

Knowledge Rich Industries and Balanced Growth for Transitional Economies

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In this paper, economic development through knowledge-rich processing industries as a potential dominating path for countries in transition is examined. It is particularly important that all countries in transition are richly endowed with intellectual resources which is shown to be a factor (a) critical for transition, (b) receiving a growing value-added compensation, and (c) giving potential for intellectual rent. A two-industry dynamic model considering intellectual resources demonstrates that there exists optimal distribution of investment allowing to maximize national income, that is, a way for balanced growth in knowledge-rich economy. Government can support this process through re-direction of investment flows to achieve optimal investment distribution and investment into institutional capital. For successful growth through knowledge-rich industries, R&D sector should also be enhanced to become market-oriented.

1. Structural aspect of economic growth

The process of economic transition towards market-oriented economy commenced in Central and Eastern Europe (CEE), and Commonwealth of Independent States (CIS) over a decade ago. It has primarily rooted from an understanding of great inefficiency of planned economies. Accordingly, the leaders of post-socialist block have accepted a transitional liberalization package, which (despite differences in countries themselves) was quite typical: liberalization of domestic markets (removal of price control at first hand), liberalization of foreign trade, privatization, introduction of finance markets, and macroeconomic stabilization [50]. However, as this program has been executed, its results have been strikingly different for various countries, ranging from mild improvement in CEE to severe crisis in some countries like Russia and Ukraine [25].

It has been acknowledged by many a reform proponents that a number of substantial mistakes have been made, especially in CIS: these reforms should have relied on formation of market institutional infrastructure rather than on implemen-

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tation of a series of standard steps [50]. Elimination of inefficient (but working) planning mechanism has created a situation of institutional ‘no man land’ as Kornai called it [22]. While CEE countries have never abandoned basic market institutions and ‘entrepreneurship spirit’, these key elements have been virtually exterminated in the Soviet Union – and so it is logical that former Soviet Union (SU) has faced a greater decline in output.

Yet, as it has been shown in author’s paper [27], another important aspect was a structure of economies themselves. Economy of post-SU republics inherited significant structural distortions: imbalances in price and supply-demand structure that could only have been reduced through inter-industrial interactions. This reduction has been a painful process accompanied by overall output decline, price increase, and emergence of ‘arrears crisis’. It may be pointed out now that a negative impact could have been less notable should more attention have been paid to economic structure.

Nevertheless, despite some obvious reformers’ faults, new economic infrastructure has emerged. There are evidences that major transformations have already accomplished:

(a) output structural shift index for countries in transition decreased, showing that a new structure of economies have been formed. Also, output shifted from ‘capacity driven’ to ‘demand driven’ dynamics [63].

(b) dynamics of economic output is impacted by external stimuli (e.g. devaluation in Russia during fall 1998) [61].

It is evidential that transitional economies have come to a crossing-post where economic policy priorities are changing. Currently, for most countries in transition economic growth has become a number one priority on agenda list [60]. It is however a critical issue what specifically may become a source of long-term growth.

Traditional macroeconomic models, and neoclassical growth models in particular, have been realized as inadequate for transitional country reform design even by leading neoclassical economists [49]. It therefore becomes important to provide new models that may give a basis for further reforms and motivated growth-oriented policies.

One of the most important drawbacks that neoclassical growth models have been criticized for is lack of consideration of economic structure. Some of the basic axioms that underlie neoclassical analysis (such as general equilibrium and representative agent prerequisites) make it technically impossible to consider non-homogenous economies. There were only rudimentary attempts to deviate from this approach, for instance, by explicit consideration of R&D sector supplying innovations to the rest of economy. However, even then growing economies are considered ‘a scaled version of what they were years ago’ [3].

Evolutionary economists have made a serious progress in consideration of non-homogenous economies (e.g. [35], [37], [41]). Their research uses, consciously or not, a ‘mushroom’ analogy – as coined by Harberger [19] who proposed ‘yeast vs mushroom’ comparison, pointing out that that growth may occur proportionally and equally in all sectors (yeast), or that bunches of sectors may spring and grow rapidly while other recess or decline (mushrooms).

Peneder [41] showed that even in OECD countries, productivity is systematically different between sectors. He therefore proposed that economic policy should

encourage structural shift towards high productivity industries. These industries are in first turn technology- and human-capital-rich (or, more broadly, knowledge-rich).

Importance of development through technological progress and manufacturing of knowledge-rich products has also been underlined by neoclassics as well, e.g. Arrow [4]. Therefore, a consensus point of view for neoclassical and evolutionary economists is that growth is achieved through knowledge-rich industries (KRIs), at least for developed countries with well-established institutional infrastructure.

To examine whether (and subject to what conditions) such path is suitable for economies in transition is a subject of this article. Article is structured as following. In Section 2, factors that can make growth through KRIs a viable development path for transitional countries, are enlisted. In Section 3, a two-industry model with supplier-consumer interactions and intellectual resources as productive factor is considered, in order to represent various growth paths and discuss a preferable one. In Section 4, two important government policy implications for balanced growth are discussed: development of state institutional capital, and means of investment flows redirection. Finally, in Section 5 basic practical mechanisms allowing implementation of KRI growth are presented.

2. Knowledge-rich industries as growth promoters

Transition economies, especially in former SU republics, are richly endowed with natural resources, stock of physical capital (created mostly in socialist times), and well-educated population [70], [48]. This is a perfect opportunity that turned into a large problem for many of them: for example, symptoms of so-called 'Dutch disease' [10] have been observed in countries like Russia or Kazakhstan, where most of available investment resources is devoured by extractive industries. For such countries, a wide variety of options exists: to become export-oriented producers of natural resources, or manufacturers of cheaper consumer goods, or providers of technological services, etc.; evidently, such countries have not yet decided on their long-term growth path.

There are several rationales that make it advantageous to choose a growth through knowledge rich industries for countries in transition.

First, human factors (R&D and education) are the particularly important in the process of economy transition [7]. Especially in its role as a substitute for other scarce factors, human development increases the absorptive capacity of local firms and facilitates the transfer of Western technology and market knowledge [56]. In Central & Eastern Europe countries, this absorptive capacity was one of the most powerful factors for development and integration into European society [30]. And, for on-going economy growth continuity of core R&D competence is one of the critical factors [42].

Second, there is an evidence from a comparative factor compensation. The trend provides the evidence that rate of compensation for the knowledge factor is growing for developed countries of the EC [11], the US and Japan [26]. It is a well-known fact that for world leading companies, a major part of their market valuation is associated with intangible assets ([51], [52]). Furthermore, empirical testing of neo-classical growth models output dynamics can only be explained if 'something else', a 'total productivity' factor (TFP), is introduced, that accounts roughly for one third to

one half of GDP growth [13]. TFP is associated with technological developments and externalities arising thereby [3]; TFP is not directly linked to capital or labor, nor to human capital.

Increased compensation for knowledge and technologies may perhaps provide explanation for the gap in per capita income between developed and developing countries.

Kaplinsky in his paper [65] demonstrates that globalization leads to re-distribution of functions in a value-chain, when developed countries start to specialize in higher value-added activities (including R&D and patenting, industrial design, branding and distribution). Through a case study Kaplinsky shows that competition is toughest, and return is lowest, in production activities with lower utilization of intellectual resources.

What is also important that transitional countries target for per capita income comparable to European, and this level of income may only be achieved if knowledge 'value lever' (called 'the lever of riches' by Mokyr [36]) is employed.

The unique factor that makes development through KRIs advantageous for transition economies is the availability of intellectual rent. It is evident that economies in transition bear, as a heritage of socialist period, a high intellectual potential. This potential has been accumulated due to necessary (and tough) intellectual competition with Western countries (the United States at first hand). Maintenance of technological progress at the comparable level was one of the priorities of governmental policy, especially in defense industries. During the socialist period, both unique technologies (war-, civil- or double-purpose) have been developed and substantial human capital has been created.

Intellectual rent (an opportunity to use intellectual potential avoiding investment into its creation), much like capital rent (an opportunity to use existing production assets created by socialist economy and privatized during transition period) is a unique feature of transitional economies. Only rough estimations of its value can be made by saying that e.g. the Soviet Union spent on scientific purposes a budget share comparable to those of OECD countries, and it had over four thousand scientific institutions; around 80% of R&D was applied research for specific industries. Socialist countries were (and their successors, in a few spheres, still are) the world leaders in natural and engineering sciences (in particular, physics, aero- and space technologies, chemistry and material sciences, life sciences, mathematics and computer sciences, etc.) [17].

Yet, utilization of intellectual potential was very low during the period of 1990s, especially in the former SU [69]. Various reasons for the failure to use this available resource have been debated, but they all more or less blame a lack of proper institutional infrastructure. A recent paper by Acemolgu, Aghion and Zilibotti [2] may provide some insights to this process. It suggests that for economies where technology is close to 'technological frontier', managerial skills are critical to employ technologies efficiently; and there was a shortage of such skills in most transitional countries.

The intellectual potential has been substantially depreciated during the past decade, and so a part of intellectual rent is inevitably lost. Since estimations of this potential have never been made, it is only possible to point out to indirect indicators. For Russian Federation, the financial support of R&D by state has been reduced by

70–80%; average age of researchers increased greatly (more than 35% of scientists are 50 and older); number of institutions has reduced by 20%. Major innovations have only been accomplished in machinery and chemistry/petrol chemistry, just two of a range of Russian industries [58]. In 1999–2001, demand for R&D has slightly increased, but still only 35% of finance came from industries themselves, indicating that demand remains fairly low.

However, the existing range of developments, inventions, knowledge and qualifications can still be used, and with minor investment it could be brought to the up-to-date level in order to produce high-tech production [68]. Thus, existing technologies and human capital allow for intellectual rent in knowledge-rich industries.

The enlisted rationales bring forth the idea that knowledge-rich industries may be a preferred way for long-term growth in transitional economies. Existence of intellectual rent allows to boost up high-technology industries with investment that is lower comparable to both developed and third-world countries. Estimates of the potential growth can only be made roughly, indicated by the size of world markets in high-tech where post-socialist countries may prove competitive (and the exact growth will definitely be linked to the success of specific technologies in specific markets). Moreover, if knowledge-rich industries grow, they will need increased supply of product of other domestic industries, according to the principle of multiplication of value-added.

Practical experience demonstrates that innovative behavior is the key way to involve intellectual resources into production sphere and to develop knowledge-rich industries. As an example, a research conducted for defense industry enterprises of CIS [64] shows the key determinants of growth for this KRI. Traditional factor of government contractual work is only important as a means to stabilize enterprise financial position. A factor of property type does not have serious impact on enterprise output dynamics: it is comparably similar for state and privatized enterprises. However, innovative activity of enterprise is key to its development: innovative enterprises are the fastest growers.

3. Two industry growth model

3.1. Model description

A problem of economic growth can be consider through a multi-industry model with varying factor productivity. A simple model of this kind is a two industry model (as in [27]): aggregated extractive industry, and aggregated processing industry. This model can be distinguished from neo-classical two-sector models, e.g. by Uzawa [57], since latter do not consider «supplier-consumer» relations between sectors, nor they introduce extractive and processing sectors. Besides, neo-classical models do not assume different level of intellectual resource utilization in sectors. Thus, proposed model is conceptually closer to models of endogenous growth with human capital such as Mankiw, Romer and Weil model [32], but unlike those, it has a two-sector structure.

Production and distribution

Following assumptions are made on factor production structure. Three types of production factors can be considered: (a) physical capital (machinery and equipment),

(b) labor, and (c) 'intellectual resources' (which include human capital, technologies, entrepreneurial skills etc.).

Rather than human capital, it is sensible to use the broader concept of intellectual resources or intellectual capital [52], [66]. Intellectual resources of a socio-economic system can be described by one macro-variable, that represents major aspect of reproduction and utilization of these resources [67]: (a) quality of intellectual resource reproduction (which can be indicated by basic, secondary, higher and professional education), (b) changes in intellectual resource content (emergence of new practices, skills, technologies, and also possible obsolescence and elimination of old practices and technologies). This broader approach to intellectual resources is based on a concept of social memory and its impact on socio-economic dynamics [28]. In terms of influence on output dynamics, it refers both to factor of human capital and to factor of technological progress.

Since a positive dependence exists between a level of intellectual resource development and factor contribution to economy value added, a technological obsolescence will mean a reduction of this contribution. It is therefore evident that a socio-economic system must maintain a certain level of R&D (even through imitation of technologies, developments and patents) in order to retain a comparable level of value-added output in its industries. This can be metaphorically described that industries have to 'run' in order to 'stay in place' (so called 'Red Queen Game' as in 'Alice in the Wonderland' [15], [66]).

In aggregated extractive industry, value-added is created by physical capital in first hand: ore mining and quarry equipment (solid mineral extraction), drilling and pumping equipment (liquid and gas mineral extraction). Technological change in extractive industries is not significant; R&D is related to geological exploration, and it also highly depends on physical capital (e.g. drilling). Of course, qualified labor is also required in such industries, as well as talented entrepreneurs, but R&D and qualification are not the critical success factors creating high value added (and this is why raw material industry is concentrated – it has economies of scale for physical capital, and requires substantial finance for operation). Product of extractive industry is intermediate good which is either exported or is used for domestic processing.

In aggregated processing industry, R&D and qualification are two main sources of value-added. Engineering developments and know-how are the main productive factors of processing industry, and high qualification for a majority of workers is critical for transformation of bright ideas into qualitative product. The product of processing industry is final good, which is either consumed (consumer goods, e.g. cloths and house appliances) or is invested (investments goods, e.g. machinery).

It is assumed that processing industries are generally knowledge-rich industries: they must produce technologically sophisticated products, they require constant modernization, modification of consumer qualities etc. Thus, one may put a somewhat equality sign between 'processing industries' and 'knowledge-rich industries' [59]. Yet, in the model primarily manufacturing of knowledge-rich commodities (and not services) is considered, as concentration on production of the latter (e.g. software, engineering etc) is only an emerging form of economic activity for transition countries, and switch to such a post-industrial organization manifests a great leap [21].

Each industry has a stock of physical capital and intellectual resources which are specific for the given industry (machinery and equipment can be mostly used for

given technology, also knowledge and skills can mostly be applied in a given industry); for purpose of modeling, a minor flow of resources between industries can be ignored. Labor resources are not specific and can be used in all industries. It can be assumed that total labor amount is constant, and that value-added creation is only determined by proportions of labor equipped in industries.

A value-added VA_i produced in i -th industry can be defined as

$$VA_i = \gamma_i L K_i^{\alpha_i} M_i^{\beta_i},$$

where L – amount of labor;

γ_i is share of labor that goes to i -th industry ($1 \geq \gamma_i \geq 0$, $\sum \gamma_i = 1$);

K_i is amount of physical capital in i -th industry;

M_i is amount of intellectual resources in i -th industry;

α_i, β_i are constants in a production function ($1 \geq \alpha_i \geq 0$, $1 \geq \beta_i \geq 0$, $\alpha_i + \beta_i \leq 1$).

It is not a target to consider an empirically understood growing compensation for intellectual labor in the model; however, it is possible to model it if $\beta_i \geq 1$.

National income Y is a sum of industries' value-added:

$$Y = \sum_i VA_i = \sum_i \gamma_i L K_i^{\alpha_i} M_i^{\beta_i}.$$

Distribution of national income can be represented, much traditionally, as $Y = C + I + S'$, where C is national consumption;

I is national investment;

S' is 'deadweight' savings (that can be observed e.g. in economy with poorly functioning banking system; in efficiently functioning market economy, $S' = 0$).

Investment is distributed between industry production factors:

$$I = \sum_i (I_{K_i} + I_{M_i}).$$

This can also be represented as

$$I = \sum_i (s_i \phi_i Y + s_i (1 - \phi_i) Y),$$

where s_i is a share of national income that is invested into i -th industry ($1 \geq s_i \geq 0$, $\sum s_i \leq 1$);

s is some limit constant, $s = I/Y$;

ϕ_i is a share of investment into i -th industry that is invested into physical capital K_i ($1 \geq \phi_i \geq 0$).

Coefficients s_i, ϕ_i may be constant or may vary in time.

Dynamics of stock of production factors in a given industry i is represented as

$$\begin{aligned} \dot{K}_i &= \theta_{K_i} (s_i \phi_i Y)^{\zeta_i} - \delta_{K_i} K_i \\ \dot{M}_i &= \theta_{M_i} (s_i (1 - \phi_i) Y)^{\tau_i} - \delta_{M_i} M_i, \end{aligned}$$

where $\delta_{K_i}, \delta_{M_i}$ are depreciation rates for physical capital and intellectual resources, accordingly;

θ_{K_i} , θ_{M_i} , ζ_i , and τ_i are constants that determine efficiency of investment into a given resource in a given industry.

In basic case, $\theta_{K_i} = \theta_{M_i} = 1$, $\zeta_i=1$, $\tau_i=1$, i.e.

$$\dot{K}_i = I_{K_i} - \delta_{K_i} K_i = s_i \phi_i Y - \delta_{K_i} K_i$$

$$\dot{M}_i = I_{M_i} - \delta_{M_i} M_i = s_i (1 - \phi_i) Y - \delta_{M_i} M_i.$$

A basic structure of output and investment for two industry economy model is represented below in Fig. 1.

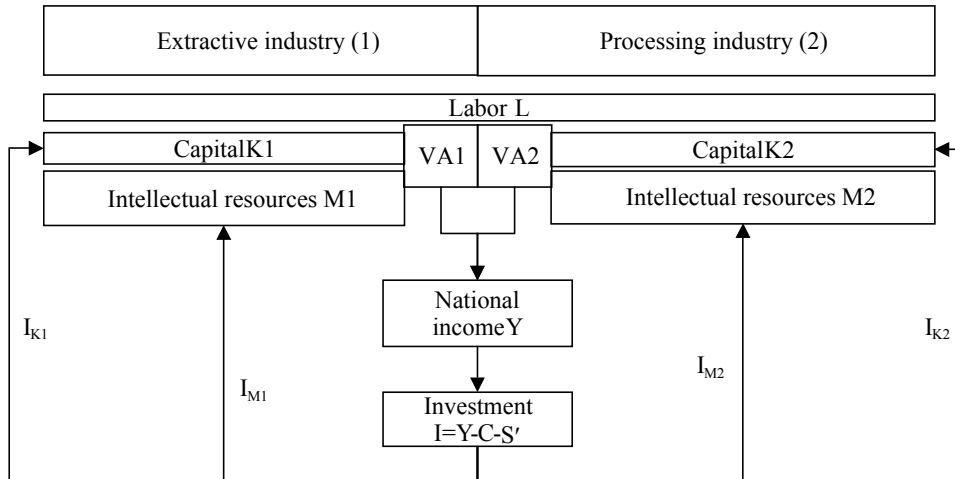


Fig. 1. Output and investment in two industry model

It can be assumed that productivity of intellectual resources is low in extractive industry and high in processing industry, $\beta_2 > \beta_1 \cong 0$. Total productivity of factors can be the same in two industries, $\alpha_1 + \beta_1 = \alpha_2 + \beta_2$. Also, investment into intellectual resources in processing industry may be more efficient than investment into other factors, $\tau_2 > 1$ ($\zeta_1 = \zeta_2 = \tau_1 = 1$).

Supply and demand

Through structure of value-added, it is possible to derive amounts of domestic supply and foreign trade. It may be assumed that extractive industry product price is P_1 , and processing product price is P_2 .

Then, an extractive industry produces (and supplies) Q_1 quantity of product:

$$Q_1 = \frac{VA_1}{P_1} = \frac{\gamma_1 L K_1^{\alpha_1} M_1^{\beta_1}}{P_1}.$$

It can be assumed that processing industry has a Leontieff-type technology, requiring λ units of intermediate product for one unit of final product. Then, a demand in processing industry (intermediate good market) is

$$\tilde{Q}_1 = \lambda Q_2,$$

where λ is coefficient of technological utilization of raw material (assume that $\lambda=1$, i.e. one unit of intermediate good required for one unit of final good). Then, obviously, $P_2 > \lambda P_1$.

A processing industry produces (and supplies) Q_2 quantity of product (case $\lambda=1$):

$$Q_2 = \frac{VA_2}{P_2 - P_1} = \frac{\gamma_2 L K_2^{\alpha_2} M_2^{\beta_2}}{P_2 - P_1}.$$

Private consumption (consumer goods) and investment into physical capital (equipment, constructions) both represent a demand for processing industry product. Investment into intellectual resources partially is used for education materials (i.e. purchase of books, hardware/software etc. – i.e. processing industry products), and partially it is distributed as tutors' income (and therefore afterwards it is used for private consumption, too). Thus, all income in a considered two-industry economy is, this way or the other, is used to purchase processing industry product. Then the demand in final good market is:

$$\tilde{Q}_2 = \frac{VA_1 + VA_2}{P_2}.$$

In basic case, it is possible to assume that foreign trade imposes no limitations on economy, i.e. a deficit of good can all be covered by imports, and excess of good can all be exported. Then, amount of export/import is determined as

$$Ex_i = \begin{cases} Q_i - \tilde{Q}_i, & \text{if } Q_i > \tilde{Q}_i \\ 0 & \text{otherwise} \end{cases}$$

$$Im_i = \begin{cases} \tilde{Q}_i - Q_i, & \text{if } \tilde{Q}_i > Q_i \\ 0 & \text{otherwise} \end{cases}$$

A basic structure of flows in a two industry economy model is represented below (Fig. 2).

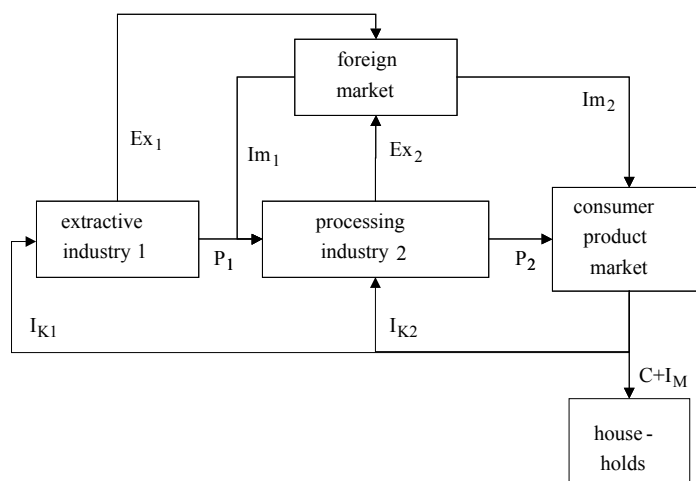


Fig. 2. Structure of production flows in two industry economy

Introducing limitations

A model introduced above can be solved analytically, provided an optimality criterion is given. However, it is evident that solution will rely on one serious assumption: that free foreign trade will cover domestic imbalances, demanding excess product and supplying deficit product. However, expansion in foreign markets is typically limited due to high competition, as well as domestic markets once lost to import are difficult to regain. Therefore, limitations can be introduced into a model, assuming that actual supply is limited either by production capacity (determined by available factors) or by market demand (which can hardly grow faster than certain pace, e.g. growth of world economy).

It may be assumed that there is no problem of intermediate good import substitution: processing industry manufacturers would always prefer to purchase raw materials domestically, should these be available.

Let $R[\cdot]$ be an operator of time lag: for some dynamic variable x_t , $R[x_t]=x_{t-1}$.

For final good industry, maximal growth of output Q_2 may be limited by a consumer preference factor ξ (indicating potential loyalty to domestic brands):

$$Q_2/R[Q_2] < 1 + \xi$$

therefore,

$$Q_2 = \min \left[\frac{\gamma_2 L K_2^{\alpha_2} M_2^{\beta_2}}{P_2 - P_1}; (1 + \xi) \cdot R[Q_2] \right]$$

and

$$VA_2 = (P_2 - P_1) Q_2$$

Domestic demand for intermediate good is defined as above from production volume of Q_2 .

Export of extractive industry product is limited by foreign market growth ω :

$$Ex_1 = \min \left[\frac{\gamma_1 L K_1^{\alpha_1} M_1^{\beta_1}}{P_1} - \tilde{Q}_1; (1 + \omega) \cdot R[Ex_1] \right] \quad \text{if } \frac{\gamma_1 L K_1^{\alpha_1} M_1^{\beta_1}}{P_1} > \tilde{Q}_1$$

and

$$Q_1 = \tilde{Q}_1 + Ex_1 \quad \text{if } \frac{\gamma_1 L K_1^{\alpha_1} M_1^{\beta_1}}{P_1} > \tilde{Q}_1$$

$$Q_1 = \frac{\gamma_1 L K_1^{\alpha_1} M_1^{\beta_1}}{P_1} \quad \text{otherwise}$$

then

$$VA_1 = P_1 Q_1$$

and

$$Y = VA_1 + VA_2 = C + I.$$

Saving behavior

Traditional theory considers several types of saving behavior [9]:

1. Investment proportional to national income (in accordance with Keynesian and neoclassical models) and is determined by propensity to save.

Then, for the model analyzed:

$$\begin{aligned} s_i^t &= s_i \\ \phi_i^t &= \phi_i. \end{aligned}$$

2. Dynamically determined rate of investment (analogue of capital market which determines target and size of investments). Several factors can have impact on a ratio of investment to national income:

(a) factor productivity in industries. In accordance with neoclassical approach, factor demand depends on relative productivity of the given factor;

(b) industry productivity. Proportion of investment that goes to each industry may depend on relative industry productivity.

In order to evaluate behavioral scenarios for the model, an approach considering varying proportions of investment ('2a' option) was used. For analytical study of the model, an approach considering fixed investment proportions was used.

3.2. Behavioral scenarios

Series of simulations have been run in order to determine major scenarios of economic development for two industry model (these simulations were particularly necessary to examine cases when analytic modeling is complicated: e.g. consideration of limitations).

These scenarios, summarized in Table 1, also represent tendencies that could be observed in real transition economies.

Table 1.

Major scenarios of economic dynamics for two industry economy

№	Description	Formal description	Examples
I	Balance of extractive and processing industry (insignificant exports and imports); can only be maintained in planning economies	$Q_1 = Q_1^D$ $Q_2 = Q_2^D$	Soviet Union economy
II	Decline of processing sector output; deficit in domestic final good market is covered by imports, excess intermediate good is exported	$Q_1 > Q_1^D \parallel Ex_1 > 0$ $Q_2 < Q_2^D \parallel Im_2 > 0$	Russia, Ukraine
III	Complete elimination of processing sector; export revenues of extractive sector are used to purchase imported final goods	$Q_1 > Q_1^D = 0 \parallel Ex_1 = Q_1$ $Q_2 = 0 \parallel Im_2 = Q_2^D$	Kazakhstan, Turkmenistan
IV	Development of processing sector; extractive industry redirected to supply mostly to domestic processing industry	$Q_1 < Q_1^D \parallel Im_1 > 0$ $Q_2 > Q_2^D \parallel Ex_2 > 0$	CEE countries
V	Complete elimination of extractive sector; export revenues of processing sector are used to purchase imported raw materials	$Q_1 = 0 \parallel Im_1 = Q_1^D$ $Q_2 > Q_2^D \parallel Ex_2 = Q_2 - Q_2^D$	(not in transitional economies): e.g. Italy, UK etc.

These scenarios are represented as flowcharts in Fig. 3 gray arrows indicate potential switches between scenarios.

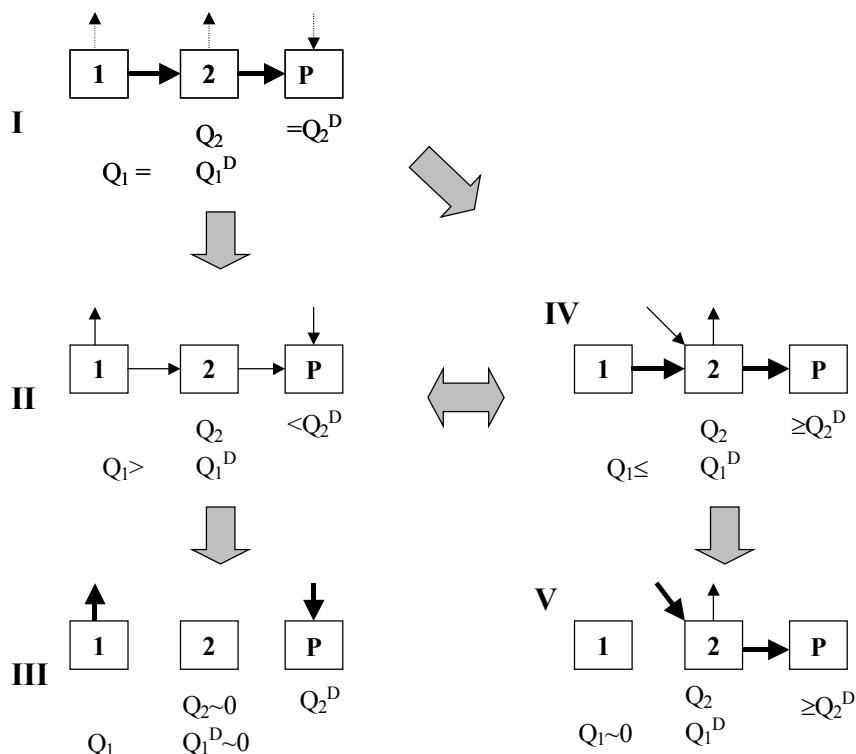


Fig. 3. Scenarios of economic development in two industry model

Scenario I is particularly not stable, since balance of two industries can only be achieved through price control, supply-demand regulations, and limitations of export/import. When economics is liberalized, these limitations are removed and a system evolves either to Scenario II (decline of processing industry) or to Scenario IV (expansion of production industry). Scenario II can evolve to Scenario III (complete elimination of processing industry); similarly, Scenario IV can evolve to Scenario V (when raw materials are mostly purchased abroad, as it can be observed in many Western Europe countries). Further, economy can switch between Scenario II (if extractive industry is developing faster) and Scenario IV (if processing industry is developing faster).

Scenario II is a typical description of what happened in the former SU republics during the beginning of 1990s. After economy was liberalized, low-quality production of domestic processing manufacturers has been replaced by imports; imports also have filled in the gap in demand that existed in final good markets in beginning of 1990s. In some countries, this tendency continued as far as Scenario III, with virtually an elimination of processing industry activities. In other countries, such as

Russia and Ukraine, extractive industries still dominate economic output and stand for a large share of exports, but processing industries represent a substantial part of the economy.

Other countries, primarily CEE countries such as Czech Republic and Poland, managed to keep the pace of processing industries and have therefore continued as Scenario IV. However, these countries have traditionally been developed as a 'processing', and they have a long history supporting this path (e.g. industrialization in these countries happened half a century earlier than in Soviet Union republics) (a revision of transition processes and underlying factors e.g. in Svejnar's papers [53], [54]).

3.3. Analytics of the model

The problem is to determine which scenario is preferable and how it can be achieved. Major model analysis results can be summarized:

(a) it is very important to provide correct criterion for best scenario. As always, investment is a major source of long-term growth. However, a task to maximize rate of economic growth in current period $\Delta Y_t/Y_t$, (if an investment rate limit s is defined: $s_1+s_2=s$):

$$\frac{\Delta Y}{Y} = \frac{1}{Y} \cdot \left[\frac{\partial Y}{\partial K_1} \cdot \frac{\partial K_1}{\partial t} + \frac{\partial Y}{\partial M_1} \cdot \frac{\partial M_1}{\partial t} + \frac{\partial Y}{\partial K_2} \cdot \frac{\partial K_2}{\partial t} + \frac{\partial Y}{\partial M_2} \cdot \frac{\partial M_2}{\partial t} \right] = s_1 \cdot (...) + s_2 \cdot (...) + (...)$$

$$s_1, s_2 = \operatorname{argmax} \Delta Y$$

leads to a myopic investors' decision to invest everything into most productive industry ($s_1=s, s_2=0$ if expression in brackets is larger for first member, and $s_1=0, s_2=s$ if expression is larger for the second member). This leads to output decline in under-invested industry (which thereby becomes even less productive); finally this results in extermination of a less productive industry, but due to this also to a drop in overall productivity (and often a decline) of a more productive industry. Maintenance of fixed investment proportions is more preferable for economy to achieve higher national income in the long run, although in a short run it may experience lower growth rates.

(b) For basic case, when no limitations are introduced to the model, and investment proportions are fixed, a model converges to a steady state if $\zeta_i \alpha_i, \tau_i \beta_i < 1$.

Accordingly, a model of two-industry economy with given properties has an equilibrium of 'stable node' type; this can be considered an extension of Mankiw et al. [32] who demonstrated a stable equilibrium for one-sector system with intellectual resource accumulation (without consideration of its inner structure).

Otherwise, a model can follow an explosive (ever expanding growth path). This is one opportunity to indicate e.g. a growing comparative compensation for intellectual resources (or, a growing utility of intellectual resources as introduced by Romer [43]); however, given the empirics of contemporary knowledge economies, Romer's assumptions can be questioned.

In case limitations are introduced, three possible types of influence upon system dynamics have been identified: (a) no impact; (b) slowing the convergence process (light impact); (c) changing the equilibrium state, e.g. a system collapses to zero

(heavy impact). Assuming the fixed investment proportions, most frequent is type 'b' dynamics; thus, limitations do not have principle effect upon steady-state solution.

There exists an optimal proportion of investment split between industries that will maximize the steady-state output, if an investment rate limit s is defined:

$$s_1^*, s_2^* = \operatorname{argmax} Y^*(\varphi_1^*, \varphi_2^*)$$

$$\varphi_1^*, \varphi_2^* = \operatorname{argmax} Y^*(s_1, s_2).$$

A target then can be to maximize steady-state consumption, that is, $C=(1-s)Y$. Formal solution of this model can be provided if basic case of factor accumulation ($\theta_{Ki} = \theta_{Mi} = 1$, $\zeta_i=1$, $\tau_i=1$) is considered.

Let

$$\chi = \alpha_1 + \beta_1 = \alpha_2 + \beta_2.$$

Values of φ_1 , φ_2 that maximize national income Y can independently be found for each industry:

$$\varphi_1 = \frac{\alpha_1}{\chi}, \varphi_2 = \frac{\alpha_2}{\chi}.$$

Then, since $s_1 + s_2 = s$, long-term level of national income Y^* will be maximal if

$$s_1 = s \cdot \frac{c_1^{\frac{1}{1-\chi}}}{c_1^{\frac{1}{1-\chi}} + c_2^{\frac{1}{1-\chi}}}, s_2 = s - s_1,$$

where

$$c_1 = \gamma_1 \cdot \left[\frac{\alpha_1}{\delta_{K_1}} \right]^{\alpha_1} \cdot \left[\frac{\beta_1}{\delta_{M_1}} \right]^{\beta_1}, c_2 = \gamma_2 \cdot \left[\frac{\alpha_2}{\delta_{K_2}} \right]^{\alpha_2} \cdot \left[\frac{\beta_2}{\delta_{M_2}} \right]^{\beta_2}.$$

Given s , maximal Y can be expressed as

$$Y = \left\{ L \cdot \left(\gamma_1 \cdot \left[\frac{\alpha_1}{\delta_{K_1}} \right]^{\alpha_1} \cdot \left[\frac{\beta_1}{\delta_{M_1}} \right]^{\beta_1} \cdot \left[\frac{d \cdot s}{\chi} \right]^{\chi} + \gamma_2 \cdot \left[\frac{\alpha_2}{\delta_{K_2}} \right]^{\alpha_2} \cdot \left[\frac{\beta_2}{\delta_{M_2}} \right]^{\beta_2} \cdot \left[\frac{(1-d) \cdot s}{\chi} \right]^{\chi} \right) \right\}^{\frac{1}{1-\chi}} = s^{\frac{\chi}{1-\chi}} \cdot E$$

where E is a constant that can be calculated depending on parameters of economy considered.

Maximal level of consumption given the rate of saving can be expressed as

$$C = (1-s) \cdot s^{\frac{\chi}{1-\chi}} \cdot E.$$

This expression achieves its maximum if $s = \chi$.

Main implications of the presented model are the following.

First, target to maximize rate of economic growth can lead to sub-optimal long-run decisions. For economic planning, it is worth setting targets that establish high level of national income in the long-run (just recently, some governments started to place such targets, e.g. the government of Russia [62]).

Second, there exists an optimal distribution of investment between industries and production factors that assures maximal level of national income in the long-run. This target is achieved through balanced growth that assumes investment of industries in certain non-zero proportions.

4. Better growth: what can government do

4.1. Investing into institutional capital

Models of economic development through knowledge-rich industries assume that there exists some 'equilibrium' compensation for value-added produced by intellectual resources, objectively established in the market (just like cost of capital and labor wage). However, since knowledge-rich industries innovate and introduce new products, market value of such products will also be influenced by entrepreneurs themselves: e.g. market demand is determined from marketing promotional activities, a so-called demand generation; supply will be determined by company's ability to protect its market from competitor intervention using patents and other legal methods [45]. Therefore, impact of regulating state authorities on 'equilibrium' price of KRI product is essential [44].

Net efficiency of technological development and human capital cannot be measured. It has been shown in a number of studies that for knowledge-rich industries, efficiency of investment to a substantial degree is settled by institutional activity of government [46]. A business environment should be created, in which innovative companies and knowledge-rich industries will be able to expand and provide a stable flow of income to their investors.

All developed countries use a number of measures that effectively increases a value-added of intellectual resources ([34], [39]):

- legislation protecting investments into knowledge-rich industries (patent laws, copyright laws etc.);
- state incentives of KRI production activities
 - direct (e.g. systems of technological parks and business-incubators supported by state donations; government finance for priority technologies; government purchases of KRI products);
 - indirect (e.g. preferential tax treatment);
- foreign trade regulation
 - protectionist measures for domestic markets of KRI products (custom and tariff regulation, currency policy, compulsion measures);
 - support of KRI exports (e.g. technical aid programs for developing countries, export subsidizing, compulsion measures).

Another important aspect of KRI growth in transition countries is emergence and development of market-type management skills as a necessary component for efficient value-added creation. Because management skills is a flair that cannot just spring up overnight and must be developed within the population, it is a responsibility of state authorities as transition process leaders to elaborate on institutional networks supporting them [20]. Whereas in CEE, deficit of managerial skills was covered by those of foreign managers from developed countries [8], lack of market-

type management institutions is one clue to why fast transition program has failed in former SU republics [55].

Besides, availability of qualified technical workforce (engineers, specialists, and researchers) is very important. All countries in which KRIs have been successfully developing, including South-East Asian countries, have succeeded due to this factor. Besides, all these countries have conducted specific state policies targeting growth of quantity and improvement of quality of their workforce [23]. However, as emphasized by Mani [31], it is important not only to have qualified workforce available, but to balance between industry demand for specialists and supply from tertiary education system.

Thus, government efforts to support knowledge-rich industries are *de facto* one more (and quite important!) production factor (in a sense that it creates industry value-added). This factor can be called 'institutional capital'. Creation and maintenance of institutional capital requires investments, performed primarily by the state (they are related to domestic infrastructure in innovation sphere and knowledge-rich industries, as well as to a country's position in the world as high-technology bearer).

Similar issues (no formal models) were considered by Easterly [12], who demonstrated that in absence of proper economic infrastructure (that depends on government efforts to establish 'game rules'), even given other growth 'prerequisites' (physical and human factor accumulation, R&D etc.), economic growth may not occur.

'Institutional capital' factor is closely linked with productivity of national innovation system (a concept introduced by Freeman [14], and extended by Lundvall [29] and Nelson [38]). A more precise definition by Nelson considers national innovation system (NIS) a complex of policy measures in industry and innovation sphere, R&D activity and innovative behavior of firms and state institutions (incl. research institutes and universities). Thus, NIS involves all participants of innovation process: knowledge producers as well as knowledge users, and also regulative authorities. Accordingly, infrastructure of NIS will have positive effect on value-added produced by KRIs; this infrastructure can be called 'institutional capital'.

Accordingly, a two industry model considered in Section 3 can be modified in order to consider institution capital factor:

$$VA_i = \gamma_i L K_i^{\alpha_i} M_i^{\beta_i} P_i^{\gamma_i},$$

where P_i is a institutional capital factor of i -th industry;

γ_i shows institutional capital productivity (it is possible to assume that this productivity is low in extractive industry and it is high in processing industry due to the reasons discussed: $\gamma_2 > \gamma_1 \approx 0$).

Dynamics of institutional capital factor can be similar to dynamics of other factors (since there will be certain 'efficiency' of investment, and since this factor would 'depreciate' once it is not maintained):

$$\dot{P}_i = \theta_{P_i} I_{P_i}^{\rho_i} - \delta_{P_i} P_i,$$

where δ_{P_i} is a depreciation rate for institutional capital;

I_{P_i} is amount of investment into institutional capital ($I_{P_i} = s_i \varphi_{i2} Y$, $\varphi_i + \varphi_{i2} \leq 1$),

θ_{P_i} and ρ_i are constants that determine efficiency of investment into institutional capital in i -th industry.

If institutional capital factor is considered in the model, an optimal distribution of investment flows (which provides maximal level of output) will change significantly, since a certain share of national capital must be invested into creation and maintenance of institutional capital in processing industries (if $\zeta_i \alpha_i, \tau_i \beta_i, \rho_i \gamma_i \leq 1$):

$$s_1^*, s_2^* = \operatorname{argmax} Y^* (\varphi_1^*, \varphi_{12}^*, \varphi_2^*, \varphi_{22}^*)$$

$$\varphi_1^*, \varphi_{12}^*, \varphi_2^*, \varphi_{22}^* = \operatorname{argmax} Y^* (s_1, s_2)$$

where $s_1^*, s_2^* > 0$. Because such investment is accomplished by state authorities, a corresponding part of national product can be extracted in form of taxes (e.g. corporate income tax) and redirected for purposes of required institutional infrastructure development. It is important to consider this factor in practical analysis in order to estimate investment proportions properly.

4.2. Directing investment flows

Maintenance of proper investment proportions and development of activities in knowledge-rich industries are two key preconditions of high level of economic growth in transition economies. However, some transition countries with vast natural resources become stuck in the situation of inefficient investment distribution.

Availability of resource rent creates disproportions in investment, since expected return is higher in extractive sector of economy. Projects in processing industries are only considered as risk-diversifying (extractive industry products all have cycle price conjuncture); but since they are treated as such, finance only goes to projects that have higher return and minimal sunk cost. As a result, extractive industries become over-invested, and processing industries remain under-invested.

State authorities can use policies that would re-direct investment flows, imposing conditions under which investors prefer to invest into specific sectors (see e.g. [47]). Since there exist a great variety of investment projects with various investment requirement and various profitability, this policy can be described as imposed change of parameters of project probabilistic distribution in extractive and processing industries.

Suppose there is a probabilistic distribution of investment options in extractive and processing industries, and total need for investment is comparable in both sectors. If all projects are adjusted by risk rate to represent expected project return, and all projects are normalized by investment volume, then their distribution will conform to the following pattern: a majority of projects will distribute around some average industry income rate R^* , with possible deviations of particular projects towards higher or lower profitability. Then, invested finance is distributed to projects that have higher expected return, then to projects with lower expected rate, and so on, up to projects with minimal acceptable rate of return (Fig. 4).

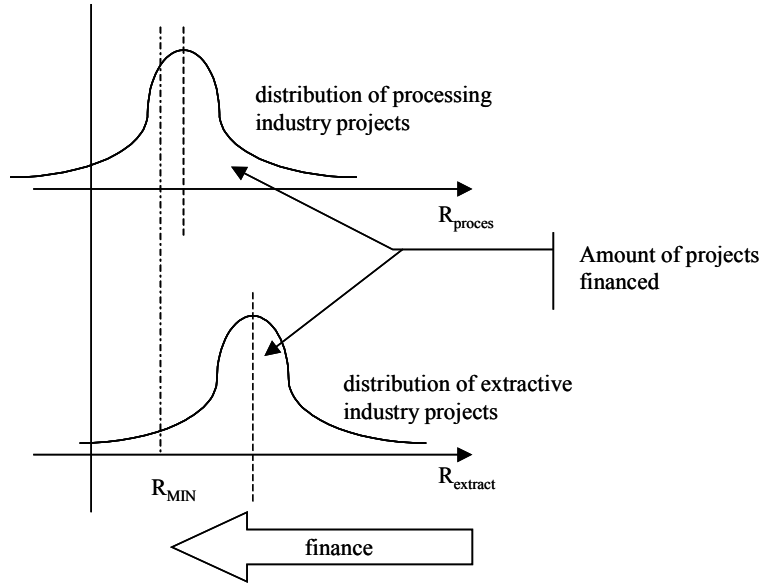


Fig. 4. Probabilistic distribution of projects and investment process in two industry economy

Then, rate of proportions in which investment is split between extractive and processing industries, is determined as

$$\pi = \frac{P_1(R > R_{MIN})}{P_2(R > R_{MIN})},$$

where π is a proportion of investments for extractive (№ 1) and processing (№ 2) industries;

P_i is a probabilistic distribution of projects in i -th industry;

R_{MIN} is a minimal acceptable rate of return (e.g. return of zero-risk investment).

In basic case, industry project distribution can be described by Gauss-type distribution function, then

$$P_i(R > R_{MIN}) = f_i(R_{MIN}, R_i^*, \Omega_{R_i}),$$

where R_i^* is an average of distribution of return in i -th industry;

Ω_{R_i} is a standard deviation of return in i -th industry.

Thus,

$$\pi = f(R_{MIN}, R_1^*, R_2^*, \Omega_{R_1}, \Omega_{R_2}).$$

If $\Omega_{R1} = \Omega_{R2} = \Omega_R$, i.e. standard deviations of return is equal into industries, then π is only determined by ratio of R_1^* and R_2^* , i.e. average of return in each industry.

Then, options for state authorities to introduce a corrective system of taxes and subsidies can be represented as

$$\pi^* = \pi(R_{MIN}, R_1^* - \Delta_1, R_2^* + \Delta_2, \Omega_R)$$

$$a) \Delta_1 = \Delta, \quad \Delta_2 = 0$$

$$b) \Delta_1 = 0, \quad \Delta_2 = \Delta$$

$$c) \Delta_1 = \Delta_2 = \frac{\Delta}{2},$$

where Δ_1 is a correction of extractive industry return through resource rent tax;

Δ_2 is a correction of processing industry return through subsidies.

Therefore, after selection of a corrective policy type, a necessary correction level Δ is determined from

$$\pi^* = \pi(R_{MIN}, R_1^* - \Delta_1, R_2^* + \Delta_2, \Omega_R).$$

Graphically, this situation is represented in Fig. 5.

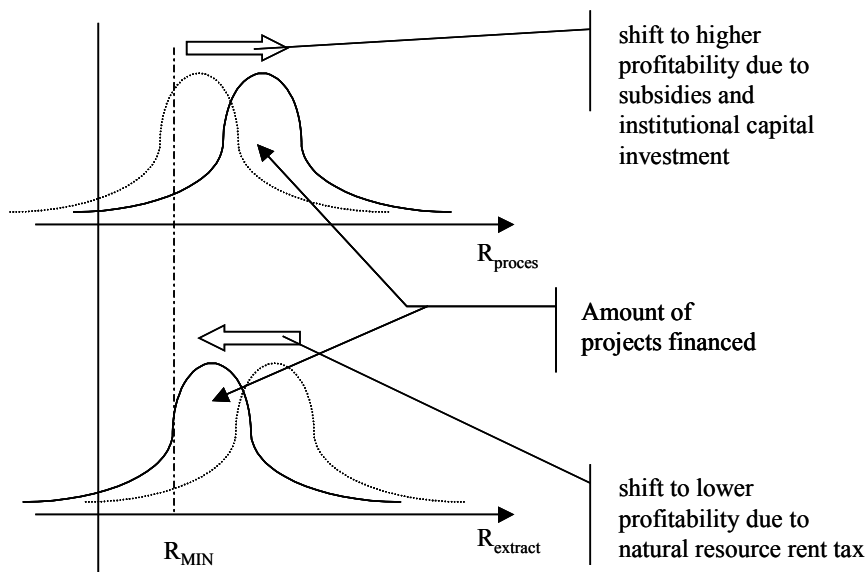


Fig. 5. Correction of investment flow proportions

It is evident that policy option (c), introduction of corrective tax on resource rent and redistribution of tax revenues in form of subsidies to processing industries, imposes a lower tax burden on extractive industries (compared to option (a)), and also creates a smaller basis for state inefficiency (due to lower subsidies compared to option (b)). A number of practical examples on the issue summarized in [40].

It should be noted that for such policy, transparency of its implementation is critical: based on experience of Norway, the only country that managed to avoid Dutch disease, availability of civil control over financial flows of oil sector and their redistribution beneficial to the society also turned to be beneficial for economy; and this is what other natural resource-rich countries lacked [24].

5. Knowledge rich industries: key success factors

It is a principle issue what mechanism can facilitate the engagement of intellectual potential in industries. Whereas intellectual potential has been partially employed in CEE, the main problem in former SU republics was that throughout the first ten years of transition its KRIs have never created any prerequisites for a successful conversion into a market-based knowledge-based economy [58].

An efficient economic growth through knowledge-rich industries involves two main components. On one side, there must be a constant demand of industries themselves for innovations and technologies. On the other side, there must exist a market-oriented R&D sector ready to fulfill this demand and to propose new technologies with potential commercial viability. One such possible organization is presented in Fig. 6: a flow of gradually commercialized technologies from R&D sector into industrial sector, spin-off in venture companies and final acceptance as a routine in large companies. A government can guide this process through subsidies and imposed standards, and institutional/financial support to R&D sector. Evidently, growth through KRIs is a long chain of concerted processes; whenever one link is missing, the whole chain falls.

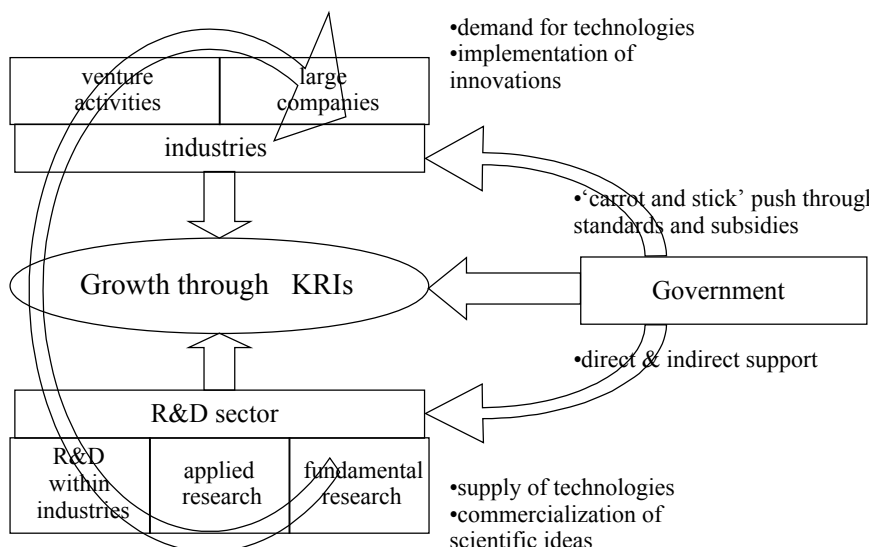


Fig. 6. Components of growth through knowledge-rich industries

It was exactly a 'missing link' phenomenon that made growth pace in knowledge-rich industries very slow for former Soviet Union countries. In fact, heritage of socialist science could doubtfully be used commercially (besides those technologies stolen *en masse* during early 1990s). Soviet science has never been commercialized: In Soviet Union, major R&D was concentrated within the second sphere accounting for 75 to 90 per cent of overall R&D; only 5 to 10 per cent of R&D were allocated in industries themselves [16]. On the other hand, there never existed an 'innovative culture', a deep understanding that innovation is a key value in industries (as it is e.g.

in the United States [18]). Some institutions critical for market-based growth in knowledge-rich industries have never existed, and some have not emerged even by now.

From industry side, development of R&D has been halted by mere commercial reasons. First, payback for R&D projects may extend to five-ten years; when inflation rate is high, such long-term investments become prohibitively expensive. Also (linked with that), the real return on investment in KRIs (including innovations) has been lower than that of 'traditional' economic activities (developing trade sector, exports of oil etc). Second, lack of formal legislation has brought industries into 'institutional blindness' (when unspecified property rights or absence of intellectual property rights protection halt practical implementations of an innovation [5]); whereas proper laws on intellectual property rights (patenting etc) are a major issue of KRI growth in developed countries such the US and Japan [33]. Third, lack of managerial skills has made implementation of innovations difficult. In particular, when forced to compete with sophisticated production of transnational companies, local entrepreneurs often failed [55].

Finally, often industries are reluctant to make innovations unless they are forced to. One thing that pushes them forward is competition; however, a tough competition also brings prices down, thereby limiting companies' abilities to invest (an expected return from investment becomes much lower, thereby innovation is not attractive). Another thing is government introduction of standards and norms, which has proven itself as good way to stimulate innovations e.g. in the EU. Similar policies have been applied recently in the automotive and aviation sector of Central and Eastern Europe, where environmental and safety standards are forcing domestic manufacturers to invest in new technologies (see [1] on automotive industry; reports on other industries can be obtained). A wise combination of protectionist measures and imposed standards is one efficient 'carrot and stick' for KRI growth stimulation.

An identification of missing elements of innovative economy may help to reveal target zones in which institutional investment by governments should first apply.

Industries would not come to growth through innovations until other (less sophisticated) opportunities exhausted. Thus, re-direction of investment flows (a formal model discussed above) may become one important target for policy makers. Development of legislation and support to managerial skills development (called investment into institutional capital above) are also very important.

From R&D sector side, it is necessary to create pre-requisites for commercialization of technologies, and institutions for fast response to industry demand.

The country's overall scientific potential may be split into three spheres – scientific potential within companies (in-house engineers and researchers), applied research in industries (industrial institutes, research centers etc), and academic research (including fundamental science, tertiary education institutions etc) For each of these spheres, depending on the degree of R&D commercialization (which is the highest in the first sphere and the lowest in the last one), mechanisms of knowledge involvement into economic life shall vary.

R&D within manufacturing companies represents the least problematic zone, as its potential is utilized by companies themselves. A promising way to use industrial potential is to enforce joint-ventures in high-tech spheres, allowing domestic industries to catch up with latest trends in R&D, and international companies to benefit from comparatively cheap local intellectual labor.

An institution that may create links between academic sector and business world is a range of commercialization agencies that advocate support to specific technologies. Emerging venture capitalists may use such agencies as intermediates to choose better investment opportunities.

For academic research, which may not necessarily have tangible commercial effect, role of state budget support is crucial. The applied research, which still holds the largest share, may use both commercial and state support combined. For all three spheres, it is important to sort out the intellectual property issues, keep in mind that an acceptable solution must not turn down the turnover of critical knowledge and key ideas (e.g. government may not necessarily put anti-piracy legislation among its priorities, since Western-type anti-piracy laws must have balanced application, whereas strict application is merely inefficient [6]).

It is evident that only smooth inter-dependent work of all these three spheres may help to maintain the intellectual potential in the long-run. Utilization of intellectual potential is therefore conditional upon the multi-directional governmental policies, implying the critical role of state for shaping the process of long-term economic growth via growth acceleration in knowledge-rich industries.

6. Conclusion

Main results of this paper can be shortly summarized. It has been argued that development through knowledge-rich industries is advantageous for economies in transition. The main factors that make such development preferable are (a) high importance of human (or intellectual) resources as a factor for transition process and as a country's competitive competence, (b) increased comparative compensation for intellectual resources value-added that is one possible gap in income level between developed and transitional countries, and (c) initial endowment with intellectual resources and thus availability of intellectual rent.

Analysis and simulations that have been carried out for a proposed two industry model have demonstrated that it is beneficial for a country to maintain certain proportions of investment into industries and factors, that is, to achieve balanced growth. Solution for these proportions has been proposed for the presented formal model.

Government plays a key role if development through knowledge-rich industries is targeted. In a case existing structure of investment flows is found inefficient (e.g. decline of processing sector due to rich endowment with natural resources), it is possible to arrange its re-distribution through a system of taxes (in extractive sector) and subsidies (in processing sector); formal model has been suggested to estimate necessary re-distribution measures. A government is able to build up and maintain a country's 'institutional capital' (basic institutes for intellectual property rights, R&D etc) that would increase value-added of the processing sector. Policies should also be applied to enhance R&D sector and to make it market-oriented.

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REFERENCES

1. ACEA & UNEP Report. Automotive Industry as a Partner for Sustainable Development. UK, 2002.
2. *Acemolgu D., Aghion P., Zilibotti F.* Distance to Frontier, Selection, and Economic Growth // NBER Working Paper Series. № 9066. Cambridge, MA: National Bureau of Economic Research, 2002.
3. *Aghion Ph., Howitt P.* Endogenous Growth Theory. Cambridge, MA: MIT Press, 1998.
4. *Arrow K.* Knowledge as a Factor of Production / The Annual World Bank Conference on Development Economics Proceedings, 1999. P. 15–20.
5. *Bacchetta M., Drabek Z.* Effects of WTO Accession on Policy-Making in Sovereign States: Preliminary Lessons From the Recent Experience of Transition Countries // WTO Staff Working Paper DERD. 2002. № 2.
6. *Bassov O.* On Externalities in the Production of Knowledge // Working Paper № BSP/2000/031-E. Moscow: New Economic School, 1999.
7. *Bonin J., Abel I.* Will restructuring Hungarian companies innovate? // Comparative Economic Studies. 1998. № 40. P. 53–74.
8. *Bugajski J., Damro C.* Up from Communism // World&I. 1996. Vol. 11. № 12.
9. *Coen R., Etsner R.* Investment // The New Palgrave: A Dictionary of Economics. L.: The Macmillan Press. 1998. Vol. 2. P. 980–986.
10. *Corden W.M.* Booming Sector and Dutch Disease Economics: Survey and Consolidation // Oxford Economic Papers. 1984. Vol. 36. P. 359–380.
11. *Cowan R.* (ed.) Innovation policy in knowledge-based economy. Study by European Commission. Luxembourg: Office for Official Publications of EC, 2000.
12. *Easterly W.* The Elusive Quest for Growth. The MIT Press, 2000.
13. *Easterly W., Levine R.* It's Not Factor Accumulation: Stylized Facts and Growth Models // The World Bank Economic Review. 2001. Vol. 15. № 2. P. 177–219.
14. *Freeman C.* Technology Policy and Economic Performance: Lessons from Japan. L.: Pinter, 1987.
15. *Gastle C.* Innovation and Entropy Within the Global Economy: Accelerating in the 'Red Queen' Game: Report for Information Technology Association of Canada, 2002.
16. *Gokhberg L., Peck M., Gacs J.* Russian Applied Research and Development / Intl. Institute for Applied Systems Analysis. Laxenberg, Austria, 1997.
17. *Gokhberg et al.* Russia: A Science and Technology Profile. The British Council, 1999.
18. *Gompers P.* Corporations and the Financing of Innovations: The Corporate Venturing Experience // Federal Reserve Bank of Atlanta Economic Review. 2002. № 4. P. 1–23.
19. *Harberger A.* A Vision of the Growth Process // The American Economic Review. 1998. № 88(1). P. 1–32.
20. *Jacoby W.* Ordering from the menu: how Central and East European states cope with EU demands for institutional reform / Proceedings of the Conference of Europeanists. Chicago, 2002.
21. *Kirby D., Kwiatkowski S., Jones-Evans J., Schwalbach J., Futo P.* Technical Consultancy in Hungary, Poland and the U.K.: A comparative study of an Emerging Form of Entrepreneurship. ICSB, Stockholm, Sweden, 1996.
22. *Kornai J.* Transformational Recession: A General Phenomenon Examined Through Example of Hungary's Development // Economie Applique. 1993. Vol. 46. № 2. P. 181–227.
23. *Lall S.* Competitiveness, Technology and Skills. Cheltenham, UK: Edward Edgar, 2001.

24. *Larsen E.* Escaping the Natural Resource Curse and the Dutch Disease? // Paper for Norwegian Research Council Project № 149107/730. Berkley, CA, 2003. (http://emlab.berkeley.edu/users/webfac/cbrown/e251_f03/larsen.pdf)
25. *Lenain P.* Ten Years of Transition: A Progress Report // Finance and Development. 1998. Vol. 35. № 3.
26. *Levin R., Klerovick A., Nelson R., Winter S.* Appropriating the Returns from Industrial Research and Development // Brookings Papers on Economic Activity. 1987. № 3. P. 242–279.
27. *Luksha P.* Reduction of Structural Distortions in Transitional Economies / Proceedings of EMAEE'01 Conference. Vienna, Austria, 2001.
28. *Luksha P.* Society as a self-reproducing system // Journal of Sociocybernetics. 2001. Vol. 2. № 2. P. 13–36.
29. *Lundvall B.* (ed.) National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning. L.: Pinter, 1992.
30. *Lyles M., Steensma K., Tihanyi L., Dhanaraj C.* The Role of Foreign Partners and Knowledge Acquisition During Economic Transition / Proceedings of the Conference on Organizing Processes of Building and Leveraging Knowledge. Copenhagen, Denmark, 2002
31. *Mani S.* Government, Innovation and Technonology Policy: An International Comparative Analysis. Cheltenham, UK: Edward Edgar, 2002.
32. *Mankiw G., Romer D., Weil D.* A contribution to the empirics of economic growth // Quarterly Journal of Economics. 1992. P. 407–437.
33. *Mansfield D.* Patents and Innovation: An Empirical Study // Management Science. 1986. № 32. P. 173–181.
34. *Merges R., Nelson R.* On the Complicated Economics of Patent Scope // Columbia Law Review. 1990. № 90. P. 839–916.
35. *Metcalfe J.* Consumption, preferences, and the evolutionary agenda // Journal of Evolutionary Economics. 2001. № 11(1). P. 37–58.
36. *Mokyr J.* The Lever of Riches. Technological Creativity and Economic Progress. N. Y.: Oxford University Press, 1992
37. *Montobbio F.* An Evolutionary Model of Industrial Growth and Structural Change // CRIC Discussion Paper. 2000. № 34. University of Manchester.
38. *Nelson R.* National Innovation Systems: A Comparative Analysis. N. Y.: Oxford University Press, 1993.
39. *North D.* Institutions, Institutional Change, and Economic Performance. N. Y.: Cambridge University Press, 1990.
40. *Parsons R.* et al. Comparative Mining Tax Regimes. Global Energy&Mining Group, PriceWaterhouseCoopers, 1998.
41. *Peneder M.* Structural Change, Development and Growth / Proceedings of EMAEE'01 Conference. Vienna, Austria, 2001.
42. *Porter M.* On Competition. Boston: Harvard Business School Press, 1998.
43. *Romer P.* Human Capital and Growth: Theory and Evidence // NBER Working Paper № 3173. National Bureau of Economic Research, Cambridge, MA, 1989.
44. *Rosenberg N., Landau R., Mowery D.* (eds.) Technology and the Wealth of Nations. Stanford, CA: Stanford University Press, 1992.
45. *Ryan M.* Knowledge Diplomacy: Global Competition and the Politics of Intellectual Property. Brookings Institution Press, 1998.
46. *Ryan M.* Markets, Institutions, Intellectual Property Rights, and Development in a Knowledge-based World Economy // Competitive Strategies for Protection of Intellectual Property. Vancouver, Canada: The Fraser Institute, 1999.
47. *Sedmihradsky M., Klazar S.* Tax competition for FDI in Central-European Countries // Proceedings of Intl' Conference Corporate and Capital Income Taxation in the European Union. Mons, Belgium, 2001.
48. *Spagat M.* Human Capital and the Future of Transition Economies // CEPR Working Papers. London, UK, 2001.

49. *Stiglitz J.* Wither reform? Ten years of the Transition / The Annual World Bank Conference on Development Economics Proceedings. Washington, DC, 1999. P. 27–56.
50. *Stiglitz J.* Globalization and its discontinuities. L.: Penguin Books, 2002.
51. *Sullivan P.* Value-Driven Intellectual Capital. N. Y.: John Wiley & Sons, 2000.
52. *Sveiby K.-E.* The New Organizational Wealth: Measuring and Managing Knowledge-Based Assets. San Francisco: Berrett-Koehler Publishers, 1997.
53. *Svejnar J.* Transition Economies: Performance and Challenges // Journal of Economic Perspectives. 2002. № 16(1). P. 3–28.
54. *Svejnar J.* Assistance to the Transition Economies: Were There Alternatives?
55. Transition Report: Enterprise Performance and Growth. European Bank for Reconstruction and Development, 1997.
56. *Uhlenbruck K., De Castro J.* Foreign acquisitions in Central and Eastern Europe: Outcomes of privatization in transitional economies // Academy of Management Journal 2000. № 43. P. 381–402.
57. *Uzawa H.* On a two-sector model of economic growth // Review of Economic Studies. 1961. № 29. P. 40–47.
58. From Knowledge to Wealth: Transforming Russian Science and Technology for a Modern Knowledge Economy. DC: World Bank, Washington, 2002.
59. World Development Report 1998/99: Knowledge for Development. Washington, DC: World Bank, 1999.
60. World Economic Outlook: Focus on Transition Economies. Washington, DC: IMF Publication, October 2000.
61. World Economic Situation and Prospects 2000 / United Nations Conference on Trade and Development. N. Y., 2000.
62. *Белоусов А.* Проект Путина на развилке концептуального кризиса // ОПЕС. 2003. 19 сентября (http://opes.ru/point_doc.asp?tmpl=point_doc_print&d_no=42008)
63. *Бессонов В.* О трансформационных структурных сдвигах российского промышленного производства // Экономический журнал ВШЭ. 2000. Т. 4. № 2. С. 184–219.
64. *Витебский В., Коленникова О., Косалс Л., Кузнецов М., Рывкина Р., Симагин Ю., Увицкая Ю.* Оборонные предприятия России: 1995–2001 гг. М.: ИСЭПН РАН, 2002.
65. *Каплински Р.* Распространение положительного влияния глобализации. Какие выводы можно сделать на основании анализа цепочки накопления стоимости? Пер. с англ.: Препринт WP5/2002/03. М.: ГУ ВШЭ, 2002.
66. *Климов С.* Интеллектуальные ресурсы общества. СПб.: ИВЭСЭП, Знание, 2002.
67. *Лукша П., Плеханов А.* Социум-культура как самовоспроизводящаяся система. Готовится к публикации.
68. *Львов Д., Моисеев Н, Петров А., Питерский В.* О некоторых возможных вариантах развития стратегии России в современном мире, ее экономики, минерально-сырьевой базы, сельского хозяйства и геоэкономического положения: Доклад Российскому прогрессивному союзу. М., 1998.
69. Научно-технический потенциал России и его использование: Сборник работ под ред. В. Кушилина и А. Фоломеева. М.: Сканрус, 2001.
70. От кризиса к росту. Опыт стран с переходной экономикой: Сборник работ под ред. М. Дерябиной. М.: Эдиториал УРСС, 1998.