УДК 330

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# "DYNAMO" (KYIV) AND "NEW TECHNOLOGICAL AGE" OR HOW TO CREATE YOUR OWN SILICON VALLEY[1]

*The paper argues about some drawbacks of traditional production functions as they appear in standard economic growth analysis. Simple model suggested here is an attempt to overcome some of these problems. Its distinct feature is allowing heterogeneous workers form a sort of "separate" equilibrium where various quality employees are grouped with fellows of similar skills. This approach rejects convergence hypothesis. Such applications as a simple explanation of income inequality, "brutally" simple arguments about role of "free economic zones" in contemporary world, specialization restricted by factors other then extent of a market, and somewhat different angle of view on technological vs. capital accumulation sources of growth are listed. Suggestion that government industrial policy may need revision concludes the paper.*

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### *Introduction*

There's common excuse used by a firm's manager during hard times. "There can be no prosperous firm in the overall declining economy". Or is it so? Casual observations do not support the statement. We do observe individual firms making significant profits in otherwise stagnating environment. We do see countries having healthy economies in otherwise poor neighborhood. Environmental conditions can be important for economic operation of an individual firm, for some more than for others. But they are hardly ever decisive.

Why can some firms (or countries) perform better than others? Why do not those underdogs just use the technology of the successful neighbor to improve their own performance? Questions like this are in heart of growth theory. We do not have completely satisfactory answers for them. Often what we attempt to do is tackling with various partial aspects of the problem. This paper is no exception to such an approach.

Some researchers make an effort to start an analysis with the Cobb-Douglas (macro)production function and add details to it when the discussed problems require it. Many other argue about futility of such efforts: differences in the economic growth in the Solow model must be explained with the variables that are themselves exogenous to the model. Sometimes the differences in saving rates, rates of technological innovations are assumed ad hoc. When they are not they must be explained beyond the model. Mr. Solow himself is known to be unsatisfied with the model. We will argue in the paper that the Solow model (and likely most endogenous growth models) lack one important feature that prevents them from explaining the differences across countries (or other units) — they do not pay much attention to the interaction between economic entities. With the Solow model, letting labor, capital and technologies freely move across the borders leads to the result know as convergence hypothesis — growth levels get equalized across the countries. Moreover, interest rate parity suggests that capital flows would overcome differences in saving rates and so we must not expect great income disparity across the countries.

### *"Multiplicative" production function*

How come "Dynamo" (Kiev) is able to buy best players from other clubs? Common layman answer we receive is that "Dynamo" is richer than other teams. Well, it is. But you don't become rich by systematically overpaying for the use of resources. And we have no particular reason to believe that other clubs make systematic error under-pricing their players. "Dynamo" cannot enrich its own shareholders by buying a player for the price that exceeds the value of his product. Can somebody force another team to sell a player for a price below the value of his product? There is also no special reason to believe that an individual player's skills change in transfer from, say, Lviv to Kyiv. It must, then, be the case that a player's product has different value when playing for different teams without change in individual performance.

Moreover, a player's product must be systematically higher in the better team. To simply argue that each player is more suitable for one team than for another is not enough. Such an argument put alone would suggest that some players are more valuable for "Dynamo" than for "Karpaty" but some other are more valuable for Karpaty than for "Dynamo".

Soccer (European football) is a team game (as are most production processes). All the players share the product. To make the quantitative modeling simple, we will use expected number of goals scored (and an opponent's attacks broken) as the measure of product. After all, the team that scores more and defends better is expected to win more often.

Assume there is a list of combinations developed by a coach. In any combination, each member of the team has his own task to perform (possibly, some without ever touching the ball). If every player performs his individual task without fault, the combination results in the goal scored. If any player makes a mistake, the combination breaks down and goal is not scored. Similar story can be told about defense.

Let us write the production function for a team.

$$\mathrm{E}(G_j) = n_j A_j \times \prod_{i=1}^{11} p_k^j,$$

where: $\mathrm{E}(\bullet)$ — expectation operator; $G_j$ — number of goals scored by team $j$; $n_j$ — number of combinations played by teamy during the single game; $A_j$ — average quality of combination (probability to score with a particular combination) for team $j$; $\prod_{k=x}^{y}$ — product operator (y, the number of players, is 11 in our case); $p_k^j$ — probability that player $\kappa$ of team $j$ makes no mistake;

### *Convergence result lost*

Assume the monetary payoff is proportional to the team performance. For simplicity, we normalize monetary payoff to be equal to the expected number of goals scored. What happens if there are many teams and heterogeneous players? Let us employ a little numerical example.

There are any two teams to compare.

$n_1 A_1 = n_2 A_2 = 1$; $p_k^1 = 0{,}9$ for $k = \overline{1,10}$;

$p_k^2 = 0{,}5$ for $k = \overline{1,10}$; $p_{11}^1 = 0{,}5$; $p_{11}^2 = 0{,}9$.

The team 1's product is:

$$\mathrm{E}(G_1) = 1 \times 0{,}9^{10} \times 0{,}5 \cong 0{,}17434.$$

The team 2's product is:

$$\mathrm{E}(G_2) = 1 \times 0{,}5^{10} \times 0{,}9 \cong 0{,}00088.$$

Is there room for trade between these clubs? For club 1 obtaining the player 11 from club 2 in exchange for their own player 11 increases its product by 0,13947:

$$\Delta E(G_1) = (1 \times 0{,}9^{11}) - (1 \times 0{,}9^{10} \times 0{,}5) \cong$$

$$\cong 0{,}31381 - 0{,}17434 = 0{,}13947.$$

For the club 2, decrease in its product from this exchange is 0,00039:

$$\Delta E(G_2) = (1 \times 0{,}5^{11}) - (1 \times 0{,}5^{10} \times 0{,}9) \cong$$

$$\cong 0{,}00049 - 0{,}00088 = -0{,}00039.$$

Any price between 0,00039 and 0,13947 makes club 1 a buyer of a good player and club 2 a seller of their best player.

What can be learned from this story? First of all, if the players are heterogeneous, no convergence will occur. The clubs that have better players from the very beginning (or start gathering better players first, or have budgetary advantage in the beginning stage) are going to attract best players from other teams, and other teams would readily agree to sell them. The same will be true about any production where decrease in quality more than proportionally diminishes value of the product.

Here the difference between this model and a "Solow-like" model becomes clear — in our model the best players (workers) are not substitutable, in the Solow model they are. With the Cobb-Douglas production function, one worker producing two units of a good can be easily substituted with two workers producing one unit each. In our case, a good worker can never be substituted by any number of worse workers.

The idea is not new. The model appears in just slightly different form (and likely more qualified presentation) in Kremer [2]. But... We do not see everyday use of it. Implications are simple but far reaching. Applications are numerous.

When is our model most applicable? The more advanced (complex) technology is used or the more hi-tech the product is the more important the features introduced by the multiplicative production function become.

Single defective part of software used with hundreds others of perfect quality may make a computer operating system unusable. On the other side, a mistake in a cooking recipe (say, wrong amount of salt) can often be easily corrected (if a dish is not salty enough, just add more salt next time). It may be prohibitively costly to find a mistake in very complex system. Little defect drives the price of high fashion dress down to the price of any casual clothes. One constructive defect of Concord airplane may cost hundred lives and billions in losses. Similar constructive defect of a road bicycle may cost just some extra efforts when riding uphill. Price of mistake might be very high in a hi-tech industry.

Let us talk some "revolutionary" applications.

*Income distribution is positively skewed*

One straightforward application of the model is an explanation for inequality of income distribution. The distribution of people abilities is believed to be significantly less skewed than the income distribution is. In fact, it is exactly what the model predicts. Figure 1 shows equilibrium distribution of income for the popu-

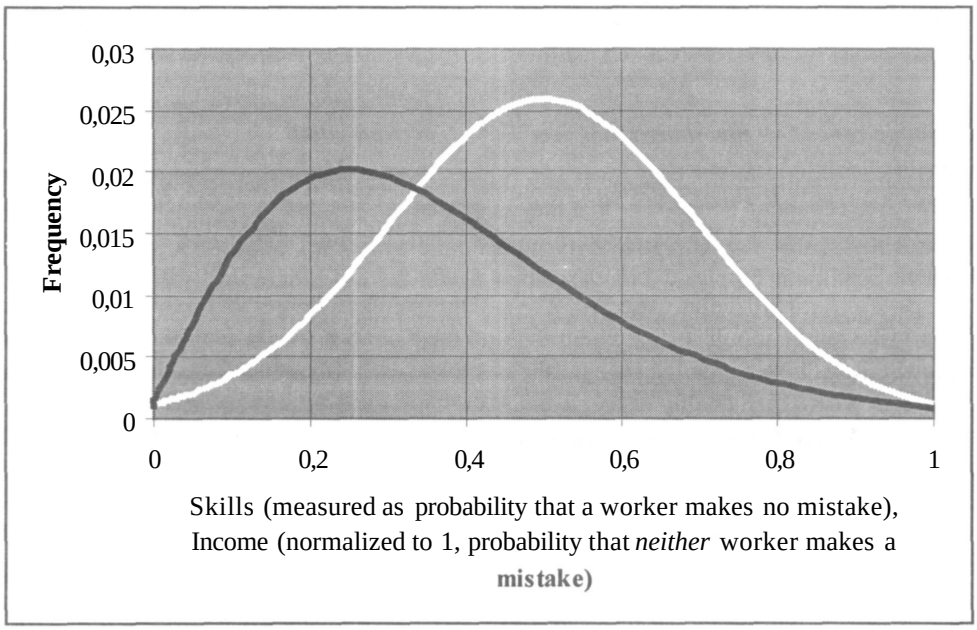


*Figure 1.* Distribution of income is more skewed to the right than the distribution of skills is. White curve is the distribution of skills (some variable $x$ following normal distribution with mean 0,5 and standard deviation 0,2). Black curve is the corresponding distribution of income when similar workers are paired (the distribution of $x^2$).

lation with normally distributed skills employed by firms (2 workers per firm).

*Gary Becker's "Silicon Valley" — best rules or best employees?*

In his article to the Ukrainian newspaper "Day" [1], Gary Becker argues that absence of the government regulation is the main reason for success of Silicon Valley in the USA. In his own words, nevertheless, workers "... are attracted by a great employment possibilities and early access to new hi-tech developments." Best workers from around the world come to work in the region. Do those workers care about regulatory climate in Silicon Valley? Unlikely. What they care about is that it is a place where other best workers from around the world have been gathered. It is the place where it is possible to do the work impossible in other places. If Silicon Valley did not exist, similar place would likely pop out somewhere else. Steve Jobs did not have regulation with regard to his business any different than any other company had. What he did have was Steve Wozniak[1], and all Jobs' strategic mistakes could not destroy "Apple" because the product produced by people gathered around Wozniak could not possibly be produced anywhere else. Such situations are ubiquitous. Almost any industry would provide a story when many firms start in equal conditions, and then some of them succeed to become the industry leaders. After that others start appealing for the government intervention in form of punishing "bad, bad, bad monopolist" or "business shark" and protecting smaller businesses "struggling to survive and create employment." The government often responds and satisfies such requests. Rules become favorable to the losers. Despite that, the leaders remain leaders.

*"Free economic zones" — investment magnets or brain drain stoppers? Or neither?*

One hope for "free economic zones" was that they would attract investments due to higher net return on investments under favorable tax and regulatory climate. Such a hope was not realized as expected. The expectations would be reasonable if the gross returns were same everywhere. In "new technological age" the gross returns are high where high quality research and hi-tech production is concentrated. All the reductions in tax rate are hardly capable to force reallocation of such industries — their main resource is people, particularly immobile factor of production.

Another possible role for free economic zones could be preventing the "brain drain." We do not loose the best players to foreign clubs because they have where to go in Ukraine. "Dynamo" Kiev offers possibility to play in Champions League without going to Italy or Spain. But such an argument for free economic zones is based on premise that they do create the "island of prosperity." Do they? "Dynamo" Kiev became a leader not because there was a special legislation about it but because it has better ensemble initially and so was able to attract the players. If there appears a firm in Ukraine which becomes he leader in, say, some area ofscientific research, it is most likely to succeed whether it given some support or not.

*Specialization?*

Since Adam Smith, we repeat a claim that degree of specialization is restricted by the extent of a market. It is based on the fact that specialization increases the product of individual worker and so the total product. It is perfectly correct for many production processes. Alas, we dare to suggest, not for all. In our multiplicative production function, adding a new worker into production process increases number of stages and so the probability of making a mistake by one of the employees. Let us employ a little numerical example again.

*rijAj* = 1 for some firm *j*, *p[* ~ 0,9 V *к*, *к* = L3. Then *E(Gj)* = 1 x $0{,}9^3$ = 0,729. Suppose we find a way to increase specialization and now employ one more worker. Suppose each worker performance improves and now *p{* = 0,92 V *к*, *к* = ЇД Then E ( ф = = 1 x $0{,}92^4$ s 0,716. Total product falls even though every worker is working better.

Firms may refuse to increase specialization if the price of a mistake in production is high.

*Technological improvements vs. capital accumulation*

Even traditional models are not particularly supportive to increase in production by increase in use of capital. The main conclusion of the Solow model is that economic growth must be attributed to technological improvement (increase in the Solow residual). Although in our model nothing points to diminishing returns or "Solow-type" steady state, "superiority" of technological improvements over increase in capital use is preserved. An increase in production may be achieved any way — by increase in capital (say, represented by increase in *n),* or by technological improvement (say, represented by decrease in number of steps in production process). The difference is that increase in capital must be paid for since more resources are

[1] Steve Jobs — creator of Apple Computer Corporation. Steve Wozniak — creator of personal computer. Good sources to learn the history of Apple Computer "for profit and fun" may be "Steve Wozniak, Inventor of the Apple Computer" by Martha E. Kendall, "Fire in the Valley: The Making of the Personal Computer" by Paul Freiberger & Michael Swaine, or even movie "Pirates of Silicon Valley" (1999) about struggle between Apple Computer and Microsoft.

employed when decrease in number of steps is accompanied not only by greater product but also by reduction in cost.

*So, how do you create your own Silicon Valley?*

Our discussion suggest that most promising way to create your "own Silicon Valley" is to create your **own** Silicon Valley. One can hardly hope to duplicate somebody else's success. Once some firm gets successful in some field it may become the most attractive place for anybody working in the field. Those in soccer game come to understand that underdogs cannot count on getting better players from the leaders but have to raise their own players. They have the edge. If the country has more good players than one top club can accommodate, second top club appears. There are some interesting examples in academic domain. Some big universities did not try to beat those frontrunners in fields they pretended to conquer for themselves. Having got enough money they just bought whole most reputed departments from other universities.

Advantage received by a firm from the very start may be impossible to overcome for anybody else. What is possible is to get such early advantage in another field, secure the niche not yet conquered by anybody else. As hi-tech and information technologies become crucial for dynamic economic progress, the role of a government must drift away from traditional industrial policy and attempts to stimulate production in some industries by reducing fiscal and regulatory pressure upon them. Instead there must be more support given to those who might initiate so called technological break-through. A list may include fundamental research (and graduate studies in sciences, engineering, and so on), joint ventures in "pioneering" industries, or industries where "revolutionary" inventions are expected.

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4. *Robert M. Solow.* A Contribution to the Theory of Economic Growth *II* Quarterly Journal of Economics; February 1956, pp. 65—94.

5. *Eugene Silberberg.* The Structure of Economics: A Mathematical Analysis. McGraw Hill, 1990.

6. Various materials from Dynamo Kyiv web-page (http://www.dynamo.kiev.ua).

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## "ДИНАМО" (КИЇВ) ТА "ЕРА ТЕХНОЛОГІЧНОЇ РЕВОЛЮЦІЇ", АБО ЯК СТВОРИТИ СВОЮ СИЛІКОНОВУ ДОЛИНУ

*У статті проаналізовано певні недоліки використання традиційних виробничих функцій у стандартноиу аналізі економічного зростання. Проста модель запропонована в цій роботі — спроба подолати деякі з цих вад. Така модель дозволяє економічній системі з різними робітниками формувати "роздільну" рівновагу, коли працівники різної кваліфікації працюють з іншими такого ж рівня кваліфікації. Цей підхід відкидає гіпотезу про зближення темпів економічного росту. Наведені деякі приклади застосування (просте пояснення нерівності доходів, "нахабно" прості аргументи про роль "вільних економічних зон", обмеження спеціалізації факторами, відмінними від розміру ринку, та дещо специфічний погляд на вплив технологічних інновацій та капітальних інвестицій на економічне зростання). Наприкінці — зауваження про можливу потребу перегляду державної індустріальної політики.*