marxist Economic Approach (for

development of debate in time, see Friedrich August Hayek 1935; Ludwig von Mises 1935, 1949; Don Lavoie 1985). The second was the methodenstreit (Great Dispute over Method), which was among the most popular controversial topics of the period, with the German Historical School that took hold of Germany and Central Europe (see Schumpeter 1911, pp. 152-201, 2002; von Mises 1969, pp. 7-19; Alexander Ebner 2000). As indicated in the biographical works (Richard Swedberg 1991), he aimed "to become the best economist", so one could not expect him to remain indifferent to these different approaches and discussions.

Schumpeter mentioned Karl Marx with praise in his articles, and he especially inspired him regarding "economic elaboration of the evolution of a capitalist society" (Schumpeter 1943, p. 44):

> *There is, however, one thing of fundamental importance for the methodology of economics, which he actually achieved. Economists always have either themselves done work in economic history or else used the historical work of others. But the facts of economic history were assigned to a separate compartment. They entered theory, if at all, merely in the role of illustrations, or possibly of verifications of results. They mixed with it only mechanically. Now Marx's mixture is a chemical one: that is to say, he introduced them into the very argument that produces the results. He was the first economist of top rank to see and to teach systemically how economic theory may be turned into historical analysis and how the historical narrative may be turned into histoire raisonnée.*

Schumpeter's Habilitationsschrift was also about the methodological discussion between the German Historical School and the Austrian School: *The Nature and Essence of Economic Theory* (1908). The German Historical School defended that the economic behaviors of humankind cannot be theorized abstractly. On the other hand, the Austrian School of Economics considers economics a subfield of the science of human action, called praxeology, and all propositions about human action could be derived from "spontaneously correct" aprioristic/deductive reasoning (such as people acting rationally). Therefore, these propositions do not need to be tested empirically (see von Mises 1962, p. 44). Schumpeter defended a third way in this controversial topic between these two schools by suggesting that Walrasian general equilibrium analysis is a more appropriate framework, especially for elaborating on "economic stability under static conditions". Here, Schumpeter's emphasis is mainly on the generality and mathematical expressibility.

However, after a while, when he adopts the problem of economic change or the economic dynamics of change in capitalism as his primary research problem, he sees the inadequacy of the Walrasian static equilibrium analysis and tries to develop his analysis. In his work, *The Theory of Economic Development* (Schumpeter 1911, 1934), he attributes the leading role in explaining the change/development in capitalism to the entrepreneurs' function of realizing new combinations or their efforts to create innovation. Sometime later, he extends and complements his model about the long-run growth of capitalism with historical and statistical analyses (Schumpeter 1939). Finally, Schumpeter changes his model according to the historical, organizational, and institutional developments in capitalist countries since World War II (Schumpeter

1943, pp. 61-163) (see also Swedberg 1993, pp. 136-166 and Esben Sloth Andersen 2012).

Four aspects of Schumpeter's methodological approach must be highlighted: First, he is a pluralist because he is open to every approach. Here, pluralism does not mean using multiple criteria (explanatory power, falsifiability, simplicity, and leading to effective discussions) to determine the most scientific theory as its meaning in economic methodology (see Bruce Caldwell 1994). Instead, it expresses different forms of analysis (static analysis, dynamic analysis, historical analysis, or econometric analysis) that may change according to the topic at hand. And here again, there is a liberalness and tolerance in the sense of being open to all ideas (Fritz Machlup 1951): "The following saying makes a lot of sense: To understand is to forgive. Better even: Whoever understands sees that there is nothing one has to forgive. And that is also true in the field of knowledge" (Schumpeter 1908, p. ix).

Second, although he is not an instrumentalist in the meaning of Milton Friedman (1953), who emphasized the predictive ability of theories as a discrimination criterion, he is the instrumentalist because theories are tools in analyzing the topics addressed (see Shionoya 2004). We can say that Schumpeter's view overlaps with Fritz Machlup's approach rather than Friedman's. Machlup (1967, pp. 26-31) identified 21 concepts of firms in economics. He claims that no firm's idea can be the most important or valuable because each one serves different purposes. The choice of theory must depend on the encountered problem and the research approach to use. Schumpeter expresses a similar view in a more literary language (Schumpeter 1908):

> *I am convinced that the contentions of almost all "schools" and of all individual authors are correct, most contentions are true in ways for which they are meant and for the purposes intended. (…) Each method has its concrete areas of application, and it is useless to struggle for its universal validity.*

Third, he used a microbased analysis as the Austrian School of Economics adopted rather than a macrobased analysis. As Herbert Giersch (1984, pp. 104-105 emphasized in his American Economic Review article, this feature is the source of both his criticism of John Meynard Keynes and the essential points of Schumpeter's analysis. As a methodological individualist, Schumpeter focuses on the analysis of process rather than of results. Here, an energetic individualist chooses/determines the terms and conditions instead of those who comply with the existing requirements. Methodological individualism is also related to Schumpeter's theoretical problem being dynamic (not static). Although the *homoeconomicus* individual of neoclassical economics was adequate for solving the static analysis problem, Schumpeter's energetic entrepreneur was needed for the dynamic problem. Methodological individualism mainly consists of two components: Passive methodological individualism is concerned with passive (and reactive) individualistic behaviors, whereas active methodological individualism is concerned with pro(active) individual behaviors (Kurt Dopfer 2007).

Fourth, Schumpeter helped initiate the triple distinction of micro-meso-macro instead of mainstream economics' eclectic dual micro-macro distinction (Dopfer 2007). The concept of meso takes place in an intermediate position between micro and macro. Economists have adopted the (previously nonexisting) dual eclectic (micro-

macro) distinction since Keynes' *General Theory* was published: The first of the two main problems of economics, the coordination between economic activities of numerous individuals, was addressed in microeconomics. On the other hand, the second problem, the economic change/growth problem of economics in time, was discussed in macroeconomics. Even though this eclectic pattern was attempted to be solved by the project of "microfoundations of macroeconomics", the final version of this project that has emerged in recent years, *the Neo-Classical Synthesis Approach*, and its *Dynamic Stochastic General Equilibrium Model* were heavily criticized in the face of the crisis in 2008.

The Schumpeterian Approach proposes an alternative analysis based on the triple distinction of micro-meso-macro rather than the existing dominant approach based on micro-macro distinction. One of its starting points was the criticism of an essential assumption of the mainstream approach: a uniform, homogeneous representative agent. The leading role belongs to the energetic entrepreneur in Schumpeterian micro-analysis. This energetic entrepreneur differed from the homoeconomicus individual, who reacts to given opportunities by trying to proactively change the opportunities. Because individuals differ in their perceptions and knowledge, an energetic entrepreneur/agent introduces an idea to the system and changes the conditions, whereas other agents actualize it. As described by Dopfer (2007):

> *Sketched briefly, a novelty represents an idea that can be actualized by many agents. The theoretical body received, therefore, a qualitative element (an idea) and a numerical specification of its actualization (a population). Thus, micro cannot be aggregated into macro, since qualities cannot be added up and the individual agent has to be treated as a distinct member of a population. What emerges is a meso unit that gives micro its distinct position and that constitutes the building block for the construction of macro. In this view, the course of formulating the theory is not from micro to macro but - with no short cut possible - from micro to meso, and from there to macro.*

With the help of this classification, the Schumpeterian paradigm suggests that aggregating the (micro) analysis of individual firms in the market does not help form an idea about the industrial structure of the economy. Industries are different as much as the firms (firms that have adopted the innovative strategy, firms that have adopted the imitation strategy). In this respect, relations between industries must be addressed separately as well as those between firms, demonstrating the necessity of meso analysis (see John Foster and Jason Potts 2009).

2. Schumpeter and Schumpeterian Paradigm on the Entrepreneurship and Firm Theories

In the postwar period, the primary subject matter of neoclassical economics has been reduced to the identification (and mathematical formulation) of equilibrium conditions. Although they always have taken place in economists' discourses that reduction has excluded concepts such as entrepreneur, firm, and competition from the mainstream theoretical framework. This situation is expressed clearly in the following two citations.

> *We conclude that an individual real-world entrepreneur, even if highly stylized, cannot at present be modeled in mainstream economics, since he or she does elude analytical tractability. In this sense, the neoclassical entrepreneur is (still) not entrepreneurial* (Milo Bianchi and Magnus Henrekson 2005, p. 373).

> *A mythical Martian, equipped with a telescope that reveals social structures and approaching the earth from space, would recognize organizations, rather than connecting markets, as "the dominant feature of the landscape". Arguably, this ubiquity of organization in the real world has not until recently been reflected in economic research. This is all the more surprising, since all sorts of allocational and distributional decisions are taken within organizations, decisions that are clearly within the scope of economic theory, and which may significantly influence market outcomes, and perhaps even have macro consequences. One may therefore legitimately wonder why the theory of the firm as something broader than a component of price theory has taken such a long time to emerge* (Nicolai J. Foss and Klein 2006).

Since the 1970s, the period that is called *The Age of Schumpeter* (Giersch 1984), or *Schumpeterian Renaissance* (Richard R. Nelson and Sidney G. Winter 2002), Schumpeterian economists, who have tried to improve Schumpeter's main themes (entrepreneur's function in economic life, theory of the firm and organization, dynamics of firms and sectors as well as competitive process especially in industries where innovation plays a key role), contributed to the development of studies concerning entrepreneurs, firms, and organizations on the one hand and have come a long way about creating their paradigms on the other (Nelson and Winter 1982; Jan Fagerberg 2003; Horst Hanusch and Andreas Pyka 2005).

Schumpeter argued that the best way to understand capitalist development is to study the dynamic evolutionary process. In this process, because people and organizations have quite different views about possible, productive, and profitable innovations, they make different decisions. There are winners and losers in Schumpeter's "process of creative destruction", and these are determined mainly in actual *ex-post* contests rather than in *ex-ante* calculation.

In the first model, Schumpeter (1928) saw the key innovative actor as "entrepreneur": Entrepreneur is essential for both making the static equilibrium analysis dynamic and understanding the capitalist change process in the real world. There is no place for the entrepreneur in the hypothetical neoclassical equilibrium model. However, in his model that aims to explain the real world, the importance of entrepreneurs may be understood when we want to address change and the dynamic process of disturbing the equilibrium, more clearly, especially spontaneous, internal to the system, and discontinuous changes in the industrial sector. In this context, the first function of the entrepreneur is to be an innovator and make "new combinations (…) by employing existing means of production differently, more appropriately, more advantageously (Schumpeter 1934, p. 132). If we want to state this function more broadly, it covers the following cases: (1) creation of a new good or new quality of good; (2) creation of a new method of production; (3) the opening of a new market; (4) the capture of a new source of supply; (5) a new organization of industry (e.g., creation or destruction of a monopoly) (Schumpeter 1934, p. 66). The second function of the entrepreneur that is

inseparable from innovator is leadership. It refers to "breaking up old and creating new tradition" that is not only in the economics but also in moral, cultural, and social fields: "[In] economic life every step outside the boundary of routine has difficulties and involves a new element. It is this element that constitutes the phenomenon of leadership" (Schumpeter 1934).

In the second model (1942), Schumpeter changed his mind about the sources of innovation as a reflection in organizational and institutional changes in the capitalist world since World War II. Modern firms equipped with research and development (R&D) laboratories that worked in monopoly competitive markets became the central actor. In a nutshell, Schumpeter's views did not only become a source for the integration of theory of the firm and entrepreneurship (Richard N. Langlois 2005), but it also contributed to the development of the *Schumpeterian* or *Evolutionary Paradigm* in economics. The distinctive characteristic of this paradigm is identified as follows (Nelson 1991): "[It] provides a very different view of what economic activity is all about and within which firms differences are central, and go on to consider the role of firm differences in the evolution of technology and modes of organizing economic activity".

The starting point of Schumpeterian or Evolutionary Paradigm is expressed that (Giovanni Dosi, Nelson, and Winter 2002, p. 1) "organizational knowledge is real and a phenomenon of central importance to the understanding of the modern world. (…) Understanding [how business firms and other organizations] develop, maintain, and advance their capabilities is (…) fundamental to understanding how society works and how it changes".

The organizational knowledge in question is associated with the organization's ability to perform and extend its characteristic "output" actions, such as creating a tangible product, providing a service, or developing new products and services. Because the paradigm advocates use different but close words for the knowledge that organizations have to maintain their activities, it will be useful to clarify them: Capability refers to having a generally reliable capacity to produce something as a result of intended action. Although the concept of capabilities relates the intention to the outcome, it refers more to the behavior of organizations: it is a kind of combination of experimental background actions, including habitual responses of human beings and automatic, physically determining the responses of machines (Dosi, Nelson, and Winter 2002). The concept of capabilities is broader than routines and differentiates it by including a purpose or conscious choice/decision. In other words, "capabilities involve organized activity, and the exercise of capability is typically repetitious in substantial part. Routines are units or chunks of organized activity with a repetitive character. Hence, it is well said that routines are the building blocks of capabilities". On the other hand, while the concept of skill is attributed to the individual, routines are used for the organization: routines are the skills of an organization. Consequently, "a useful meaning for the 'skills of the organization' would simply be the collectivity of skills possessed by individuals in the organization, regardless of whether the skills are modular, organization-specific, or not organization-related at all. Then, it could be said that organizational routines have the major function of coordinating the organization's skills, i.e., of turning that collectivity of skills to useful effect" (Dosi, Nelson, and Winter 2002).

Besides, concepts such as distinctive competence, core competence, and dynamic capabilities are used to have similar meaning and refer to "firm's ability to carry off the balancing act between continuity and change in its capabilities, and to do so in a competitively effective fashion". A final word used in this field is called combinative capabilities that connote the firm's ability to transform old capabilities into new ones. This transformation occurs either in the form of new capabilities with existing capabilities and new knowledge or in changes in organizational rules that drive their operations (Dosi, Nelson, and Winter 2002).

Schumpeterian or Evolutionary Paradigm is based on two propositions: First, firm differences within an industry exist and do matter significantly. Second, firms have specific capabilities and decision rules that show vital elements of continuity (routines are reproduced through practice as parts of the firms' organizational memory) (Nelson and Winter 1982, p. 4 and p. 14). These propositions provide a basis for the intersection of the evolutionary concepts of variation, selection, and retention: "Variety in the form of heterogenous firm behavior patterns gives the market selection process something to work on; because the patterns persist, market's selection and promotion of successful ones has significant systemic consequences over time" (Dosi, Nelson, and Winter 2002).

This dynamic evolutionary process can also be expressed in terms of three essential features of the firm: its strategy, structure, and core capabilities (Nelson 1991):

> *Firm diversity is an essential aspect of the processes that create economic process (...) It is virtually inevitable that firms will choose somewhat different strategies. These, in turn will lead to firms having different structures and different core capabilities, including their R&D capabilities. Inevitably, firms will pursue somewhat different paths. Some will prove profitable given what other firms are doing and the way markets evolve, others not. Firms that systematically lose money will have to change their strategy and structure and develop new core capabilities or operate the ones they have more effectively or drop out of the contest.*

Pursuing these ideas, Schumpeterian/Evolutionary economists developed a knowledge/capability-based theory of the firm and a framework for the make-or-buy decision quite different from that put forward in transaction cost economics, which is the dominant approach in this field. While some economists traced back its roots to the studies of Adam Smith, Karl Marx, and Frank A. Knight (Geoffrey Hodgson 1998), one of the founders of the paradigm emphasizes the importance of some strategic management studies (such as Herbert A. Simon 1957; Edith Penrose 1959; Richard M. Cyert and James G. March 1963; Alfred D. Chandler Jr. 1977, 1990) in the formation of the bases of their approaches (Nelson 1991). Because of this, to understand more Schumpeterian or Evolutionary Theory of the firm, it will be helpful to compare it with other theories of the firm and to have a look at the discussions around the theory of the firm and organizations that have made significant and efficient progress since the 1970s in economics and strategic management fields.

The neoclassical theory of the firm was all about a "black box" at the beginning of the 1970s. The price mechanism in neoclassical theory (or in Walrasian general equilibrium model) was allocating resources effectively and ensuring the general equilibrium in the economy. Therefore, there was no place or need for either the

entrepreneur or the firm. Indeed, in neoclassical economics, the firm was no existence but just its name. It is only a mental concept for analyzing the supply and demand, rather than a description of a concrete firm in the real world. The firm was described with its three characteristics: First, it was a "profit-maximizing unit and necessary for the industry analysis"; it includes noting for consideration by economists. Second, it is defined as "a technological concept, a production function". Third, knowledge is taken as "a stock of objective entities" that are open and attainable for everyone. There is no possibility of the firms conceiving and using existing knowledge differently (Christian Knudsen 1995; Manuel Becarra 2009). In other words, the firm is a secondary element for analyzing the industry or the market in neoclassical economics; for this reason, it was completely natural to assume that all companies in an industry were homogeneous and had the same cost and demand characteristics. Since those years, efforts to make up for this gap have turned into an area of research named the firm's modern theories. It consisted of four issues connected with the firms or organizations: the raison d'etre, boundaries, internal organizational structures, and competitive advantage (capabilities) (Foss 2003, 2006; Foss and Peter G. Klein 2006).

It is important to emphasize three points here: First, the development of modern firm literature involves a historical dimension, in which the first three issues (existence, boundaries, and internal organizations) were first addressed in the organizational economics, and then the last issue was maintained in the strategic management. Second, as an implication of the first, it refers to a development based on interdisciplinary collaboration. Third, the common dominator of these new theories was to reject the assumption of an identical/homogenous firm in an industry. Accepting a unique firm is worth investigating on its own.

As seen in Table 1 (Ronald H. Coase 1937; Machlup 1967; Armen A. Alchian and Harold Demsetz 1972; Oliver E. Williamson 1975, 1985; Stanford J. Grossman and Oliver Hart 1986; Langlois 1989; Nelson 1991; Foss, Knudsen, and Cynthia A. Montgomery 1995; Knudsen 1995; J. Stanley Metcalfe and Andrew James 2000; Foss 2006), besides the neoclassical theory of the firm, three essential conceptualizations of the firm can be specified. Each of them focuses on a specific aspect of what firms do: Behavioral Theory of the Firm, Knowledge-Based Theory of the Firm, and Contractarian Theory of the Firm. Although each of these theories has attempted to fill in the gap in the Firm Theory, there is no commonly accepted approach yet (Knudsen 1995; Becarra 2009). However, especially two of them came into focus as competing main approaches: Knowledge-Based Theory of the Firm and Contractarian Theory of Firm. In this context, the Schumpeterian/Evolutionary Approach is an essential constituent of the debate on modern firm theories. At the intersection of the behavioral approach and the resource-based approach, it contributes to the discussion by addressing the structure of firms (and their capabilities) and industries, especially within the context of technological innovation. Much more important is that, following this channel, the Schumpeterian Paradigm paradigm sets up the foundation of a modern theory of innovation and growth, on the one hand, and makes crucial progress for constructing a new framework to analyze the nexus of micro-(meso)-macro on the other.

Table 1 The Comparison of the Firm Theories

Main Theories	Neoclassical Theory of the Firm	Behavioral Theory of the Firm	Knowledge/Competence-Based Theory of the Firm		Contractarian Theory of the Firm		
					Ronald Coase		
					Incomplete Contracts Theory		Complete Contracts Theory
Sub-Approaches & Representatives		Herbert Simon-Cyert & March Carnegie Melon University	Evolutionary-Capabilities Approach (Nelson & Winter)	Resource-Based Approach (Penrose)	The Firm as a Governing Structure of transactions		
					Transaction Cost Approach (Williamson)	Property Right Approach (Hurt)	The Nexus of Contracts-Agency Approach (Alchian-Demsetz)
What is the Firm?	The firm as a unitary decision maker; he firm as a production function	The firm as a decision making (information processing) structure and coordination among individuals and groups	The firm as a bundle of routines. The firm as an historical entity because its productive knowledge is the result of endogenous, experience-based learning process	The firm as a collection of resources under an administrative framework	The firm as a governing structure of transactions	The firm as collection of the assets that the firm's owners or managers control	The firm as an efficient solution of a 'blind' process selection and adaptive learning
Behavioral Assumption	Perfect rational system. Rational profit maximization	Adaptive Rational (Imperfect Adaptive) System	Creativity, Rule Following Search, Learning	Rationality	Adaptive Institutions		
					Bounded Rationality	Opportunism Incentive Conflicts	As if maximization
Central Agent	Producers	Managers	Entrepreneurs	Entrepreneurs	Managers	Managers	Managers
Central Units of the Analysis	Production function	Political Coalitions	Routines	Resources	Contracts	Contracts	Contracts
Level of the Analysis	Market and Industry	Firm	Industry	Firm	Firm	Firm	Firm
Central Object of the Analysis	Market structure and determination of prices	The Analysis of the firm as a result of adaptive/ bargaining process between single individuals and groups under the assumptions of uncertain environment and limited information	Existence and Boundaries of the firm when inputs, outputs and technology changing. Technological Evolution. Dynamic Competition	Sources of Competitive Advantage. Diversification. Growth of firms	Existence and Boundaries of the firm when outputs and technology are given		Existence and Boundaries of the firm when inputs outputs and technology are given

Source: Authors' compilation.

3. Technological Change, Economic Growth, and International Trade

As mentioned previously, the central theme of Schumpeter's works is to explain the dynamics of economic change in capitalist societies (he defines capitalism as an engine

of change). In this context, Schumpeter defenses that Walrasian neoclassical static theory is not adequate for this purpose (although price competition among companies can ensure effective allocation of resources under given technological conditions and under conditions of perfect competition). Instead, he suggests that economic change may be explained by the technological change brought about by innovation competition among entrepreneurs/firms, which he names as creative destruction.

This topic in question led both to the development of Schumpeterian Growth Models, which discuss the effect of the concept of technical change on economic growth, and the development of Schumpeterian International Trade Models, which explain international trade patterns using technological change and technological gap. These models suggest that "absolute advantage in technology" is more significant than "comparative advantage in goods" in determining the place of countries in world trade. Thus, these models provided a theoretical framework addressing the mutual interaction of technology, growth, and foreign trade in an open economy. To understand the significance of this framework, we have to understand technological change and innovation processes and then determine its place among the foremost growth and international trade theories.

3.1 Economics of Innovation and Technological Change

Schumpeterian or Evolutionary Paradigm tries to construct a framework for analyzing the nexus of micro-meso-macro by focusing on the relationship between economic forces and technical progress. The scope of the Economics of Technology (or Economics of Innovation and Technological Change) consists of three parts (or a set of questions): the first is to examine the nature of an innovation process (what people do in this process); the second is to assess the observed direction of technological change (whether existence patterns represent reactions to market signals or whether there are other factors that influence the pattern of technical change); and the third is to explain the characteristics that determine the differences between companies, sectors, and countries in terms of innovative activities (why firms/industries/countries display differences in innovations of the new products or process) (Dosi 1988).

Dosi (1988, p. 1128) defines a technological paradigm as "a pattern of solution of selected technological problems based on highly selected principles derived from natural sciences, jointly with specific rules aimed to acquire new knowledge and safeguard it, whenever possible, against rapid diffusion to the competitors". On the other hand, a technological trajectory is "the activity of technological process along the economic and technological trade-off defined by paradigm". The crucial hypothesis of the Schumpeterian or Evolutionary Paradigm is that "innovative activities are strongly selective, finalized in quite precise directions and often cumulative". The vital point that must be underlined is that technology is quite different from the technology equation with information that is generally applicable and easy to reproduce and reuse. They have emphasized their understanding of technology and innovation as follows. First, although incomplete and asymmetric information is accepted in economic activities, the differences in the innovative capabilities between firms cannot be constrained to the field of information. Second, it departs from any microeconomic representation of innovation as an equilibrium outcome of rational, forward-looking decisions of

symmetric agents. Their microeconomic foundations consist of highly differentiated agents embodying diverse and asymmetric competencies (Dosi, Keith Pavitt, and Luc Soete 1990, p. 85).

Since the 1970s, various studies on technical change have expressed some crucial common points for understanding the technological innovation process: (i) the innovation process cannot be described as a reaction only to changes in market conditions. It also has technical-specific rules; (ii) scientific knowledge, although it is one of the essential inputs of the innovation process, plays an essential role in opening new possibilities in technological developments; (iii) the more complex the R&D is, the more it triggers corporate organizations (rather than individual innovators); (iv) a significant part of the innovation is done by individuals and companies learning by doing; (v) these activities include uncertainty; it is difficult to predict the technical results of research activities in advance; (iv) technical change is not random: (a) the direction of technical change depends on the existing technologies; (b) technological change is a cumulative process (Dosi, Povitt, and Soete 1990, p. 83).

In a market economy, the change rate and pattern of market structure and technological performance are endogenously determined by the structure of demand, the nature and strength of opportunities for technological advance, and the ability of firms to appropriate the returns from private investment in R&D. In other words, technology-specific and country-specific aspects of opportunity, cumulativeness, and appropriability of technical advances determine both intersectoral distribution of sources, uses of innovation, and the international distribution of technological advantages/disadvantages.

In a nutshell, the evolutionary paradigm succeeds in establishing a framework that entails a specific balance among exogenous determinants of innovation, determinants that are endogenous to be competition, and technological accumulation of firms and industries. This analysis includes essential elements to eliminate the microeconomics-macroeconomics disconnection and provides an excellent alternative base for this aim. But, first, let us look at the relationship between the pattern of technological change and the pattern of economic growth and then the relationship between the pattern of technological change and the pattern of international trade.

3.2 Technology and Growth

Together with various classical and neoclassical economists (such as Adam Smith, David Ricardo, Thomas Malthus, Allyn Young, Frank Knight, Simon Kuznets, Zvi Griliches, Jacob Schmookler, and Nathab Rosenberg), Joseph A. Schumpeter is recognized as one of the essential economists who prepared the fundamentals of the developments in modern growth theory since the 1950s (Robert J. Barro and Xavier Sala-i-Martin 1995, p. 9; Gino Gancia and Fabrizio Zilibotti 2005, p. 113). These fundamental ideas consist of a competitive general equilibrium model, the role of diminishing returns and its relation to the accumulation of physical and human capital, the relationship between *per capita* income and the growth rate of population, the effects of technological progress in the forms of increased specialization of labor, discoveries of new goods or new methods, and the role of monopoly power as an incentive for technological advance (Barro and Sala-i-Martin 1995, p. 9).

Indeed, economists' interest in growth theory began in the 1940s with the Harrod-Domar model. In this model, the Keynesian short-term analysis and long-term growth dynamics were tried to be combined. The model's assumptions that emphasize the importance of capital accumulation in long-term economic growth were the fixed capital-labor ratio and fixed capital productivity rate (inverse of the capital-output ratio). Because of these assumptions, the inference of the model is that it would not be possible to reach an equilibrium growth path unless the economic growth rate increased equally with the population growth rate. In a nutshell, capitalism is an unstable system due to its nature that is swept between high unemployment and excessive capital stocks. However, this inference of the model did not match the dynamics of economic growth in the real world (see Robert M. Solow 1994).

Significant developments within the theory of growth have followed in the path of Solow (1956) and Trevor W. Swan (1956), based on the neoclassical growth model rather than the Keynesian instability-imbalance path. The Solow-Swan model, starting with a neoclassical production function, indicated the impacts of saving, population growth, and technological progress on economic growth. The model assumes a closed economy with a commodity; all saved output is invested; there are no places for Keynesian difficulties and stability problems. In addition, there are no fundamental assumptions related to the Harrod-Domar model, such as fixed capital-output ratio and fixed capital-labor ratio. Finally, the model mainly focused on capital accumulation and concluded that long-term growth is impossible unless externally determined the technology (Solow 1988, 1994).

Two essential predictions of the model, both based on the assumption of diminishing returns to the capital, led to comparing the model inferences with the real world. Moreover, they triggered the theoretical studies on the causes of long-run economic growth. The first prediction, the conditional convergence, has provided notable explanation and measurement opportunity for economic growth differences among countries or regions (N. Gregory Mankiw, David Romer, and David N. Weil 1992). The second prediction suggests that when technological development is not continuous, *per capita* economic growth will stop in the long-run. However, we know that the *per capita* growth rate exists over time, contrary to this prediction. As mentioned previously, the inconsistency between the neoclassical growth model and the observations of real-world developments was first overcome by accepting technology as exogenous (Solow 1956, 1994). However, this was unsatisfactory for two reasons: first, by placing the source of sustained growth outside the model, the theory could not explain the determinants of long-run economic performance, and second, empirical evidence pointed out that technical progress often depends on deliberate economic decisions (Gancia and Zilibotti 2015).

Endogenous growth theories, which refer to the incorporation of technological change into the studies on modern growth theories, have been possible in the mid-1980s and early 1990s with significant theoretical works carried out in several stages. In this context, Romer emphasized very well what was necessary (Paul M. Romer 1994, p. 11): "What we lacked were good aggregate-level model. (…) progress in economics does not come merely from the mechanical application of hypothesis tests to

data sets. A creative act is associated with constructing new models that is also crucial to the process".

Although some economists classify the models developed in this process with different names, we can split them into three groups: spillover (learning by doing or *AK*) models, product variety (horizontal innovation) models, and Schumpeterian (quality innovation) models (Romer 1994; Gancia and Zilibotti 1995; Philippe Aghion and Peter Howitt 2009; Daron Acemoglu 2011). The incorporation of technology into the model endogenously was related to the economists' ability to cope with two fundamental assumptions of the neoclassical model: the diminishing returns of production and the constant returns to scale.

In the first stage, a group of economists tried to endogenize the rate of technical change by *AK* (spillover) models: technological change in a country is determined by funds allocated to innovative activities, accumulation of human capital, and decisions of firms chasing after profits. Thus, technology becomes an internal variable determined by economic actors' economic reasons. According to the model, while economic growth continues - because of the externality of human capital or the dissemination of knowledge - the return on capital in a broad sense will not diminish (Romer 1986, 1987; Robert E. Lucas Jr. 1988). However, the inclusion of the concept of endogenous technology into the model gives rise to the problem of increasing returns-to-scale phenomenon. Thus, there must be an element of incentive for humans to develop the technology. But there is only capital and labor with constant returns to scale in the aggregate production function for which conditions of perfect competition are assumed. We also know that, in this case, there will be no resources left to improve technology when total output is distributed between capital and labor according to their marginal products.

This group of models surpassed the problem by Kenneth Arrow's (1962) proposition named "learning by doing": Technological progress is an unintended consequence of the production of new capital goods. If technological progress depends on aggregate capital production and numerous firms, firms maximize profit by making payments to labor and capital according to their marginal products. This process would create technological progress regardless of the singular activities of firms. Consequently, the model is expressed as a production function, $Y = AK$, where the marginal product of capital is equal to a constant A. In short, the problem of decreasing returns of capital is overcome by the characteristics of public goods, whereas the assumption of the constant return to scale is preserved[1]. In addition, the long-term growth of a country depends on savings and the effective use of resources.

Two criticisms are directed to this first group model: First, technological progress and capital accumulation cannot be distinguished clearly in the model. When all capital accumulations are expressed in aggregate, diminishing returns are eliminated, thanks to the accumulation caused by technological progress. Second, economic growth is a phenomenon that is related to creativity and innovation rather than savings and effective use of resources (Aghion and Howitt 2009).

[1] Solow and some economists argue that the concept of decreasing returns of capital is important in neoclassical growth models but that the concept of constant returns to scale is not necessary to be abolished (see Sergio Rebelo 1991; Solow 1994).

According to the second criticism, two types of innovation-based growth theories have been developed in the literature: the product variety (horizontal innovation) models and Schumpeterian (quality innovation) growth models.

One of the most typical examples of Product Variety Models, which we found in Romer (1990), claims that innovation creates new varieties of products and increases efficiency. The models rest on the production function containing numerous intermediate products, each of which is produced using specific capital units. The degree of product variety in the economy shows the aggregate efficiency parameter of the economy, and growth in this parameter provides the economy's growth rate of *per capita* output. An increase in efficiency is determined by increased specialization of labor, which uses an increasing number of intermediate goods and research spillover, where a new individual innovator uses the total existing stock of innovations. Here, the knowledge about innovation is "nonrival" in the sense that another innovator uses them freely in their research activities and is partially excludable, meaning that each innovation is rewarded with monopoly rent (incomplete intellectual property right). Thus, this income prospect encourages research activities/investments that aim at discovering new varieties (Romer 1990).

The model has two characteristics: one problematic and one that included a radical change. First, if there is a single innovation, it always results in the same kind of new product. Thus, the only variable that determines aggregate efficiency is product variety, and the sole effect of a change in this would be on gross domestic product. Second, with these models, economists have adopted the assumption of an imperfectly competitive market (firms may sell their products at a price above unit product costs) by giving up the assumption of perfectly competitive markets (where firms are price takers) in analyzing growth.

On the other hand, the solution of two shortcomings of the product diversity models (which neither consider the role of exit or turnover of firms in the growth process, nor are also convenient to formalize the notion of technical or product obsolescence) leads us to the Schumpeterian growth models with a formulation of Schumpeter's famous concept/thesis (Schumpeter 1947):

> *... The fundamental impulse that sets and comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates (...) illustrate the same process (...) of industrial mutation that (...) revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of creative destruction is the essential fact about capitalism.*

However, the critical feature of the product diversity models to be underlined before moving to Schumpeterian Models is that the concept of the technology spillover forms the basis for developing the new trade theories. Especially in the global age, when the endogenous innovation-based models are extended to include international trade and investment, they will provide a prolific theoretical framework for discussing international movements of goods, capital, and ideas (Gene G. Grossman and Elhanan Helpman 1994).

Schumpeterian (or Quality-Enhancing Innovation) Growth Theory is the product of a series of studies that aimed to model Schumpeter's concept of creative

destruction in the last 30 years - the process of replacing old technologies with new innovations (Paul S. Segerstrom, T. C. A. Anant, and Elias Dinopoulos 1990; Segerstrom 1991; Aghion, Ufuk Akcigit, and Howitt 2014, 2015a, b). Its superiority over other growth models can be summed up at two points. First, the model that examines creative destruction can also shed light on the microeconomic aspects of the growth process, such as the role of competition, firm dynamics, and cross-firm and cross-sector reallocation. Second, the model differs from other growth models by testing hypotheses using rich micro data such as input, output, and firm size distribution. With these two features, Schumpeterian growth theory is a vital candidate for filling the gap between microeconomics and macroeconomics and providing an alternative to mainstream economics.

The Schumpeterian growth model (Aghion, Akcigit, and Howitt 2014, 2015b) is based on three main ideas: (a) long-run growth results from innovations; (b) innovations result from entrepreneurial investments that are themselves motivated by the prospects of monopoly rents; and (c) new innovations replace old technologies. In other words, growth involves creative destruction.

In the model based on industrial organization theory, the final good is produced by intermediate input with existing technology (input quality) in a moment, as seen in Equation (1):

$$Y = Ay^{\alpha}. \tag{1}$$

It is assumed that existing technology (input quality) A increases with every new innovation ($\gamma > 1$) (which is called quality ladders by Grossman and Helpman 1991), and a unit labor is used for each intermediate input. In short, y indicates both intermediate input and labor productivity. Total labor consists of labor used in the production of intermediate-input and labor devoted to R&D. The allocation of labor between these two sectors is determined according to the current wage rate and the return of the future innovation (research arbitrage Equation (2)):

$$w_k = \lambda V_{k+1}. \tag{2}$$

Eventually, economic growth is determined by the productivity of technology, the size of innovation, total labor quantity, and the intertemporal discount rate (Equation (3)). In other words, economic growth results from innovation that improves the quality of the intermediate input used in the production of final goods. In this context, first prediction of the Schumpeterian growth model is that the turnover rate λz is positively correlated with the growth rate g.

$$E(g_t) = \lambda z ln\gamma. \tag{3}$$

The Schumpeterian Model's distinctive proposition from both the neoclassical and Romer's product variety models is that competition increases rather than decreases growth. This proposition is made by dividing the sectors of intermediate inputs into two groups. In the first group of the sectors, firms near the technology frontier (or compete for neck and neck with their rivals) and new entries stimulate incumbent firms' innovations and increase productivity. Increased product market competition

will encourage these firms to innovate to acquire a lead over their rival in the sector. This situation is referred to as the *escape-competition effect.*

On the other hand, in the second unleveled sectors that firms are not neck and neck, increased product market competition will have a more ambiguous effect on innovation. In particular, it will discourage innovation by laggard firms when they do not put much weight on the (more remote) prospect of becoming a leader and instead mainly look at the short-run extra profit from catching up with the leader. This situation states the *Schumpeterian effect*. Finally, the steady-state fraction of neck-and-neck sectors will depend on the innovation intensities in neck-and-neck *versus* unleveled sectors. We refer to this as the *composition effect*. In other words, the overall impact on growth will thus depend on the (steady-state) fraction of leveled *versus* unleveled sectors. But this steady-state fraction is itself endogenous, as it depends on equilibrium R&D intensities in both types of industries. The Schumpeterian Model suggests a second prediction from this overall effect: competition and productivity growth display an inverted-U relationship. Higher competition starts from a low level of competition, which stimulates innovation and growth; when starting from a high initial level of competition, higher competition has a less favorable or adverse effect on innovation and productivity growth. The third related prediction is that patent protection complements product market competition, encouraging R&D investments and innovation.

The proponents of the Schumpeterian growth theory were not content with this but also made a series of empirical studies to test the various relationships between growth and firm dynamics using data at the microfirm level. Some of the facts that non-Schumpeterian growth models cannot account for can be referred to as follows: (a) the firm size distribution is highly skewed; (b) firm size and firm age are highly correlated; (c) small firms exit more frequently, but the ones that survive tend to grow faster than the average growth rate; (d) a significant fraction of R&D in the United States is done by incumbents; and (e) the reallocation of inputs between entrants and incumbents is an essential source of productivity growth. In addition, neo-Schumpeterians also accounted for the relationship between growth and development by various empirical studies on the appropriate innovations, institutions, and firm dynamics (Aghion, Akcigit, and Howitt 2014, 2015a, b).

3.3 Technology and International Trade

The efforts to develop endogenous growth theories based on technology in closed economies and application of these efforts also on international trade led to a change in the existing foreign trade theories (based on factor endowment and specialization) such that they also include technology. The existing theories rest on a static equilibrium analysis under assumptions of conditions of perfect competition, diminishing returns to scale, and given technology (or the fact that all countries have the same technology) (which also make up the hardcore of neoclassical growth theory). In this view, countries' factor endowments and comparative advantages determine the international trade patterns. The new theoretical framework, which forms the basis of Schumpeterian international trade theory, on the other hand, is a dynamic continuous adjustment or disequilibrium process. It defends the view that international trade pattern is

determined by technology (or product quality) gaps between countries under assumptions of imperfect competition and increasing returns to scale.

The technology gap between the countries excluded from the analysis with an assumption in the traditional neoclassical foreign trade theories resulted in reformulations of conventional theories and the development of new trade theories.

As a reformulation of the traditional trade theory, Neo-Endowment Theory of Trade, while keeping the assumption of the constant world production function, converted the conventional model with two factors of production into a multifactor model with considering science and technology as intermediate goods. Accordingly, just as in the two-factor comparative advantage model, countries with a comparatively richer stock of knowledge will produce knowledge-intensive goods (Bart Verspagen and Katharine Wakelin 1997; see for two examples Robert M. Stern and Keith H. Maksus 1981 and Leo Sveikauskas 1983).

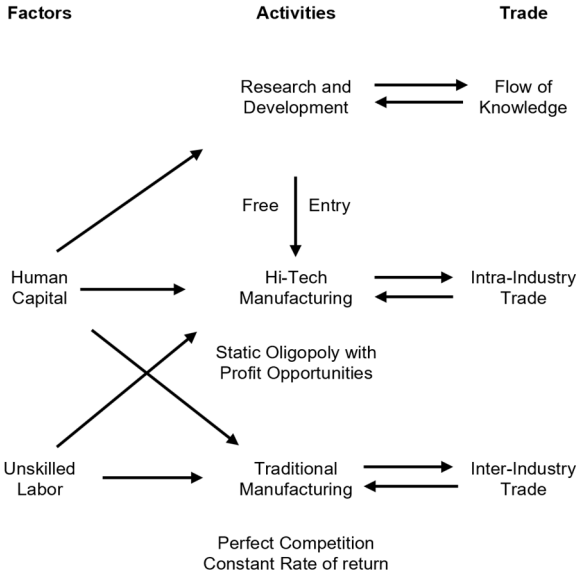
One of the models in which technology is considered as an endogenous factor is *New Trade Theory*, and the other is *Neo-Schumpeterian* (or *Evolutionary*) *Trade Theory.* The difference between these two approaches is specified as follows: "The most recent new growth contributions (e.g., Romer, Lucas), particularly when concerned with open economy issues (e.g., Grossman and Helpman), follow similar lines of concern. However, their treatment of technological change remains as yet rather traditional and, in our view, somewhat remote from the process described by the Schumpeterian paradigm of the economics of technological change" (Dosi, Pavitt, and Soete 1990, p. 198).

Here we would like to state the essential characteristics of these models without going into mathematical details.

3.3.1 New Trade Theory (Grossman and Helpman Model)

The starting point of the Grosman and Helpman (1990a) model is the hypothesis that technological progress will not lead to diminishing returns. Thus, the engine of economic growth in the world economy is industrial innovation. Developments in the global economy have also created significant opportunities to comprehend the growth performance of economies through foreign trade. First, the extent to which countries would specialize in creating knowledge and producing human-capital intensive goods using new technologies may be considered with the help of known comparative advantages. Second, the larger-scale world economy increases the chances of using the benefits of R&D and guides toward new technological investments. Third, in the world of fast and cheap communication, ideas and information quickly spread on a global scale. Thus, countries may earn from their knowledge-capital investments to a certain extent and also suffer losses to a certain extent due to the spillover effect. Fourth, participation in international capital markets creates significant opportunities for funding all kinds of investments, including knowledge capital (Grossman and Helpman 1990b, p. 86).

A relationship is built between technological innovation, growth, and international trade through three factors of production and three production activities in the model. The model can be explained by using Figure 1 (Horst Siebert 1991, p. 806; Gülsün G. Yay 1993).



Source: Siebert (1991).

Figure 1 The New Trade (Grossman-Helpman) Model

In this model, three factors of production include capital, unskilled labor, and human capital: Whether labor is skilled or unskilled is based on training in job and education.

On the other hand, three activities where human capital and unskilled labor are used at varying intensities are R&D activity, high technology manufacturing, and conventional manufacturing, respectively. Therefore, the features of each sector/activity can be stated as follows:

- Perfect competition and constant returns to scale prevail in the traditional manufacturing sector.
- The high-technology (hi-tech) manufacturing sector is defined by an oligopolistic market structure and continuum of industries. The situation of each hi-tech firm in the market depends on R&D input. If R&D input has been determined, an oligopolistic structure in the product market is a given. Oligopolies are static in this sense. The hi-tech manufacturing sector is modeled in two ways: In horizontal innovation, there is the creation of innovations, additional products that increase the number of options for consumers who like variety, and extension of the existing set of goods. In this case, the outcome of the R&D process is new and differentiated goods. In the quality improvement model approach, there is vertical innovation. Here, a superior-good is being produced in terms of quality and qualification, and the outcome of the R&D sector is the chances of an entrepreneur to succeed in a research attempt, that is, the product in the following period (Grossman and Helpman 1991b).
- The target of R&D activities is to reap profits in the hi-tech manufacturing sector. In other words, profit opportunities in the hi-tech manufacturing sector

determine the R&D process, leading to free entry. R&D activity is an ordinary activity that associates input with output through production technology to obtain new and advanced products, improve quality, and reduce costs. However, because of profit expectations in the hi-tech manufacturing sector, firms do not avoid R&D costs and allocate resources to achieve a favorable oligopolistic position in the market (Siebert 1991, p. 803).

Because the Grossman and Helpman Model considers the R&D process within the scope of free entry, it accepts that entrepreneurs may establish research laboratories once they realize the incentives of this activity. Then, in a state of equilibrium where there is an active R&D sector, the expected returns of this activity must be standard; that is, the capital must reflect the opportunity costs and compensate for the risks (Grossman and Helpman 1990a, p. 87). R&D competition between firms keeps both innovation activities and imitation activities alive. The availability of new products and imitations may reduce profit flows. The same perspective also applies to international trade. The presence of foreign competitors and imitators may shorten the period of any profit opportunity (Segerstrom 1991, p. 808).

Another critical issue in the model is that innovations are dealt with as a by-product of the stock of knowledge capital. The outcome of the R&D sector is a function of the human capital used in this sector and the existing stock of knowledge capital. Because knowledge capital is defined as a public good, consumption of which is non-rival, and creates an externality, R&D activities do not only create blueprint imitations, for which patent rights may be obtained, or new product designs, but they also increase the stock of knowledge. The link between a firm's investments (or innovation activities) and its stock of knowledge is established *via* the patent system. Suppose firms cannot avoid the spread of their technological innovations. In that case, the patent system may protect innovators' rights (profits) at the national and international levels. At the same time, it also causes the spread of knowledge at the international level. Therefore, the patent system also accelerates growth while encouraging innovations at the international level.

There are four types of international trade are described in the model:

- Interindustry trade in the traditional manufacturing sector is explained within the framework of the Heckscher-Ohlin Model's well-known comparative advantages, differences in factor endowment, and perfect competition assumptions.
- Intertemporal trade is similar to interindustry trade within the framework of the time dimension. For example, a country with high savings (one with a low ratio of time preference) would export today and import tomorrow. On the other hand, a country with a high marginal rate of transformation would import today and export tomorrow. This associates capital flows with trade.
- Intra-industry trade defines the international trade of hi-tech products (firms that can produce such goods) in the oligopolistic competition process.
- Finally, there is the flow of technical knowledge.

In the Grossman and Helpman Model, the world economy gives us an international trade system consisting of the core (Northern) countries that create innovations and compete for innovations (Japan, United States, European countries) and the

periphery countries, which are (Southern) countries that produce imitation products that may substitute products made in the core.

The starting point for the model is the Heckscher-Ohlin Theory, which suggests that the initial factor endowments of countries would determine their areas of expertise and pattern of trade. Accordingly, core (northern) countries rich in human capital stock will specialize in R&D activities, which are intermediate inputs of hi-tech products, and export hi-tech products. On the other hand, periphery (southern) countries with a high stock of unskilled labor will specialize in producing and exporting conventional goods. If we assume that there is no probability of spreading knowledge at the international level in the system, a growth pole will form in core countries at the end of the process.

However, factor endowments do not have to be static: Human skills may improve through education, and capital stock may increase through investments and savings. Moreover, suppose there is no barrier to spreading innovations/technical knowledge globally. In that case, this will cause to grow in the world knowledge-capital stock and positively impact the outputs of other countries (Siebert 1991, p. 806).

In this case, on the one hand, monopolistic power and profit of Northern (Core) countries that initially allocated resources to R&D and producing products with increased quality would rise. On the other hand, in the South, Southern firms that imitate the advanced techniques in the North would engage in a costly business and earn monopolistic profits in return. Therefore, countries that are trade partners will have obtained mutual gains from international trade. Profit flows of the entrepreneurs in the North cease with the emergence of imitation products. The earnings in the South continue until a new development takes place in the industry.

3.3.2 Neo-Schumpeterian Trade Model

Neo-Schumpeterian trade approach is based on the role of technology in explaining both static trade specialization and the evolution of trade patterns. The approach qualifies a disequilibrium approach that deals with technology in detail as an economic concept. In other words, international economics (or international trade pattern) describes a continuous process of adjustment rather than a process automatically directed toward equilibrium. The absolute advantages will determine the place of a country in this adjustment process in terms of costs (wages) and technology (product quality).

Characteristics of the model expressing that the development of international trade flows will be determined by global and intersectoral technology differences (or technology gaps) may be summarized in four aspects (Dosi, Pavitt, and Soete 1990; Verspagen and Wakelin 1997):

1. The main motivation of the dynamic process is absolute rather than comparative differences between countries. Just as a country's economy consists of numerous firms, the international economy may also be considered a whole as numerous firms in various sectors and countries. In other words, technology is not a free good but shows varying degrees of appropriability at the company and country levels. Absolute differences between firms determine both their presence in the biological sense and their competition with other firms in the economic sense. The main determining factors

at the international level are product quality and price differences between firms. In these respects, firms will increase or lose their shares in global markets based on their levels of international competitiveness.

2. Technology is assumed to be an endogenous phenomenon as in the new trade theory. Technology may be both private and public at the microeconomic level. Therefore, benefits of innovation may be partially appropriated. Based on the assumption that the spread of knowledge/technology across countries will be more complex than its spread within the country, technology differences between countries are considered continuous. In other words, through imitation, national economies will not catch up with the global technology frontier. In short, the technology gap depends not only on different endowments but also on capital accumulation.

3. There are significant linkages between specialization and growth. For example, higher innovation may mean higher economic growth, whereas specific goods specialization implies a particular growth regime. In other words, there is a mutual interaction between endogenous technology, endogenous comparative advantage, and growth.

4. The significance of institutions in the development of technological change is emphasized. Institutional differences between countries are in mutual interaction with technological gaps. Institutional-historical characteristics such as the level of education in the country, legal framework concerning innovation rights such as the patent system, country history, and market structure play a significant role in relationships between technology, growth, and trade.

Here, significant aspects of the relationship between technology and growth in an open economy are emphasized within the Neo-Schumpeterian trade theory developed in Dosi, Pavitt, and Soete (1990).

The model's starting point is that the main factor for determining different growth performances of open economies and the degree of their participation in world trade (in other words, their trade patterns) is technology asymmetries between countries. Technology is not a free good in the model and depends, to a certain extent, on the characteristics of the firm or country. A sequence of technical patterns listed as superior or inferior in economic terms is defined. Their absolute technical advantages are the main determining factors of countries' trade patterns.

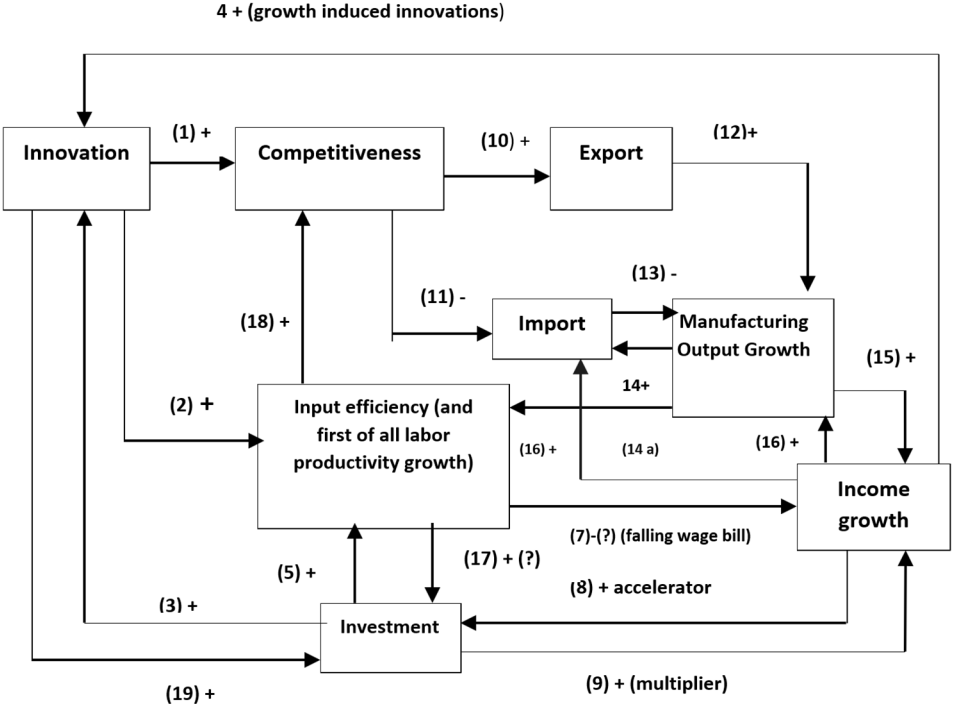
Significant consequences arise when we adopt the concept of technical change to the growth process. First, each economy's probability of growth is technically limited to its production coefficient. Second, the production pattern of an economy does not depend only on its consumption and production coefficients but also on factors that determine its international specialization and international terms of trade. Third, an economy must pay its imports by its exports while buying goods from another country. Technology influences all of these variables and determines the growth of national economies.

In this respect, the model analyzes mutual interaction of three topics: (a) the effects of technological differences between and within countries; (b) the microeconomic processes of specialization; and (c) Keynesian account of macroeconomic levels of activity in open economies.

Without entering the mathematical formulation of the model, we can say that the mutual interaction between technical change or innovations, international trade, and growth may be explained as follows through three channels.

The first channel, named *technological regime*, shows the chain of causality between innovation and growth. These links (shown as links 1-5 and 19 in Figure 2) depend on the direction and intensity of the positive feedback between growth and technical change as much as on the quality of technology. Innovation increases both competition and efficiency simultaneously, thereby encouraging economic growth.

The second channel, *the regime of insertion in the world economy*, shows the effect of innovation on the country's competitiveness (links 1, 10-13, and 18). Absolute advantages brought about by innovation result in increased exports, although this effect also depends on the country's trade balance. The relationship between tradable and nontradable sectors (links 15, 16) is also shown here. This demonstrates in some way that the openness and growth rate of a country are linked to the efficiency of tradable goods.



Notes: (+) and (-) signs stand for likely direction of the effect.

Source: Dosi, Pavitt, and Soete (1990, p. 229).

Figure 2 New Schumpeterian Model

The last channel, *the regime of macroeconomic demand formation* (link 19), shows the mutual interaction of increased efficiency brought about by growth (learning

by doing) and multiplier-accelerator mechanisms. Thus, it is combined with the technological regime (links 7-9, 14a, and 17 in Figure 2). Dosi, Pavitt, and Soete (1990) make the following inference about their model:

> *We can predict that it presents an adequate representation of international differences in growth patterns, whenever both the technological regimes and the regimes of macroeconomic demand formation are stable through time, when they are relatively similar across countries, and when the institutional set-ups and policies are rather similar. One can see that these conditions broadly correspond to the period of high growth following the Second World War.*

4. Conclusion

Schumpeterian economists, who take Schumpeter's opinions as a basis, have laid the foundations of a different paradigm, which will shed light on and guide current issues of societies, with the studies they have conducted in various fields of economics in the last 35 years (Hanusch and Pyka 2005, 2007). Neo-Schumpeterian paradigm has contributed to the emergence of an integrated theory of the firm and entrepreneurship based on innovation, learning, and knowledge. It has also obtained significant achievement in creating a different firm approach by itself. The same applies to the macro field of economics: Models of the Schumpeterian paradigm in growth and international trade are central to modern growth and foreign trade discussions. At the same time, it also offers an integrated macro framework that includes economic growth and foreign trade by itself.

In addition, beyond the distinction of micro and macro, at the meso level, we may talk about the Schumpeterian industrial economics, which emphasized the importance of technological innovations, internal dynamics (roles of small and large firms) of industries, and interindustry relations. It is a distinctive contribution of the Schumpeterian paradigm.

Finally, the view of Schumpeter that economics should not be reduced solely to the static analysis of human behaviors and that it must be turned into a universal social science that addresses the dynamic analysis of economic change of societies together with its institutional, historical, and sociological aspects stands out as a research program to all economists. Thus, the critical implication of the research program is related to enhancing the theoretical framework/toolbox of economics: enhancement of analytical power of economics by linking it to other sister disciplines such as history and sociology. In this context, it is impossible to analyze the economic evolution of societies without the organizational, institutional, and social elements.

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