



Pohulak-Żołądowska, E.. (2016). Innovation in Contemporary Economies. *Oeconomia Copernicana*, 7(3), 451-466. DOI: <http://dx.doi.org/10.12775/OeC.2016.026>

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## **Innovation in Contemporary Economies**

**JEL Classification:** *H53; O12; O32; O38*

**Keywords:** *innovation; knowledge; market economies; the state*

**Abstract:** *The hereby article discusses the issues related to the existing or required support given by the State to enterprises in order to provide them conditions to innovate. Neoclassical economy puts an emphasis to the price mechanism as a decision making effective tool, but enterprises meet many barriers in creating and introducing innovation, like high cost, high risk or lack of demand for innovation. These phenomena tend to inhibit innovation of enterprises. This means that market is not an efficient mechanism for innovation activity of enterprises, and its imperfections provoke the State's intervention. The goal of the article is to shape the objectives of State's impact on decisions of innovative enterprises. Research method is the critical literature review and public data on State's support on business R&D analysis. The research results show State's support for both – incremental and radical innovation, which proves that innovative activity of enterprises is far from being a spontaneous, market-based process.*

## **Introduction**

Contemporary economies development is strongly related to innovation. Innovations which are understood as „something new proven to be useful” cause the productivity, value added and economic growth. The ultimate performers of innovation are enterprises. And according to Schumpeter – innovation is an autonomous feature of an entrepreneur, who looks for new solutions and introduces them to the market. His most important goal is to maximize the profit. However, innovation activity (especially in the field of disruptive innovations) is an activity that involves high cost, risk and uncertainty. Profits constituting the reward and the basic motivation for an entrepreneur in innovative activity are highly uncertain and deferred. Thus the entrepreneur does not necessarily find innovative activity attractive. The question arises whether decisions on introducing innovative activity in enterprises are independent business decisions. If an entrepreneur avoids high risk and uncertainty, what makes him become innovative? The huge role is played by the State. Its actions are of twofold nature: first – it reduces the “market imperfections” which makes innovative activity in enterprises possible. Second – the State creates markets and enables innovation diffusion. The goal of the article is to identify the tools thanks to which the State influences the innovative decision of enterprises in case of both: sustained and disruptive innovations.

## **Research Methodology**

The hereby article is an attempt to specify the tools the State uses for the purpose of stimulating the innovative behavior of firms. First, the importance of innovation for economy has been described. The growth theories for which innovations (as a technological change) are the important pro-growth factor have been shown. The possible State’s actions in promoting technology-driven growth have been underlined. Then the innovations have been classified. Four innovation types have been listed with respect to two criteria: the level of financial involvement and the risk (profit). In the next paragraph, the twofold attitude of entrepreneurs to innovative activity has been taken into account (as a result of their opportunism) – autonomous (spontaneous) innovator, and “conditional” innovator. The first entrepreneur type is “Schumpeterian-like”, the other – “State-dependent”. Innovative activity of enterprises is a high-cost, high-risk activity, therefore the State – as a stimulus, plays a huge role here. The tools by which the State influences firms’ decisions have been specified, and then matched with

each innovation types. Therefore, two kinds of tools have been listed – classic and institutional ones. The R&D expenditures as the main category of classic tools has been considered.

For the purpose of achieving the objectives of the hereby article, the critical analysis of literature has been made, in territorial, theoretical and methodological contexts.

### **Innovation in Growth Theories**

Many words have been said about innovation so far. As Oslo Manual (OSLO, 2005) says, innovation, as an outcome of creative application of knowledge, is seen to play the central role in the knowledge-based economies. It gives the knowledge a crucial role in economic processes, and for this reason the nations that develop and manage effectively their knowledge assets perform better. And innovation – as a new product, process or method, freshly introduced to the market – is an outcome of relevant knowledge application. Its role is to bring wealth and social welfare (Vaitheeswaran, 2007), it is an inherent feature of entrepreneurship.

Entrepreneurship and innovations constitute the basis for the first theory explaining the activities that lead to economic growth in capitalist economies. The author of that theory is Schumpeter (Schumpeter, 1960). His theory centers around innovations done by entrepreneurs, and their key driving role in the economic growth. Schumpeter argues that competition among market participants makes them look for new ways to improve technology, new ways to do business and other types of advantages that would increase profit margins and directly influence the entrepreneur's standard of living. Schumpeter identified innovation as the critical dimension of economic change. He argued that economic change revolves around innovation, entrepreneurial activities, and market power. Schumpeter gives the entrepreneurial power of enterprises the leading role in creating innovation.

Subsequent economic theories trying to explain the interplay between innovation and economic growth were Abramowitz (1956) and Sollow (1956), who showed that the economic growth is rather a result of “unexpected residual” reflecting the productivity growth rather than the quantity of production factors. But it was Robert Sollow who modeled the growth through production function, where the output is a function of quantity of physical capital and human labor – *ceteris paribus*. The technological change responsible for innovation was performed as exogenous to the production factors (compare Mazzucato, 2014; Woźniak, 2008, p. 189). As the technology became a more vital part of innovation and – growth landscape,

the economists had to reconsider its place in the growth models. This gave rise to the “endogenous” or the “new growth” theory. This theory states that it is the technology that gives the endogenous outcome of an R&D investment function as well as investment in human capital formation (Grossman & Helpman, 1991). It is noteworthy that in the new growth theory, new ideas were treated as endogenous to the enterprise, not to the institutional organization that transforms ideas into products. The relation between technological change and growth indirectly led policymakers to focus on the importance of investment in technology and human capital to foster growth (Mason *et al.*, 2009). The consequence of that is the emergence of innovation-led growth policies that support the knowledge economy. Policy indicators like R&D spending and patent success became the evidence of the market value of firms and their innovation performance. But the State with its policies became a vital part of the innovation landscape.

The ‘Evolutionary Theory of Economic Change’ (Nelson & Winter, 1982) was built in opposition to the endogenous or exogenous growth theories. The theory was built on the basis of Schumpeterian approach to innovation. In perspective of this attitude innovation is firm specific and highly uncertain.

The mix of Schumpeterian and ‘evolutionary’ approach to studying firm’s pro-innovation behavior has led to the ‘systems of innovation’ policy, where the most important thing is to understand the way in which firms are set in a system of sectoral, regional or national levels. In this view, not the quantity of R&D is important, but the way it is distributed throughout the economy. And here’s the place for State’s dominance – it is the State that influences the distribution. The definition of systems of innovation describes relations of economic actors: “...networks of institutions in public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies” (Freeman, 1995), or “...the elements and relationships which interact in the production, diffusion and use of economically useful knowledge” (Lundvall, 1992).

The importance of innovation for the economies’ performance is unquestioned. Schumpeter asserted that innovation is a result of autonomous entrepreneurial decisions of entrepreneurs. Further growth theories found innovative activity of the firms susceptible to State’s action in form of innovation support policies (Manso & de Matos, 2015, p. 14). The question is – who is the innovator? Is it still an autonomous enterprise or not? Are profit prospects that significant that enterprises innovate (or auto-innovate)? Or is it State’s policy that introduces innovation to enterprises (by lowering risk and costs)?

### **Types of Innovation**

The crucial issue at this moment is to understand the idea of innovation. The dominant part of each innovation definition is the word “new”. So innovation is defined as a new solution, new product, new process. Its novelty is the most important part of the definition. Innovation is a solution introduced to the market. Innovation without a market success is only an invention.

But how new are the innovations? The definitions of innovation show a wide range of possible examples of innovative solutions, from small-step improvements to great, disruptive projects. But are the enterprises equally willing to create incremental and radical innovations? Where is the difference between those definitions?

Incremental innovation can be understood as a series of small improvements to an existing product or product line that usually helps maintain or improve its competitive position over time. Radical innovation is concerned with exploration of new technology, it is fundamentally different from incremental innovation that is concerned with exploitation of existing technology. "Radical innovation is a product, process, or service with either unprecedented performance features or familiar features that offer potential for significant improvements in performance and cost"(Leifer *et al.*, 2000). It creates such a dramatic change in processes, products, or services that they transform existing markets or industries, or create new ones. The differences between incremental and radical innovation are shown in Table 1.

**Table 1.** Radical vs. Incremental innovation

<b>Radical innovation</b>	<b>Incremental innovation</b>
Explores new technology	Exploits existing technology
High uncertainty	Low uncertainty
Focuses on products, processes or services with unprecedented performance features	Focuses on cost or feature improvements in existing proceses, products or services
Creates a dramatic change that transforma existing markets or industries, or creates new ones	Improves competitiveness within current markets or industries

Source: Retrieved from [http://www.1000ventures.com/business\\_guide/innovation\\_radical\\_vs\\_incr.html](http://www.1000ventures.com/business_guide/innovation_radical_vs_incr.html).

In 1997 Christensen in his seminal work suggested different view on the innovation. He’s also identified two kinds of innovation: disruptive and sustaining ones (Christensen, 2010).

The first characteristic of a disruptive innovation is that it initially provides inferior performance (as measured by the prevailing industry metrics) to existing products available. As a result, it is usually not of much interest to existing users or customers. The second characteristic of a disruptive innovation is that it is adopted by a market that is currently underserved, or not served at all. In other words, it serves a market segment that did not exist before. Since disruptive innovations are usually not of interest to a company's existing customers, market leaders are rarely a source of disruptive innovations.

As opposed to disruptive innovation, there is a sustaining one. Sustaining innovation is one that perpetuates the current dimensions of performance – for example Intel developing faster and faster chip speed. In contrast to disruptive innovation, a sustaining innovation does not create new markets or value networks, but rather only evolves existing ones with better value, allowing the firms within to compete against each other's sustaining improvements. Sustaining innovations may be either "discontinuous" (Christensen describes as "revolutionary" innovations as "discontinuous" "sustaining innovation" i.e. "transformational" or "revolutionary") or "continuous" (i.e. "evolutionary") (Christensen, 2010, pp. 21-22).

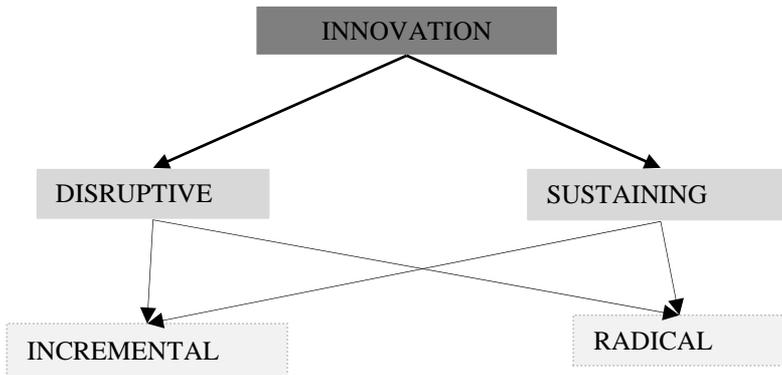
Radical and disruptive innovations differ. Radical innovation almost always seems to mean an order of magnitude improvement in performance, or a significant shift from existing performance or solving a complex problem that existing products don't solve. This means more sophisticated technology, based on pushing the boundaries of knowledge (like biopharmaceutical drugs – a completely different technology addressed to medical problems that could not be solved satisfactorily by existing drugs).

Disruptive innovations do not need to be based on radical technological innovations of this nature (microfinance, for example, did not involve radically new technology). However, some disruptive innovations can be radical as well.

Radical innovations would rarely be classified as disruptive because, as we have seen, they are often aimed at driving the performance frontier rather than serving under-served or unserved markets.

Undoubtedly these two classifications of innovation refer to different distinctive features. Incremental and radical innovation are innovation types distinguished due to the creation method. Disruptive and sustaining innovation are more about consequences that entrepreneurs have to bear due to market introduction of a new product or process. This means that from an entrepreneur's point of view there are two kinds of innovation: disruptive and sustained. And these innovation types have two features each: radical or incremental.

**Figure 1.** Innovation types and features

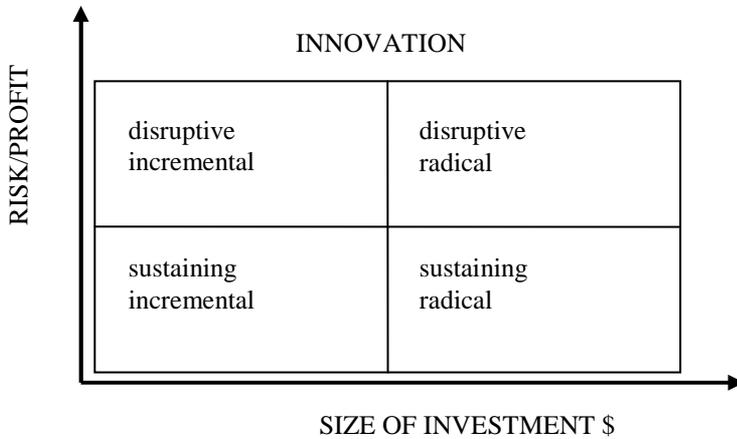


Source: own work based on Christensen (2010, p. 21-22), Leifer *et al.* (2000).

The crucial determinant of entrepreneur’s engagement in innovative activity is the level of risk. And the risk (uncertainty) level is correlated to the height of investment done (the higher uncertainty level the more money is being invested). The motivation for high-risk, high-cost investment is a possibility of obtaining a profit that is higher than in any alternative activity.

The level of risk is the determinant of autonomous innovative activity of enterprises. With increased risk the propensity to innovate autonomously decreases. Unlike Schumpeter claimed, enterprises do not fancy risk much enough to invest in areas where returns are highly uncertain. This puts disruptive radical innovations in the position of the matrix (see Figure 2) where the level of the risk and money necessary to invest discourage firms from their entrepreneurial activity. If the level of autonomous firm’s involvement in innovative activity can be understood as the money that enterprise is willing to invest – the term “incremental” will determine the autonomous innovation activity of enterprises. High profits from disruptive incremental innovations can be understood as a bonus here.

High level of investment is the barrier that stops many firms from innovative activity. Radical sustaining innovations are high cost/low risk ones, and they result with smaller profits than disruptive radical ones, which are top risk and top cost ones. Undoubtedly they have a potential of high profits, but at high cost that excludes enterprises from this kind of activity. This means that enterprises behave in a Schumpeterian way to a limited extent.

**Figure 2.** The innovation matrix

Source: own work based on Christensen (2010, p. 21-22) and Leifer *et al.* (2000).

### **Inclination to Innovation**

According to the types of innovation selected in the previous paragraph, one can find that the criterion of firm's involvement in innovative activity is firstly – the cost, and secondly – the risk. This means that the autonomous innovative activity of a firm refers mainly to the incremental innovations. The sustaining incremental and the disruptive incremental innovations are both the low cost ones, and more often the result is sustaining than disruptive. The relation between incremental innovation and growth is inadequate. As Tucker in his seminal work says: “Because much of the innovation taking place today is incremental, so is its impact on growth. Little ventured, little gained” (Tucker, 2008). It means that entrepreneurial behavior of firms seeking innovation does not bring the growth. And the improvements – important to firm's production process because of the productivity increase and firm's economic performance, do not cause the upswing of economy's competitiveness.

On the opposite corner of the innovation matrix there is disruptive-radical innovation. If successful – it guarantees high profits and new market emergence. It is a high-risk and high-cost activity that majority of enterprises will not choose. It is concentrated on new knowledge creation (more like basic, than applied or experimental research). Moreover – disruptive radical innovation do not only mean “high cost”. They also mean “new

product” with no existing market. So the profits from this kind of activity are possible to achieve in a more distant future than an enterprise is willing to wait. However, disruptive radical innovations have a positive impact on economy’s performance. They are more likely to create growth and increase competitiveness than incremental ones. So are radical-sustaining innovations. They can create new markets, they do not break the business cycle, but they create new products. They are developing new technologies.

Enterprises do not accept the high-risk innovation activity, but such an activity can cause many benefits to economy. The catalyst of high-risk innovation activity is the State. The State’s activity is twofold. The classical attitude to the role of the State in the economy concerns “market failure” approach. The State’s role is to fix the “market failures”, which are unexpected (and therefore not included in the costs) external effects of economic activity of market players like, for example: pollution (a negative externality, not included in firm’s costs), etc. The standard economic theory justifies State’s intervention when social return on investment is higher than private return, which makes it unlikely that private business will invest (Mazucato, 2014). The modern attitude to State’s role in this field is more complex. The State’s role is not only to “de-risk” private sector decisions. It’s role is to solve main socioeconomic questions like ageing, hunger, diseases, climate change, etc. Rather than active correction of ‘market failures’ its role is to shape and create the markets (Gorączkowska, 2015, p. 146). The most adequate here are the findings of Karl Polanyi (1944), who emphasized how the capitalist ‘market’ has from the start been heavily shaped by the State’s actions. In innovation, the State not only ‘crowds-in’ business investment but also ‘dynamizes it in’ – creating the vision, the mission and the plan.

### **Tools to Promote Innovation**

In general, State’s impact on innovation in enterprises is at least twofold. First – State can provide a direct or indirect support. This is a well-known kind of support used as a part of country’s industrial policy. The support given to enterprises may take the form of direct (e.g. subsidies, grants, loans etc.) or indirect (fiscal policy instruments) financing. It can also have a form of institutional support (like DARPA or SBIR for innovation in USA). Second – knowledge-based economies are strongly dependent on new knowledge. Therefore, the State’s role is also to create society’s creativity in order to reap benefits from it.

It is noteworthy that the State's support to enterprises in the form of financing R&D expenditures is dedicated more to incremental innovation than to radical ones. The high risk and uncertainty of the innovation process are the main reasons for which profit-maximizing companies would invest less in basic and more in applied research (D from R&D). The greater and more immediate returns from the latter are a good explanation of these. Investment in basic research is a typical example of fixing 'market failure' where the market alone would not produce enough basic research, so the government must step in. Therefore, enterprises mainly get involved in the development, which is a more predictable activity than research (especially basic research). Innovations that arise in this way are mainly improvements and developments of the existing products or processes. Radical innovations strongly rely on new knowledge, which is created mainly in form of basic research. As the data show (OECD 2013, p. 102; 2014, p. 194) most basic research is performed in universities and in public research organizations. The mission-oriented, highly risky and unsecure, but potentially extremely profitable projects are based upon basic research. For the US economy, for example, the government spending on R&D makes up only 26% of the total R&D, with the private sector making up 67%, with the proportion being much higher when basic research is considered in isolation. Indeed, public spending accounts for 57% of basic research in the USA, with the private sector accounting for only 18% (Mazucatto, 2014). So, the State's support to this kind of research institutions influences new knowledge creation and therefore impacts both forms of radical innovation creation.

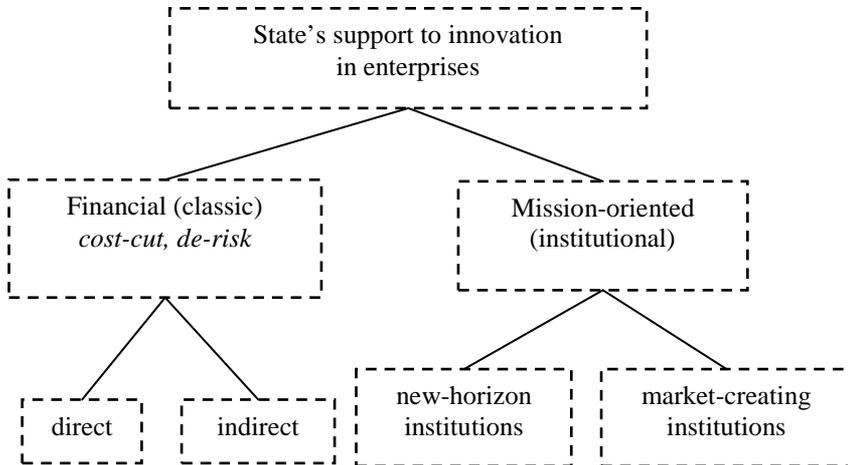
The State's support to innovation does not only mean reduction of risk and cost, especially in case of disruptive innovations. Disruptive innovations constitute the supply of innovations that are addressed to an unknown market or – such a market does not exist yet. Therefore the States' support must reach far beyond financing. The interplay between demand and supply is needed here to provide a market for innovation. The problem has been widely discussed in literature (Etzkowitz, 2008).

As presented in Figure 3, the State's support to innovation in enterprises is twofold. Financial support to innovation creation considers mainly financing of enterprises R&D activity – directly or indirectly (see Table 2).

Direct funding enables regulation of the way research is conducted, and it is often used to stimulate cooperative research. This activity is aimed at strengthening the network between research institutions and firms in order to stimulate knowledge and technology transfer. Direct funding also reduces the high risk taken by private business while investing in research, and encourages innovative investment. Moreover, direct funding generates

a value added. However, direct funding comes in the form of recognition and is often criticized for picking the winners (Rószkiewicz, 2014, p. 4).

**Figure 3.** State’s support to innovation in enterprises



Source: own work based on Mazzucato (2014) and Etzkowitz (2008).

The State’s mission-oriented support for business innovation can be characterized as institutional support, because the State – through establishing the institutions affects both – firms’ propensity to involve in risky and costly activity and creates the conditions for innovation to diffuse. They are both important to disruptive innovations. There are numerous examples of State’s activity in this field. For example public procurement for R&D and innovation. It is an instrument that creates a demand for technologies or services that do not exist, or, targets the purchase of R&D services (pre-commercial procurement of R&D). It also provides early-stage financial support to high-risk innovative technology-based small firms with commercial promise. The examples here are Small Business Innovation Research (SBIR) Program (USA) and SBIR-type of programs (UK). Another example can be technology consulting services and extension programs that expand the diffusion and adoption of already existing technology, and contribute to increase the absorptive capacity of targeted firms (especially SMEs). Provide information, technical assistance, consulting and training, etc.

**Table 2.** Major public instruments for financing business R&D and innovation

Financing instruments	Key features	Some country examples
<i>Grants, subsidies</i>	Most common funding instruments. Used as seed funding for start-ups and innovative SMEs. Granted on a competitive basis and in some cases, on the basis of private co-funding. No repayment is usually required. Supply-side, discretionary instruments.	ANR subsidies (Argentina), Central Innovation Programme for SMEs (Germany), R&D Fund (Israel), Small Business Innovation Research (SBIR)Program (USA)
<i>Credit loans</i>	Government subsidised loans. Require sorts of collateral or guarantee. Obligation of repayment as debt. The investor/lender does not receive an equity stake.	Novallia (Belgium), High-Tech Gründerfonds (Germany), Public Investment Bank (France), Microfinance Ireland, Slovene Enterprise Fund, British Business Bank (Great Britain)
<i>Debt financing</i>	<i>Repayable grants/ advances</i>	Repayable Grants for Start-Ups (New Zealand)
	<i>Loans guarantees and risk-sharing mechanism</i>	Used widely as important tools to ease financial constraints for SMEs and start-ups. In the case of individual assessment of loans, can signal ex ante the creditworthiness of the firm to the bank. Often combined with the provision of complementary services (e.g. information, assistance, training)..
	<i>Non-bank debt/equity funding</i>	New funding channels. Innovative lending platforms and non-bank debt or equity funds.
	<i>Mezzanine funding</i>	Combination of several financing instruments of varying degrees of risk and return that incorporate elements of debt and equity in a single investment vehicle. Used at later stage of firms' development. More suitable for SMEs with a strong cash position and a moderate growth profile.
<i>VC funds and funds of funds</i>	Funds provided by institutional investors (banks, pensions funds, etc.) to be invested in firms at early to expansion stages. Tends to increasingly invest at later -less risky- stage. Referred as patient capital, due to lengthy time span for exiting (10-12 years). The investor receives an equity stake.	Seed Fund Vera (Finland), France Investment 2020, Yozma Fund (Israel), Scottish Co-investment Fund (Great Britain)
<i>Business angels</i>	Provide financing, expertise, mentoring and network facilities. Tends to invest in the form of groups and networks. Financing at start-up and early stage.	Seraphim Fund (Great Britain), Tech Coast Angels and Common ANGELS (USA)

Table 2 continued

Financing instruments		Key features	Some country examples
Direct public funding	<i>Innovation vouchers</i>	Small lines of credit provided to SMEs to purchase services from public knowledge providers with a view to introducing innovations in their business operations.	Innovation vouchers (Austria, Chile, China, Denmark, etc.)
	<i>Tax incentives</i>	Used in most countries. Broad range of tax arrangements on corporate income tax, including tax incentives on R&D expenditure and, less frequently, tax incentives on IP-related gains. Indirect, non-discriminatory. Available in many countries. Broad range of tax incentives on R&D and entrepreneurial investments and revenues that apply to personal income tax, value added tax or other taxes (consumption, land, property, etc.). Indirect, non-discriminatory.	SR&ED tax credit (Canada), R&D TaxCredit (France), exemption on payroll withholding tax (Netherlands), patent box (Great Britain) Personal wage tax reduction for foreign researchers and key staff (Denmark), wealth tax exemption for business angels (France), Business Expansion and Seed Capital Schemes (Ireland)
Indirect public funding	<i>Tax incentives on CIT</i>		
	<i>Tax incentives on PIT</i>		

Source: OECD (2014, p. 157).

A great example of institution that gave rise to new disruptive innovations is DARPA. It was set up to give the USA technological superiority in different sectors, mainly those related to technology. Its budget is more than 3 billion USD per year, with 240 staff. Going beyond simply funding research, DARPA funded the formation of computer science departments, provided start-up firms with early research support, contributed to semiconductor research and support to human-computer interface research, oversaw the early stages of Internet. DARPA provided both – supply and demand for innovation (Mazucatto, 2014). The next example is SBIR – a consortium between Small Business Administration and different government agencies like Department of Defense, Department of Energy and Environmental Protection Agency. The Small Business Innovation Research programme required government agencies with large research budgets to designate a fraction (ca. 1,25%) of their research funding to support small, independent firms. As a result, many highly innovative start-ups were supported. Literature shows other examples of successful institutional support, like Orphan Drug Act (ODA) supporting biotechnology or, National Nanotech Initiative (Mazucatto, 2014).

One can notice that support given to disruptive radical or disruptive incremental innovations is not only about financing. An even more important issue here is creating a market for innovation or “picking winners” – which means targeting a new growth areas (as a result of industry-university-enterprise interplay).

## Conclusions

Innovation in market economy comes from enterprises. Anyway enterprises are innovation producers. But innovative activity comes not only from enterprises opportunism. Schumpeter claimed that entrepreneurship means innovation. In modern market economies, innovation is strongly dependent on new knowledge creation which often means that it's risky and costly, and entrepreneurs avoid high risk and cost. However, the innovation gives growth and wealth, increases competitiveness of economies. There are numerous tools supporting innovation in business, but the most growth-giving innovations are disruptive innovations. However, their characteristics exclude enterprises as innovative agents. The State, as the main beneficiary of innovation (growth), takes the control on promoting and supporting innovation with help of numerous supporting tools.

The history of breakthrough innovations shows that the State's role in promoting innovation in business goes far beyond financial tools. The State

finances the most risky research – basic and applied, but also can be – and usually is – the source of the most radical disruptive innovations. The State’s role is not only to “fix markets”, but also to create them.

Moreover, the State – thanks to its institutions (laboratories, agencies, Acts) has the potential to accelerate the knowledge diffusion. This means, that the State is the main player of the innovation system, so its role is not limited to the country level, neither to long-term subsidies for specific sorts of activity. The State, in order to create markets and introduce technological progress, uses regulatory tools, orders, public procurement. It means that the State is the catalyst for technology change.

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