WARTA
Kebijakan Iptek & Manajemen Litbang

Vol. 7 No. 2 Tahun 2009 ISSN : 1907-9753

Warta Kebijakan Iptek & Manajemen Litbang	Vol. 7	No. 2	Hlm. 103 – 220	Jakarta, Desember 2009	Terakreditasi sebagai Majalah Ilmiah berdasarkan Keputusan Kepala LIPI No. 536/D/2007 Tanggal 26 Juni 2007

LIPI

PAPPIPTEK-LIPI

Pusat Penelitian Perkembangan Ilmu Pengetahuan dan Teknologi

Lembaga Ilmu Pengetahuan Indonesia

WARTA
Kebijakan Iptek & Manajemen Litbang

LIPI

Vol. 7 No. 2 / Desember 2009 ISSN : 1907-9753

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Warta Kebijakan Iptek dan Manajemen Litbang (KIML) adalah jurnal ilmiah yang dimaksudkan untuk menjadi forum ilmiah tentang teori dan praktik kebijakan ilmu pengetahuan dan teknologi (Iptek) dan manajemen penelitian dan pengembangan (litbang) maupun manajemen inovasi di Indonesia. KIML dimaksudkan sebagai wadah pertukaran pikiran peneliti, akademisi dan praktisi kebijakan iptek untuk pembangunan ekonomi. KIML juga berisi sumbangan ilmiah dalam manajemen litbang dan inovasi untuk daya saing eknonomi. Tulisan bersifat asli berisi analisis empirik atau studi kasus dan tinjauan teoretis. Redaksi juga menerima tinjauan buku baru tentang kebijakan iptek dan manajemen litbang dan inovasi. Terbit dua kali setahun pada bulan Juli dan Desember.

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PENGANTAR REDAKSI\

Warta Kebijakan Iptek & Manajemen Litbang Volume 7 No. 2 Tahun 2009 mengemukakan enam bahasan mengenai masalah-masalah kritis yang terjadi dalam konteks kebijakan iptek dan manajemen litbang. **Erman Aminullah** dalam "*The Needs for Adaptive Innovation Policy under Free Market Complexity: The Indonesian Experiences*" mengawali tulisan Warta edisi ini. Tulisan Erman Aminullah dilatarbelakangi oleh pemahaman yang mendalam tentang peran strategis inovasi dalam penciptaan daya saing, serta lingkungan kebijakan inovasi dalam kompleksitas pasar bebas. Dalam kondisi ketidakberfungsian dan pola-pola yang membingungkan, menyebabkan: (1) harapan berbeda dengan kenyataan; (2) ketidaksetujuan muncul dari pelaksanaan yang tidak adil; (3) percepatan menciptakan pelemahan; (4) solusi menyebabkan masalah; dan (5) resistensi dan penundaan. Penulis berpendapat bahwa diperlukan pendekatan sistemik dalam memahami lingkungan yang kompleks tersebut. Sistem ekonomi yang kompleks membutuhkan pemodelan umpan balik yang adaptif yang dicirikan oleh proses pembelajaran. Berdasarkan pemikiran ini, penulis mengajukan model kebijakan inovasi adaptif untuk bertahan dan dapat menciptakan keuntungan dalam persaingan pasar bebas.

Tulisan berikutnya hadir dari **Erry Ricardo Nurzal, dkk.** dengan judul "Analisis Faktor-Faktor yang Memengaruhi Intensitas Penggunaan *Open Source Software (OSS)* dengan Menggunakan Model Penerimaan Teknologi yang Dimodifikasi". Tulisan tersebut berhasil mengungkapkan tingkat penerimaan OSS paling banyak berada pada kelompok satu-empat jam/hari baik pada kelompok perguruan tinggi negeri maupun swasta. Selain itu, tingkat penerimaan OSS juga paling banyak berada pada kelompok satu-empat kali/minggu baik pada kelompok perguruan tinggi negeri maupun swasta. Selain itu, dari penelitian tersebut terungkap juga faktor eksternal yang memengaruhi intensitas penggunaan OSS secara langsung adalah kualitas OSS, ketersediaan OSS dan gender. Sementara itu, variabel faktor eksternal yang mempengaruhi penggunaan OSS secara tidak langsung adalah kualitas OSS, ketersediaan OSS, keinovatifan personal, gender, pendapatan, dan afinitas budaya.

Sementara itu pada tulisan ketiga yang berjudul "Intensitas Jejaring Litbang dalam Sistem Inovasi Sektor Kesehatan dan Obat-Obatan: Studi Kasus 12 Pelaku Industri Kesehatan dan Obat-Obatan", yang ditulis oleh **Hadi Kardoyo dan Sayim Dolant** berhasil mengungkapkan sejumlah temuan dari penelitiannya. Penelitian yang dilakukan terhadap 12 pelaku industri kesehatan dan obat-obatan dari tiga elemen sistem inovasi (perguruan tinggi, lembaga litbang, dan pelaku bisnis) tersebut mengungkapkan masih banyaknya kelemahan-kelemahan yang terjadi terkait dengan upaya pengembangan sektor industri kesehatan dan obat-obatan.

Permasalahan-permasalahan umum yang lazim ditemui seperti tingkat jejaring litbang di industri kesehatan dan obat-obatan di Indonesia, dapat dikatakan masih rendah, belum optimalnya bentuk-bentuk klaster yang pada dasarnya sangat penting dalam mendorong kinerja industri kesehatan dan obat-obatan, dan aktivitas jejaring litbang di pelaku-pelaku industri kesehatan dan obat-obatan merupakan kebijakan-kebijakan yang bersifat institusional dari masing-masing institusi. Selain itu, permasalahan yang lebih khusus terkait dengan pentingnya sebuah sistem inovasi sektor dengan melibatkan aktivitas jejaring litbang menjadi dasar pemahaman dalam pengambilan kebijakan dalam membangun sektor industri farmasi dan bioteknologi.

Tulisan keempat berasal dari penelitian **A. Herryandie, dkk.** berjudul "Kajian Perbaikan dan Introduksi Teknologi untuk Peningkatan Produksi dan Mutu Gambir Ekspor Indonesia". Penelitian ini berkesimpulan bahwa teknologi pengolahan gambir asalan oleh masyarakat menghasilkan mutu gambir yang rendah dan tidak seragam. Pengadaan unit pengolahan gambir bergerak diusulkan agar dapat membantu masyarakat meningkatkan efisiensi ekstraksi getah gambir, serta menjaga kesinambungan produksi dengan tidak menghilangkan aktivitas di rumah kempa dan tidak menghilangkan pekerjaan para buruh rumah kempa. Unit pengolahan gambir yang bergerak tersebut juga memungkinkan tingkat pemanfaatan (utilisasi) alat-alat dan mesin yang tinggi. Di samping sisa pengempaan tetap dapat dikembalikan ke kebun gambir sebagai pupuk organik.

Wati Hermawati, dkk pada tulisan kelima mengangkat penelitian berjudul "Analisis Prioritas Program Penelitian dan Pengembangan Bidang Energi Baru dan Terbarukan di Lembaga Ilmu Pengetahuan Indonesia". Penelitian ini menyimpulkan bahwa untuk mendapatkan usulan riset Energi Baru dan Terbarukan (EBT) LIPI jangka pendek, menengah dan panjang yang maksimal diperlukan pendekatan yang menyeluruh dalam melihat kebutuhan riset EBT, baik dari segi produksi, pemakaian, pendistribusian, penggunaan sumber daya, maupun manajemen sehingga riset yang dilakukan akan melibatkan semua pusat penelitian yang ada termasuk dalam bidang sosial dan kemanusiaan. Dalam penyusunan rencana strategis sebuah institusi litbang, sebaiknya difokuskan untuk mendorong peranan swasta dalam pengembangan EBT. LIPI diharapkan dapat menjembatani peningkatan pemanfaatan EBT dengan pihak swasta, dan dapat membantu pemerintah dalam meningkatkan penggunaan EBT dalam memenuhi permintaan energi oleh masyarakat. Selain itu, karena salah satu hambatan dalam pelaksanaan EBT adalah faktor regulasi yang belum menjawab kepentingan swasta, maka LIPI melalui risetnya (litbang) dapat berperan untuk memberikan usulan dan masukan kepada pemerintah untuk memperbaiki sistem dan kendala regulasi yang ada.

Muhammad Zulhamdani pada tulisan keenam menyuguhkan penelitian berjudul "Analisis Kebutuhan Masyarakat terhadap Pengembangan Teknologi Pangan, Energi, dan Kesehatan Di Indonesia". Penelitian ini menegaskan bahwa keberadaan lembaga penelitian dan pengembangan di Indonesia sangat dibutuhkan untuk menemukan dan mengembangkan iptek yang meningkatkan kualitas hidup manusia dan tentu saja memberikan keuntungan bagi Indonesia. Berdasarkan telaah kebutuhan terhadap tiga bidang pengembangan teknologi pangan, energi dan kesehatan, diperoleh hasil bahwa lembaga litbang perlu memperhatikan kebutuhan-kebutuhan masyarakat tersebut. Hal ini dikarenakan setiap hasil penelitian dan pengembangan lembaga litbang yang ada harus sesuai dengan kebutuhan masyarakat dan dapat menjawab permasalahan yang ada di masyarakat.

Akhirnya tak ada gading yang tak retak, kritik dan saran kami harapkan demi kemajuan Warta di edisi-edisi mendatang. Selamat membaca!

Jakarta, Desember 2009

Redaksi Warta

THE NEEDS FOR ADAPTIVE INNOVATION POLICY UNDER FREE MARKET COMPLEXITY: THE INDONESIAN EXPERIENCES [1]

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ABSTRACT

This paper attempts to explain how technological innovation can soften pressure and enlarge opportunity to gain the benefit of free market competition. The free market operation becomes uncertain in relation to the domestic affairs and global circumstances. The accelerated process of moving toward free market under a domestically worsening economic situation may backfire, while slowing it down becomes backward under the globally progressing free market circumstances.

In dealing with the complexity of building up competitiveness under the pressure of free market competition, we propose a model; the so-called *'adaptive innovation policy'*. The model is drawn from the metaphor of living system and its environment. The adaptive innovation is continuous enrichment of technology as the nutrition of living economic system to evolve in gaining the benefit of free market competition.

The simulation results from the model imply that: i) dealing with the complexity of free market competition requires understanding the behavior of multiple feedback inside the complex economic system; ii) spurring the economic growth by capital investment beyond the carrying capacity of market could bring about economic instability; iii) enlarging the carrying capacity of market needs to increasing the added-value of marketed goods through technological innovation; iv) developing countries require innovator as well as seriously need investor in facing the free market competition, and; v) a clear design of industrial and technology policy for the promotion of innovative activities are still relevant to ensure that developing countries will participate in global market economy.

Keywords: *complex system, free market, economic instability, adaptive innovation, innovation policy.*

1 Paper presented in "Global Network for the Economics of learning, Innovation & Competence-building systems (Globelics-Africa 2005)", Tshwane University of Technology, South Africa, 31 October - 4 November 2005.

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1. INTRODUCTION

The matters underlying policymaking in a complex system are: i) the reality of policymaking on all levels face multi-dimensional complexity, change over time and filled with uncertainty, and; ii) the reality that the results of policymaking are considered off-target when controversy, delay and rejection have to be faced in its implementation. Two keywords, *complexity* and *viewpoint* determine the types of policymaking. On the one hand, the viewpoint of regarding the complexity as a mechanical process is reflected by rational policymaking. On the other hand, viewing the complexity as an organic process is reflected by policymaking characterized by learning. A shift in viewpoint from rational to systemic learning in seeing the current complex world is increasingly required. Applying the systemic approach in policymaking for the solution of current and future problems of development, becomes increasingly relevant (Aminullah, 2005).

Furthermore, the matters underlying the technological innovation in economic complexity are the following: i) the reality of economic complexity in pursuing the free market is multi-dimensions, interconnected, non-linearity and containing with uncertainty, that resulting in an immediate or delayed process, influenced by the improvement or deterioration of prosperity on the road to the free market, and; ii) the reality of accelerated process on the road to the free market under deteriorating the prosperity may cause social upheaval, while the delay of process may result in the strain of government commitment toward global free market. The structure and behavior of the past complex system, in response to the free market environments, is simplified in the model of adaptive innovation policy as an adaptive feedback system. This model explains strong and healthy economic development through technological innovation.

This paper will be concluded by policy options concerning the needs for decreasing of the government strain in facing the free market environment through, i) softening the pressure of free market environment and ii) adaptive innovation policy for strengthening the competitiveness in the free market. This paper proposes policy options: *adaptive innovation for development*, in addition to the common policy of *growth with capital investment*. The core is creating the innovator in addition to inviting the investor for strong and healthy economic development in response to the free market environment.

2. POLICYMAKING UNDER COMPLEXITY

Dealing with complexity of policy problems

Ilya Prigogine, 1977 Nobel Prize winner in Chemistry for the theory of thermodynamics, the so-called 'far from the equilibrium system', has contributed to the understanding of natural process where the current realities and future possibilities are going through a complex change. Where classical knowledge customarily emphasizes equilibrium, order and stability, in reality we will witness the waves of imbalances, disorder and instability, so that our view toward nature changes rapidly into something multi-dimensions, with a time dimension and a complex situation (Prigogine, 1977; 1984).

Viewed from multi-dimensions, the matter we cannot deny is that in reality everything in nature is interconnected, causing a need for an overall view respecting the existence of nature as a system (Aminullah, 2004) From the time dimension, adhering to the current situation will leave us unable to make anticipation in facing the future of change. Thus, it rises the need for the capacity of managing a change by learning from the future possibilities (Fahey, 1998). From the viewpoint of complex situation, disregarding towards seemingly small thing lead to unawareness and inability to control heavy shock starting from the small matter in interconnected world. This brings to emerge the needs to understand change, fluctuation, turbulence, crisis, and chaos as an interconnecting process that creating a 'butterfly effect' or Lorentz curve (Ormerod, 1998).

Studying the complex system means dealing with unpredictable complexity. In complexity, the substance may be of importance to think is preparing adaptive steps in anticipating the possibility of emerging the unexpected events from complex system behavior (Gershenson, n/a). In order to understand the complex system, complexity studies are needed by utilizing the complexity theories to frame the ways of thinking and viewing the complex system (Mitleton-Kelly, 2003).

The complexity studies have become important in interconnected world characterized by non-linearity and uncertainty. In interconnecting situation a change in a small element may cause change in all elements in wide scope, resulting in new phenomena and creating a different environment. A non-linear change containing uncertainty and approaching chaos still has understandable patterns. In brief, complexity studies is relevant to understanding the situation that moving between order and chaos, where a life is determined by the success or failure in surfing at the edge of chaos (Lewin, 2001; Pascale, 2000).

The development of knowledge on complexity as a science is still in the early stage. The 21st century, characterized by complexity, is a challenge for conducting the complexity studies. Scientific research on complexity contributing to the development of complexity science will continuously be needed to bring the position of complexity science from pseudo-science into science (Phelan, 2001).

The complexity of real world has brought into changing the ways of thinking in solving the complex problems. The logical and rigid ways of linear thinking shift into the reflective and adaptive ways of feedback thinking (Maboussin, 1997; Corning, 1996). In the past the policy makers viewed economic problems as a matter of creating the wealth needing the economic modeling, at present the policy makers view economic problems as a matter of improving the prosperity requiring the complexity modeling on interconnected economic, social, political and security characterized by non-linearity and uncertainty (Durlauf, 1997).

Some changes in the ways of thinking for the solution of complex problems influence the development of theories and concepts. In organization, the concept of work motivated by objective has developed into value-driven performance (Dolan, 2000). In economics, from the theory of efficient market mechanism has been equipped

with the theory of resilience in economic organism (Arthur, 1997; Krugman, 1996). In business management, from the management by objective has shifted toward the preparedness of managing the future possibilities (Sterman, 2000). In policymaking, from the rational decision process has been equipped with the systemic learning in decision process (Chapman, 2002).

The ways of thinking in seeing the complex policy problems, implemented in policy analysis resulting in knowledge on the ways of influencing the system. There are two ways of thinking in influencing the system or solving a problem, namely: i) based on a given objective including the utilization of template, and ii) based on the reality of main process, involving the human activities (Aminullah, 2004). The first way is rational, with the policy matters being something not in accord with the objective, followed by the formulation of suggested policy to reach a situation in reference to objective or template. The weaknesses are the problem and solution being limited with objective or template. It is possible that the objective or template only fit with a certain situation, certain region, and the past times.

The second way is characterized by learning process with the policy matters being something not in line with the continuously developed system, followed by the formulation of desirable and feasible policy to reach a situation in accord with the continuously developed system. The weaknesses are the problem and solution may expand into irrelevant system. Consequently, the irrelevant system may adversely create complexity and uncertainty. Nowadays, the challenges of development and freedom with many possibilities in complex system may be understood by – and requiring – complexity modeling.

Complexity modeling

The process of simplifying thought into a certain frame to understand a complex system is called complexity modeling. Currently three types of complexity modeling are known, namely i) the input-output system, ii) the feedback system, and iii) the adaptive feedback system (Aminullah, 2004; Bankes, 2002).

First, the input-output system modeling is usually implemented in certain fields, mostly economics, bounded by quantified thought, tending to disregard the process inside the system, environmental uncertainty and messy elements those are hard to quantify. The excellence of this type of thinking lies in convincing calculation for quick decision making in a stable environmental condition. The limits to this type of thinking is the tendency to be too hasty with the assumption that the environment is constantly stable, such as overinvestment based on the calculation of expected high demand, which may turn out to be false hope.

Second, the feedback system modeling is called cybernetics. The cybernetics system improves the discrepancy of performance to maintain the stability of system. Its weakness lies in the impossibility of working autonomously if the performance discrepancy occurs because of: i) damage inside the system, and: ii) defective material inputs and the influence of unfavorable environment. Thus, it is requiring policy intervention from outside the system. The choices of desirable and feasible policy are done after passing the process of policy

analysis. This type of thinking is standard in the field of advanced business management. The excellence of this type of thinking lies in the fact that the system performance seems to be stable in reaching the desired performance. The limit of this type of thinking lies in its state not being elastic toward sudden shocks from the system environment, with the result that the system still can be shaky and apt to collapse.

Third, the adaptive feedback system modeling is sensitive and adaptive to the environment, resulting in the model may explain why and how the system could become failure and collapse in the long run. In general, the system failure occurs because of misjudgment toward the system environment and/or lack of system endurance. If the system collapses because of the impact of system output suddenly rejected by the environment, this means the system failure as a result of misjudgment toward system environment. If the system collapses due to a sudden change in system environment, this means that the system failure has occurred because of weak system endurance in facing the pressure of environmental change (Mckelvey, 2004).

In general, the system failure occurs eventually and is recognizable in the earlier period. However, the failure may be covered up through short term solution. The short term solution afterwards tends to grow massively and at the time the problem breaks out, the system collapses. The failure of short term solution then tends to be blamed on the failure of other things outside the system.

In brief, modeling is a tool for simplifying and managing the complex system. The simplified model of complex system representing the entire real world. A good model is the one which functions as the adhesive of differences among various parties in viewing the whole of interconnected parts of system. A model facilitates in reaching the agreement on the similarity of thought and common ways to be taken in solving the complex problem. The solutions are expressed in desirable and feasible decisions. In other words, modeling is the entrance to policymaking under complexity.

Policymaking under complexity

Rational policymaking process is generally proper to handle a discrete and stable system. On the other hand, policymaking, characterized by learning, is normally suitable to handle a continuous and moving system. A discrete system is usually found at physical, mechanical and engineering objects. On the other hand, a continuous system is frequently found at living, social, cultural, economic and political objects. In reality, the discrete and continuous objects exist in a unity. The stable states are inseparable from moving processes, similar to those not being able to separate among goods, services, products, technology, economy, politic, social or cultural aspects. A good policymaking, therefore, is i) able to manage non-linearity and uncertainty in complex system as a result of blending the discrete and continuous objects, and ii) able to maintain stability in complex system requiring the flexibility toward unexpected pressures inside the system and quick changes from the environment.

The rational policymaking assumes that the policy object is a simple system under the condition of certainty, stability and predictability. In addition, the rational policymaking also assumes that the

policy object can be controlled by the objective of program and project design. The assumption often do not correspond with the reality of system. A top-down planning may be good for organizing the orchestra group, ballet dance, bureaucratic machine, and military force which are working on the same note and rhythm under the stable environment. In reality, the central system exists in a changing environment, with the result that the system tends; i) quickly to get obsolete as it is locked toward innovation, ii) susceptibility toward failure as the actor depend on instructions from above, iii) get stagnant because the actor activities are limited by the authority, and iv) disregarding the performance as the actor putting the procedural-based in front.

In the interconnected complex systems containing non-linearity and uncertainty, the process of policymaking closer to reality is that with the ability of anticipating many possibilities in its implementation, namely i) the emergence of surprise events, pleasant or unpleasant one, ii) the difficulties of controlling the overrun processes, iii) the emergence of risky results those are disregarded earlier, and iv) unintended impact which spurring the overall resistance by the mutually enforcing elements inside the complex system.

In reality, policy makers often face many possible phenomena, results and dangerous impacts. It is unavoidable except for just following without becoming the part of the danger. The situation of policy-makers is like surfing at the edge of sea waves without getting folded up by large waves or slipping on small ones.

The ability of a surfer moving above the waves and anticipating the complex waves is a model of learning to surf on the top of waves. Small waves may suddenly change into large waves understood as the dynamic behavior of natural waves. From understanding the dynamics of wave behavior, the surfer makes correct decisions (often intuitively) to move beautifully on the edge of sea waves. By imagining the complex situation, portraying the dynamic interaction and understanding the behavior of system, correct decisions may emerge as anticipative steps in facing many possible phenomena in complex system (Eoyang, 1998).

In a complex system, the process of policymaking closer to reality is by placing all actors as learners, able to adapt to environmental change. This is in line with the reality of policy-makers as a part of whole actors often facing difficult situation, conflict of interest, disorganized threat but not mutually hitting. The actor is unable to run away except for mutually adapting in bringing the chaos to move toward order. The situation of policy makers is like a group of heron shaken and flying away, first seemingly in chaos, but not mutually colliding, then moving regularly forming the patterns of flying herons.

The movement of flying herons while mutually adapting is the adaptive feedback model in maintaining the direction, distance and speed of flying. Changes in direction of flying herons forming a silhouette, which is headed in turn by the heron incidentally flying in front, that is understood as dynamic behavior of flying herons. From understanding the dynamics of flying herons' behavior, the heron is seen as the learner in making correct decision (often intuitively) for moving elegantly while watching the

direction, distance and speed without planning and a planner. By placing actor as a learner, correct decisions may be made by adaptive steps in facing environmental change in complex system (Odell, 2002; Senge, 1990).

The application of policy analysis characterized by learning, for the purpose of policymaking in a complex system, here will explain Indonesian economic recovery in facing the free market complexity. The analysis, of the structure of economic recovery as well as the complexity of free market competition, will reveal what anticipative and adaptive policy needed in building a strong and healthy economy for the future.

3. INNOVATION POLICY UNDER FREE MARKET COMPLEXITY

Free market complexity

The extreme desires for competition in responding the free market environment may become a complex problem, as the free market is claimed as the only way to mechanically improving the process efficiency and production quality in the economy, resulting in disregard on the reality of organic interaction among thought, physical aspect, and values embedded in the free market. The aspect of thought, extremely bound by economic efficiency through free market competition would drive for the ability of mutual destroying. The physical aspect, related to degrading the economic resources as a result of freedom to exploit beyond the limits, it is inseparable from the value aspect of greedy individual behavior for piling up unlimited economic profit. The free market competition is hard to control, characterized by two failures: i) the adaptive failure of system structure in facing of malfunctioning free market, and; ii) the anticipative failure of system behavior in responding to confusing free market. Both originate from the failures of understanding the free market in global economy as complex organic process (Cole, 2002; Baker, 1999).

The complexity of free market operation in Indonesia, as a developing country, requires the awareness of community and individual concerning the possible problems in the field of economy, social, politics, culture and the environment. At the onset, the consumers may be happy with the free market, but at the moment of economic, social, political, cultural and environmental complexity arise, everybody will experience a 'disappointment of the common'. The free market complexity is composed of several malfunctioning and confusing patterns, namely i) expectation differing from reality, ii) disputes arising from unfair practices, iii) acceleration creating deterioration, iv) solution causing problems, and v) resistance and delay.

First, *expectation differing from reality*. The free market, according to the rules of linear thinking, is a good way for enhancing the process efficiency and quality improvement of products in the economy. The end is that the people as consumers will get advantages. All parties nurture the hope of freedom without barriers reaching the consumers in whatever regions and countries, under free market. The march toward free trade is expected to move forward, accelerated by the information technology networking which becomes increasingly easier and inexpensive in facilitating the free flow of marketed goods and services. In this process, the government is expected to serve all parties desiring the free trade without barriers.

The expectations of freedom without barriers may differ from reality, as the freedom of economic actor is actually limited by protection. The freedom of economic actor is mutually protecting in informal institutions, takes the form of family and ethnic business enterprises, in addition to mutually regulating in the form of formal trade networks such as business alliances, business groups, business associations, chambers of commerce, trading partners, and economic cooperation among nations (such as AFTA, APEC, NAFTA, FFC, G-8, G-33). This global and regional institutions discuss and make formal agreements to arrange the members' interests in managing of free competition in the interconnected economy. (Davis, 1999) The formal agreements concerning the free market may differ in its implementation after facing and being tested by reality which might happen in the free market.

Testing by reality lies in the trade-balance between nations. In free market, export and import between nations are managed in a balanced mode, without creating excessive deficit. However, in reality the deficit between nations may enlarge as the result of currency value in addition to the competitiveness of production factors. In other words, the obstacles of free market may be imposed by nations with strong currency. The USA as the champion of free market but with strong dollar currency, is now being threatened by the yuan currency of China, takes protective measures within America's domestic economic interest (Laver, 2005; Greider 2005; Azis, na).

Second, *disputes arising from unfair practices*. The global free trade may increase labor productivity, product quality, production efficiency and production quantity as reflected by a significant decrease of production costs. Sometimes, such low production costs still get subsidy, primarily for agricultural and animal husbandry products, from the government policy of developed countries. Thus, some developed countries will be the happiness parties with the freedom of marketing their production surplus outside their country (generally to developing countries) through global free market. For developed countries the global free market means more 'success to the successful' in the competition.

The products of developed countries inundate the market of developing countries are packaged under the phrase 'respecting the right of consumers' to get high quality products at low price. The products of developing countries are often rejected by the global market because of strict standards and are even not salable in the domestic market because of expensive price. The failure of developing countries in penetrating the free market is packaged with a phrase the 'unavoidable consequence' of global free market. For developing countries, global free market means more 'fail to the failure' in the competition.

Because of unfair practices, it is natural that the difference of views arise in seeing the free market. From the difference of views with different interests, it is natural that different solutions come up in facing the free market, either on regional, national, economic sector and enterprise levels. The difference of views concerning the problems and its solution not seldom grow to be lengthy disputes among various parties, both in the scope and time of practicing the free market. In brief, the complexity of practicing

the free market is inseparable from the disputes arising from unfair practices.

Third, *acceleration creating deterioration*. Some countries which shift quickly from protected markets to free market will tend to be pressured by the economic deterioration. Countries which at the onset suffered from economic backwardness because of poverty distribution in the protected market, currently face economic difficulties because of debt burden after participating in the free market very quickly, such as Russia. This country which formerly was immersed in economic unfairness under protected market, currently moves in the direction of another economic unfairness with inequality grow after implementing the free market quickly, like in South Africa (Allie, 2003). The state is filled with ambitious implementation of the free market, but still with the support of inefficient economic institutions, constantly indicating the low level of efficiency and productivity, such as Turkey and Indonesia (Demir, 2002; Aminullah, 2004).

Indonesia's experience in connection with acceleration or pushing the free market, once also gave more regretful impression. The implementation of assistance in policy and capital from IMF on the condition of freeing the market and executing privatization once suffered pressure because of deteriorating the economic crisis situation in Indonesia. After freeing herself from policy assistance and IMF capital, in 2003, Indonesia's policy seemed more adaptive to increase domestic economic competitiveness in facing the free market. In facing the strong flow of the free market waves, the government seems to pay attention to small-scale enterprises which are still unable to compete in the global free market. The basic matter is that Indonesia as a nation with strong character goes on respecting her own constitution which states that 'the branches of production, important to the state and mastering the people's living necessities, will be taken charge of by the state'. This might cause the current government's carefulness in implementing the thought of global free market which is filled with complexity.

Fourth, *solution creating problems*. The current global free market is managed by the 'global regulators', namely the World Bank (WB), the International Monetary Fund (IMF), Organization for Economic Cooperation and Development (OECD), World Trade Organization (WTO), and the four seem to be dominated by developed countries and controlled by the President of the United States of America (USA). (Dimitrov, n/a) The developing countries tend to make use of the services of these global regulators as an easy way in solving their domestic economic problems. Such habit has resulted in the problems of dependency and low ability of developing countries to build her domestic economy, simultaneously increasing the importance of global regulators who seemingly assist in building the developing countries. In reality those global regulators control the global finances and make rules of the game for the free market system within the interest and advantage of the developed countries (Drezner, 2004).

The economic planners in developing countries tend to become shadows of, and obediently serve, those global regulators. The economic experts in developing countries who become the lips of 'global regulators' shout loudly for the free

market, seemingly under pressure, as they acclaim that the continuation of their country's economic survival is controlled by the capital and expertise of those global regulators. Capital investment and regulators expertise naturally have side with the interests and advantages of the developed countries, rather than improving the level and quality of life of developing countries. This has triggered the discontents of world economic experts who are criticizing the performance of global regulators in managing the free market in order to decrease the number of poor populations in the world (Stiglitz, 2002).

Fifth, *resistance and delay*. Heavy enforcing toward putting into effect the free market as the only driver in the economy, may opposed, as disadvantaged or weak small-scale economic actor resist to be buried by the strong competitors. It just like heavy enforcing toward putting the protected market into effect, as the only authority in the economy, failed on account of resistance by economic actor who felt hampered by the state in developing their business. In reality, the developed countries esteeming as the champion for free market, is also showing the disobedience from the free market, such as the USA (Laver, 2005; Greider 2005; Azis, n/a). As a matter of fact, a country formerly shown a resistance in practicing the free market, later has been successful in practicing the managed free market, by delaying in putting the free market into effect, such as in China.

Resistance and delay in practicing the free market policy because of uncertainty is a matter of discrepancy between real attainments and expected targets. The delay of reaching expected targets tends to occur as the consequence of resistance among parties. The ordinary ways of reducing the resistance on either by enforcing the authority, creating a policy umbrella and improving the cooperation among parties. The controversy of policy *process* among institutions are decided by institutions with higher authority. The resistance toward policy *contents* among the competing parties are harmonized by creating a policy umbrella. The disputes toward policy *actions* in facing the free market are bound by policy cooperation among parties. However, all of this often does not solve the core of problems.

The resistance and delay in implementing the free market because of uncertainty, in essence, are a matter of feedback loops in policy implementation, representing the situation and processes of the real world. In its implementation, a policy may experience delay because of resistance may cause even wider resistances and create unexpected deteriorating situation. In brief, the resistance and delay in the policy implementation occur on account of mismatch between the reality of complex system and the way of thinking in seeing that reality. The following is the real situation of Indonesian economic recovery under free market complexity.

The slowness of past recovery

The above free market complexity correspond with the real structure of Indonesian economic recovery after the 1997 crisis. The structure takes the form of six interconnected feedback loops, influencing the slowness of Indonesian economic recovery. This feedback loops comprise i) the cost of restructuring pressing the sources of development financing, ii) low domestic capacity to

meet the improving demand covered by import, iii) the needs for the protection of domestic production because of lack preparedness in facing the free market competition, iv) the limited sources of development financing calling for abolishing subsidy and protection, v) delaying the effect of economic stimulus to activate domestic production, and vi) lack of competitiveness in the free market because of ignoring technological innovation.

First, *the cost of restructuring pressing the sources of development financing*. Low efficiency due to the burden of overshooting in capital investment before the crisis, then was overcome by debt restructuring, so that production could continue in under-capacity because of low market demand during the crisis. The cost of restructuring not only in the form of recapitalizing borne by the government that pressing the sources of development financing, but also unemployment due to a sharp decrease in asset value or bankruptcy (Frecaout, 2004; Frakenberg, 1999). It was followed by low wages resulting in low purchasing power and demand in the economy. In other words, the slowness of economic activity was shaped by the restructuring cost resulting in low demand, requiring further restructuring during the crisis.

Second, *low domestic capacity to meet improving the demand covered by import*. Government expenditures plus loans from IMF and the privatization of state owned enterprises (SOEs), to cover budget deficits, again increased demand in the economy. Parallel with freeing the market, an increase of demand was met by import besides capacity utilization of the still alive enterprises. With available capacity, relatively low wages and weak rupiah currency, export could be increased. The import of consumer goods and raw materials increased in addition to export also increased surpassing import, so that Indonesia's foreign exchange reserves improved, supported by the delay of private debt interests payment. The increase of export could be pressed by limited production capacity due to the delay of investment in capital goods and means of production during economic recovery (Samuel, 2005). In other words, the revival of economic activities was caused by improving demand, filled by rising import because of limited capital investment for capacity enhancement which continually tend to decrease.

Third, *the needs for the protection of domestic production because of lack preparedness in facing the free market competition*. Domestic production, primarily in agriculture, was depressed by the low price of agricultural products, resulting in the low income of farmers. At the moment of agricultural production increased, farmers' income did not increase because of low market price. This low price was increasingly pressed by imported agricultural products overflowing the domestic market. As a result, the agricultural sector has become increasingly unattractive and uncared for, causing the continuous decrease of productivity and constantly increase of imported agricultural products (Okfam GB-Indonesia, 2001). The farmers had no choice but request protection and additional assistance to prevent them from getting weak as before. Thus, two systemic deteriorating loops was formed i) the larger the assistance, the higher production, the heavier pressure on price, again the larger the assistance, and ii)

the heavier pressure on price, the lower the domestic production, the larger the need for imported agricultural products, and again, the larger the pressure on the need for the protection of farmers.

Fourth, *the limited sources of development financing calling for abolishing the subsidy and protection.* To finance economic development, the government faces limited development budget due to large expenditures to pay debt installments, fuel price subsidy and assistance for saving the lives of the people suffering from national disasters. Two plans to cover the shortages budget for large expenditure, comprise: asking new loans or raising fuel price, both tend to be rejected by the people. Lowering the subsidy by raising fuel price, at the onset rejected by the people, was subsequently accepted, after people got convinced that the money would be utilized for financing the welfare (education, health and food) for the poor. Reducing new loans in order to decrease the debt stock, as a general rule, in developing countries (including Indonesia), there is a pattern of the larger the debt stock, the worse the poverty level (Rihani, 2003). So that the decrease of debt stock will have a significant effect in easing the pressure of paying debt installments and gradually eradicating poverty. However, Indonesian has experienced difficulties in escaping from debt addiction to cover the limited sources of development financing.

Fifth, *delaying the effect of economic stimulus to activate domestic production.* The efforts of attracting foreign industry to move to Indonesia with the advantage of cheap labor have not stimulated capital investment yet, as much physical infrastructure is deteriorating, worsened by damages coming from natural disasters, in addition to the slow improvement of forming efficient government institutions after the economic crisis. Economic stimulus through rebuilding the physical infrastructure and improving the government institution's efficiency require a long time before the results are visible. The capital investment in productive sector also requires time before unemployment is absorbed. The time delay is increased by the carefulness of banks in providing loans for capital investment after successful of doing financial restructuring in economic recovery (OEDC, 1999). This results in limited absorption of labor, in addition to wide-scale unemployment enlarged by urbanization of workers in the agricultural sector from the rural areas. This situation generates loop of delaying the results of economic stimulus bearing impact on unemployment.

Sixth, *lack of competitiveness in the free market because of ignoring technological innovation.* The low content of technology in production tends to result in expensively low-quality products, leaving them unable to compete with imported products. An increase of technology content may be achieved by buying, making and mix of buying-making technology. The habit of buying technology shifts to the pattern of dependence on the pleasure of buying technology, if it can be bought, why take the trouble to make it? This process of dependency slows down the desire to increase innovative capability in the productive sector. Disjointing of the chain of dependency requires a change in the view of development from economic to techno-economic perspective (Gammeltoft, 2004; Aminullah, 2005a).

Although a small number of Indonesian domestic enterprises has long practiced the innovative activities declared to be ready for free market competition, many others screamed to give up facing the free market competition, because they felt lacking in speed, efficiency, effectiveness based on technological capability. The competition is good for spurring the spirit for innovation in domestic enterprises, but requires time to change the loop of 'culture' from the habit of buying technology into making technology. Under depressing the needs for cultural change Indonesia has to deal with the systemic obstacles before their situation changes toward a strong and healthy economy.

Systemic obstacles

After the economic crisis, Indonesia indicates having locked-in by systemic obstacles to build a strong and healthy economy, such as the following interconnected matters:

First, *the power financing.* The needs for large fund to restore and build physical economic infrastructure face limited government development budget, so that it obviously need a large private funding participation. If the capital investment stimulus for this purpose is responded by the private sector, and may become reality, the next problem is to what extent the capital investment for physical infrastructure that creates demand and consumption followed by increasing in domestic production, in order to avoid recurring the phenomena of heavy depending on import for consumption.

The limited government development budget is related to two matters, namely the government income and expenditures The planned expenditures tend to exceed the expected income then the shortage of income is covered by new loans and by selling state assets. The pressure of reducing debt burden forces the government to cut expenditures by gradually abolishing of fuel subsidy (compelled by current world oil price hike), in addition to increasing income from taxes. The large portion of government expenditures currently is to pay debt installments and interest. The amount of debt stock is hard to be reduced when the debt payment is paid by getting new loans, unless the amount of new loans can be reduced considerably. In other words, in the near future, the large portion of government expenditure remains for paying the debt installments and interest, with the result that the development budget remains limited. (Radianti, 2004)

The utilization of income from reducing of fuel subsidy could go to three possibilities, namely: i) increasing the income to cover the government budget deficit, resulting in lowering the needs for new loans, ii) paying the debt in order to reduce debt stock, resulting in lowering the burden of debt installments and interest, and; iii) increasing the development budget for financing the investment in physical infrastructure (agriculture, energy, communication and transportation, and public works) and non-physical infrastructure (quality of education and health services). The choice depends on how the government seeing the essence of problems faced by the nation. Each choices has its trade-off i) if the income to cover the shortage of government development budget, the needs for new loan may be decreased, but the debt burden will remain heavily, ii) if the income for paying the debt

stock, the burden of debt installments and interest will reduce but new loans are still needed to cover the shortage of development budget, and iii) if the income for increasing the development budget this may result in future income, but the debt burden will remain heavily. The government has chosen to utilize income from reducing of fuel subsidy for increasing the development budget, either for helping the poor or to finance investment in non-physical infrastructure such as education quality and health services. It means that the burden of debt installments and interest will remain heavily as long as economic actor activities have not yet developed quickly.

Second, *the activities of economy*. The Indonesian development planning for the expansion of economic activity and domestic production require the support of investment in physical infrastructure and the improvement of non-physical infrastructure. A sufficient physical infrastructure such as electric power, roads, transportation and port facilities will improve economic efficiency, while adequate non-physical infrastructure such conducive regulation and skillful labor also determine efficiency and productivity in the economy. The availability of well-trained labor will determine efficiency, while well-educated labor will influence innovation and competitiveness in the economy. The availability of adequate physical infrastructure plus well-trained labor are important for efficiency and productivity, but this is increasingly insufficient in the free market, where the source of competitive advantage coming from knowledge creation and innovation with the support of well-educated labor (World Bank, 1999).

The provision of adequate physical infrastructure with well-trained labor would lure investor to invest in labor-intensive industry in Indonesia, as long as well trained Indonesian labor is cheaper than in neighboring states, like China and Vietnam. Furthermore, the provision of adequate physical infrastructure with well-educated labor may be attractive for investor to invest in knowledge-based industry in Indonesia, as long as the well-educated Indonesian labor is more competitive than those in neighboring state of India. Those two provisions are still long roads to realize, with existing inadequate physical infrastructure plus well-trained labor are even now attractive for investor from neighboring state with adequate physical infrastructure, like Malaysia, to recruit the cheap Indonesian labor for working as migrant workers in Malaysia.

The delay in enhancing of domestic production capacity under the pressure of obsolete production facility from preceding capital investment, cause to increasing in import for consumption. A crisis of supply may occur again when the instability of domestic production is in line with the difficulties of financing the import to meet the increase in consumption. Meeting the needs of consumption through the increase of imported products in the free market would hit domestic production, which again, increasing the need for further import In the case of investment in physical infrastructure leading to increasing in import for consumption, the benefit would be more enjoyed by those foreign exporter than domestic economic actor.

Third, *Straggling to evolve in the free market competition*. Indonesian high expectation from the free market opportunity has stimulated to abolish

various kinds of economic protection. This abolishment is justified by for defending the interests of the poor (farmers, factory workers, etc.), with the reasoning that protection is enjoyed more by the rich one (land owners, factory holders, etc.). The benefit gained from the abolishment of economic protection enjoyed by the rich could be easily transferred to direct and indirect subsidy for the poor, if those two categories were separate elements which could be engineered. In reality, those two elements are interconnected strongly as a complex system, if the work of one element is hampered then the system's turbulence will follow too, such as bankrupt agriculture enterprise, neglected agriculture estate and suffered small-scale business. All this will contribute to unemployment which again becomes a burden to the government. In other words, the abolishment of economic protection may possibly create unintended consequences which are more difficult to solve.

Economic subsidy, primarily in agriculture, is felt as a burden because of strong ties between large and small elements, with the large ones enjoying the subsidy which has more become a burden. Like the mixture of stones with sand, with the binder of cement, will become a strong and heavy concrete system, felt as an obstacle because of having a weak foundation. The possible solutions are i) a strong foundation to support the burden of heavy concrete, such as in developed countries with strong economic fundamentals felt no obstacle to support the burden of subsidy for farmers owning agriculture enterprises, ii) reducing cement and adding some hardening substance, making the concrete still strong but light and suitable to the soft foundation, such as in Thailand, decreasing the subsidy after adding the value to agricultural products through technological innovation, becoming competitive in export and increasing the farmers' income (Trakoontivakorn, 2002), and iii) reducing cement and making the concrete light but fragile, such as in Indonesia, reducing the economic subsidy while letting the low-quality of agricultural products because of insufficient nutrition of technology, so that it becomes uncompetitive followed by lowering the farmers' income.

Fourth, *nutrition of technology in the economy.* In the global competition, economic policy without technology policy, (education, R&D and R&D financing) may obstruct the economic development by itself (Stiglitz, 2003). Focusing on economic growth just by pushing capital investment, may experience diminishing the value of capita. The more capital investment, the larger the capital depreciation, the lower the value of capital, the less output and the more expensive price become, as is indicated by the decrease of Indonesian agricultural production, foot-loose industry's outputs and local manufacturing industry's products with expensive price. Eventually the more uncompetitive they become, and the less the prosperity. On the other hand, economic development with technology investment will increase the value of capital. The more utilization of technology, the larger the capacity for technology development, the more output resulting from higher productivity, and the less expensive price, as is often indicated by the increase of quantity and quality of production through utilization of technology, finally becoming more competitive and increasing in prosperity.

The utilization of technology requires the supply of technology which in Indonesia mostly occurs through foreign capital investment (Okamoto, 2001). The acquisition of foreign technology embedded in capital will be successful through technological learning. Lack of success in technological learning due to low level of human capital in Indonesia, especially the quality of research scientist and engineer (RS&E), which is constrained by i) RS&E capability, ii) organizing the RS&E and iii) RS&E management. The RS&E capability to absorb technology by learning on how to improve the existing technology depends on skill and expertise determined by the level of training and education of RS&E. Organizing the RS&E in innovative activities through learning organization depend on trust, cooperation and the network of information exchange internally and with parties outside in the free market. RS&E management depend on the ability of manager in improving RS&E capability, simultaneously organizing RS&E as a responsive, efficient and qualified system, from which the system is adaptive in facing the rapid changes of global free market environment.

There is very much hope in Indonesia that the supply of technology comes from the outputs of R&D activities of national research institutions. However the research institutions tend to produce R&D outputs fitting to be arranged and stored into the pride of institutions, because the outputs are not easily implemented by the users who may wish to acquire the technology. The acquisitions may be successful through institutional reform to promote the entrepreneurship of research institutions, namely i) state financing for R&D activities after going through links with the need of users for R&D results, ii) private financing for R&D activities done by national research institutions should be considered as tax-deduction for the private enterprise concerned, and iii) in the long run, the research institution which has put private sector as the main sources of financing, should slowly shift to the position of an autonomous research institution carrying out business activities.

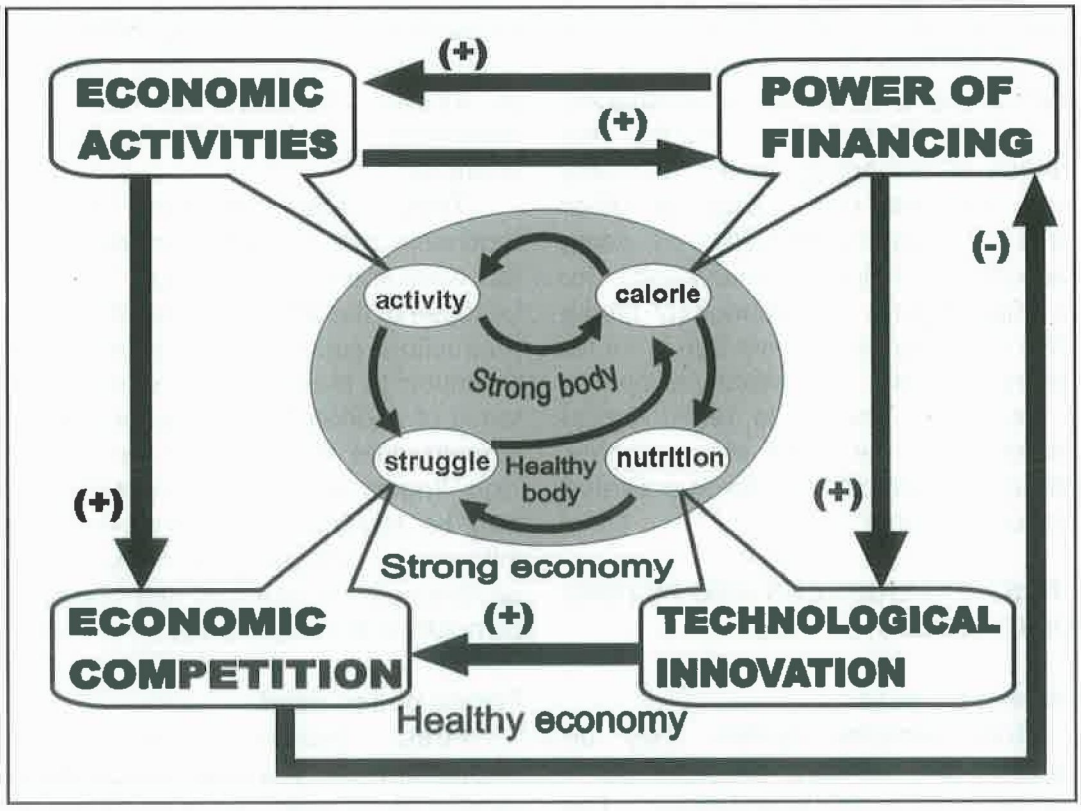
Adaptive innovation policy

Provided that the slowness of past recovery and systemic obstacles facing for the future have created a complex economic system. The ability of complex economic system to evolve in the rapidly changing free market environment is a life of surfing at the edge of competition waves and cooperation. The secret of surfing on free market waves, closer to reality, is the adaptive ability for competition and, simultaneously, cooperation (Beinhocker, 1997). In the free market, competition is a matter of managing the power to gain self benefit, at the same time, cooperation is a matter of power to manage gain for mutual benefit (Davis, 2004). The competitiveness is revealed by the strength of 'genetic seed' in the body of economy. (Mae-wan, n/a) It would be flourishing into *strength and healthy economy* by aforementioned elements i) *the power* of financing, ii) *the activities* of economy, iii) *nutrition* of technology in the economy, and iv) *struggling* to evolve in the free market competition (Witt, 1999; Baryam, 1997).

The interaction of those elements is called the model of *'adaptive innovation*

policy' for building a strong and healthy economy. Adaptive innovation is continuous enrichment of technology as the nutrition for living economic system to evolve in gaining the benefit of free market competition. This model explains that a strong economy with lacking the nutrition of technology may become a sick economy because of vulnerability against shock from the environment of free market competition, such as experienced by Indonesia during the 1997 economic crisis (Keller, 2002; Aminullah, 2004). Thus, innovation policy should be developed and formulated adaptively to softening the pressure of free market competition. *See* picture 1.

Putting the model to work through i) a strong economy will be achieved by the sufficient *power* of financing to increase the *activities* of economic actor, again by increasing the economic activities will generate additional financing power (Arthur, 1990). However, such a positive feedback loop is balanced by the following negative feedback loop the more expansive the economic activities, the fiercer the economic competition to evolve in the free market, the bigger the draining of financing power, and i) an-



Picture 1. Adaptive Innovation Policy Model

healthy economy is achieved by the sufficient *nutrition* of technology in line with strong economic body. The stronger the economy, the bigger the fund to finance the nutrition of technology, the more competitive the economy, again the bigger the financing power for enhancing economic activities.

After tracing the working of model and the behavior of elements through a model simulation, there are two important aspects revealed by simulation results, namely: i) in short range, the power of financing which is still limited will hamper the activities of economic actor, which will effect on the strain of economic actor in facing the pressure of free market competition, and ii) in long range, the strain caused by the competition in the free market faced by economic actor will be softening, together with strengthening the competitiveness through the *nutrition* of technology in the economy which requires time delay. In other words, challenging difficulties by doing gradually technological innovation, for the improvement of technology intake in the economy is the *leverage* point for building a strong and healthy economy for the future. The key is, technological innovation by the actor of economy, although it is difficult, should be activated quicker as of now.

4. PAST EXPERIENCES AND FUTURE POLICY NEEDS

Past experiences

First, complex system may be observed but is hard to plan, as it may result in many possibilities. The mutually interconnected things in complexity, containing non-linearity and uncertainty, may be studied but is hard to control, because it could be processing unexpectedly. Dealing with complex economic system requires adaptive feedback modeling characterized by learning. Suitable action or policy to influence the behavior of complex economic system is adaptive innovation.

Second, the free market influencing the way of thinking, deciding and acting by the government and private parties, is a complex process and contains uncertainty. The environment of free market exists in interconnecting with many fields outside the market economy, such as political and social and cultural aspects as well as living environment. Economic complexity in the free market needs a strategy of applying the freedom to be flexible between competition and cooperation, namely working adaptively in fulfilling promises to the 'global regulators' while safekeeping domestic interests.

Third, policy problems in future Indonesia are i) the domestic supply for consumers goods could runs low because of the slow increase of domestic production capacity, this will be covered by import to meet the high demand as a result of economic stimulus for physical infrastructure development, and ii) the high import with low domestic supply may be leading to economic instability followed by increasing in unemployment, as domestic enterprises are unable to compete in the free market.

Future policy needs

First, economic stimulus for investment in physical infrastructure, parallel to investment stimulus for the increase of domestic production capacity.

Second, enhancing the domestic production capacity needs parallel with

raising the added-value of products manufactured domestically, to make them competitive and improving the prosperity.

Third, raising the added-value of domestically manufactured products needs increasing in the level of knowledge and technology, which are acquired, utilized and disseminated by implementing the *innovation policy for development,* in addition to implementing *growth policy by capital investment.*

Fourth, applying the policy instruments which directly stimulate technological innovation in private sector. Essentially, the idea for the future is: Indonesia needs innovator in addition to investor in developing a strong and healthy economy, in responding to the free market environment.

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