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How Much is too Much? An Endogenous Growth Model with an Optimal Level of Informality

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How much is too much? An endogenous growth model with an optimal level of informality*

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Abstract

We develop an endogenous growth model in which informal practices, trust and transaction costs take the key role and dictate the speed of the long-term economic development. A decision maker chooses how much informal behaviour to allow in the economic system in order to maximize the rate of innovation by taking into account the productivity gains and loses associated with building trust and lowering transaction costs. The model shows that economic systems in which changes in informal practices are taken into account will grow at a faster rate compared to economic systems in which the same changes are ignored. This provides an alternative explanation to divergence in output per capita between different countries from the point of view of the new institutional economics.

Keywords: *economic growth, informal institutions, new institutional economics*

JEL Classification Codes: D23, E71, O17, O43, Z1

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1 Introduction

"*How much informal behaviour is just enough in my organization?*" - this is a question that puzzles managers all over the world when they think about how much informal practices can be allowed in an organization in order to enhance the process of production and innovation. In this article we argue that informal activities and practices in an organization affect the trust of the workers which in turn impacts transaction costs and the rate of innovation. Too little informal activities impede the process of building trust, don't lower the transaction costs to their minimum and hamper the production of new technologies. However, too much informal activities are also not beneficial for the organization, because they can decrease the trust in the leadership and the organizational structure, which will increase the transaction costs and also hamper the production of new technologies. Thus the manager must find a balance between the costs and benefits of informal practices in order to keep the trust level in the organization at its optimum, while also keeping the transaction costs at their minimum. Under these conditions the organization will create innovations and grow at an optimal rate.

In the classical works of Banfield [8], Coleman [13] and Putnam [32] trust is broadly defined as cooperative attitude outside the family circle. But how trust improves the efficiency of an economic system? In his analysis of the limits of organization, Arrow[7] considers trust as co-substantial to economic exchange in presence of transactions costs that impede information and contracts. Fundamentally, the economic efficiency of trust flows from the fact that it favors cooperative behavior and thus facilitates mutually advantageous exchanges in presence of incomplete contracts and imperfect information. In Arrow's term, trust would act as a lubricant to economic exchange in a second-best allocation.

Research on the relationship between trust and growth focuses essentially on generalized trust, in other words on relations among individuals who are not bound by the kind of personal ties that bind members of the same family, or fellow workers [24]. In this context, the generally used definition of trust is taken from Coleman [14], according to whom "*an individual trusts if he voluntary places resources at the disposal of another party without any legal commitment from the latter, but with the expectation that the act of trust will pay off*". Defined this way, trust is also linked to the notion of social capital utilized by [21], [32] and [23], for whom social capital is the ensemble of those persistent and shared beliefs and values that help a group overcome the free rider problem in the pursuit of socially valuable activities. The interest of the economic literature in social capital is fueled by the strong positive correlation between income per capita and average trust levels across countries or regions, first illustrated by the seminal work of Knack and Keefer [26]. Trust also play a preponderant role in the sort of economic activities—investment and especially innovation—that are attended by uncertainty on account of moral hazard and the difficulties of contract enforcement. In their article on the link between trust and growth, Knack and Keefer [26] showed a positive correlation between trust and investment as percentage of GDP. By facilitating cooperation among

anonymous persons, trust favors the emergence and growth of private and public organizations [21, 27, 9, 38, 5, 6].

The main theoretical mechanisms through which social trust influences the long-run growth rate and economic performance can both be direct or work indirectly through affecting institutions, factor accumulation and the elasticity of substitution [11, 39, 10, 16, 15]. Trust may affect education and investments levels, and the development of productivity directly, as well as indirectly through its influence on the institutional framework [11]. An important mechanism mentioned by Fukuyama [21] is that as trust increases, firms and individuals will rationally be able to divert fewer resources to protective purposes because higher trust reflects a lower probability of theft, violent crime and predatory litigation. This therefore not only includes physical protection in the form of guards and fences, but also enables firms to economize on direct transaction costs such as writing shorter and thus cheaper contracts and investing fewer resources in monitoring and enforcing contract compliance [27]. All other things being equal, employing fewer potentially productive resources on protection either provides the firm with a cost advantage or allows it to invest proportionally more resources to investments or innovative purposes [19]. This type of mechanism would therefore be consistent with both factor accumulation effects through larger investments in physical capital and with a factor productivity effect if the free resources are spent in research and development, and thus effectively on innovation [11, 20, 5, 6].

As such, due to directly lower transaction costs in the production of knowledge as well as the financial intermediation necessary to put ideas to productive use, trust so to speak greases the wheels of innovation and makes economies more productive [31]. Similarly, several papers building upon ideas in Fukuyama discussed the consequences of how trust might lower the transaction costs of obtaining relevant information. Knack and Keefer [26] for example noted that when "*trust facilitates the enforcement of contracts, the return to specialized education will increase*" which will cause more people to invest in formal education; likewise, when hiring decisions in low-trust societies rationally depend on personal knowledge of applicants or shared kinship [22], "*the returns to acquisition of educational credentials*" are reduced, causing fewer people to acquire education. Given that education in general makes people more productive and tends to affect long-run growth, such direct mechanisms could theoretically affect the growth rate. Dixit [17] provides an encompassing overview of such mechanisms not restricted to only trust-related theories.

Zak and Knack's [39] theoretical model thus predicts that as higher trust levels reflect lower risks, high-trust societies should exhibit higher investment rates, all other things being equal, and thus also higher long-run growth rates [11, 20, 16]. Cline and Williamson [12] provide a set of similar, although informal, theoretical arguments for how trust could affect financial development. The basis of their main argument is that the adherence to informal social norms – for example causing delinquent individuals to feel shame or guilt when they do not abide by internalized norms of proper behavior – work as effective internal constraints on individual behavior. High trust thus reduces the need for formal

enforcement of rules against self-dealing in financial markets, such that trust and formal institutions become substitutes [11, 34].

Knowing that trust leads to higher economic growth, the question arises - how to internalize trust? Internalizing economic choice and showing how it can lead to long run economic growth is primarily explained by the endogenous growth theory. The field explains higher long run growth as a result from rational agents' choices which lead to higher rate of innovation and increase in productivity. The seminal articles of Romer [33] and Aghion and Howitt [3]gave rise to growth models based on vertical and horizontal innovation by a firm that has monopolistic power. Klette and Kortum [25] and Acemoglu et.al [1] developed growths models in which firm entry and exit fuel innovation and long run economic growth. Doepke and Zillibotti [18] introduced an endogenous growth model in which the entrepreneurial spirit of the society is the key ingredient, that leads to generation of new technologies. Akcigit and Kerr [4] continued the development of endogenous growth theory and show that internal innovation scales moderately faster with firm size than external innovation. Acemoglu and Azar [2] introduced an endogenous growth model with production networks in which cost reduction spreads through the production chain leading to diversification of the used inputs in production and long run growth.

In the current article we continue this line of economic thought by developing an endogenous growth model in which the rate of innovation is based on an endogenous choice of how much informality to be allowed in an organization. The choice of how much informal activities to include in an organization will shape the environment in which trust can be build. If the environment is without any informal activities, trust will be hard to build and the organization will produce new technologies below its optimal level due to higher transaction costs. The reverse is also true - if the environment is full with only informal activities, trust will be also too hard to build due to intrigues, lack of confidence in the leadership or the organization structure.

2 The Model

We incorporate our trust framework in the standard neoclassical growth model. The model consists of two sectors – competitive firms that use physical capital, human capital, labour, and technology to produce a single valued output and a R&D sector that produces technology in a similar manner as proposed by Romer [33] . Informal rules are then endogenously defined by a rational decision making agent in the R&D sector. These informal practices determine the optimal amount of trust which leads to the lowest transaction costs and fuel the growth rate of technology which in return generates the growth of the output in the final sector. We begin with a description of the neoclassical model, as presented in [28].

2.1 The standard neoclassical growth model

The time is discrete, and each period is denoted with a time index t. The final goods sector is described as operating in perfect competition and producing an aggregate output Y_t each period, defined by:

$$Y_t = A_t F\left(K_t, L_t\right) \tag{1}$$

where A_t is the level of technology, K_t is the stock of physical capital and L_t is the quantity of labour used in production. The production function $F\left(K_t, L_t\right)$ is homogenous of degree one, implying constant returns to scale, and the standard assumptions hold: $\frac{\partial F}{\partial K_t} > 0$ and $\frac{\partial F}{\partial L_t} > 0$; $\frac{\partial^2 F}{\partial K_t^2} < 0$ and $\frac{\partial^2 F}{\partial L_t^2} < 0$ and the Inada conditions are satisfied. The evolution of technology provided by:

$$A_t = (1+g)^t A_0 \tag{2}$$

where with g we denote the net growth rate of technology. The technology is considered to be non-rival and non-excludable. Dividing byL_t and using the constant returns-to-scale properties of the production function we define the output per worker y as:

$$y_t = \frac{Y_t}{L_t} = A_t F\left(\frac{K_t}{L_t}, \frac{L_t}{L_t}\right) = A_t F\left(k_t, 1\right) = A_t f\left(k_t\right) \tag{3}$$

We also assume that the labour force grows at a constant net rate n, so that:

$$L_{t+1} = (1+n) L_t \tag{4}$$

and that the physical capital grows by:

$$K_{t+1} = (1-\delta) K_t + I_t \tag{5}$$

Where δ denotes the rate of capital depreciation and I_t is the investment during the period t. Dividing (5) by (4) yields the equation for the growth of physical capital per workerk_{t+1}:

$$k_{t+1} = \frac{K_{t+1}}{L_{t+1}} = \frac{(1-\delta) K_t + I_t}{(1+n) L_t} = \frac{(1-\delta) k_t + i_t}{(1+n)} \tag{6}$$

where with $i_t = I_t / L_t$ we denote the investment per worker in time t. Saving is defined as a fixed fraction of the output sy_t with $0 < s < 1$ holding. Assuming closed economy, we known that at equilibrium $i_t = sy_t$. Substituting with (2) in (3) and then with (3) in $i_t = sy_t$, yields $i_t = s(1+g)^t A_0 f\left(k_t\right)$. Finally substituting with this expression into (6) yields the fundamental difference equation of the model:

$$k_{t+1} = \frac{(1-\delta) k_t + s(1+g)^t A_0 f\left(k_t\right)}{(1+n)} \tag{7}$$

To keep this part of the model as traceable as possible we assume that $A_0 = 1$ and $n = 0$. The version of (7) that we will extensively use then can be written as:

$$k_{t+1} = (1-\delta)\, k_t + s\,(1+g)^t\, f(k_t) \tag{8}$$

With a constant rate of technological growth g, the economy will converge towards a balanced growth path (BGP) at which the growth rate of capital and output are constant. For our purposes we assume that the production function is Cobb-Douglas of the form:

$$f(k_t) = k_t^{\alpha} \tag{9}$$

in which α denotes the fraction of the economy's income that goes to capital. We define the growth rate of capital as an unknown constant rate: $\gamma = \frac{k_{t+1}}{k_t}$. Using (8) we get:

$$\gamma = \frac{k_{t+1}}{k_t} = \frac{(1-\delta)\, k_t + s\,(1+g)^t\, k_t^{\alpha}}{k_t} = (1-\delta) + s\,(1+g)^t / k_t^{1-\alpha} \tag{10}$$

and solving this for k_t yields:

$$k_t = \left[\frac{s\,(1+g)^t}{\gamma - (1-\delta)}\right]^{\frac{1}{1-\alpha}} = (1+g)^{\frac{t}{1-\alpha}} \left[\frac{s}{\gamma - (1-\delta)}\right]^{\frac{1}{1-\alpha}} \tag{11}$$

Substituting back into (10) for both $k_t$and k_{t+1}, we can write (10) as:

$$\gamma = \frac{(1+g)^{\frac{t+1}{1-\alpha}} \left[\frac{s}{\gamma-(1-\delta)}\right]^{\frac{1}{1-\alpha}}}{(1+g)^{\frac{t}{1-\alpha}} \left[\frac{s}{\gamma-(1-\delta)}\right]^{\frac{1}{1-\alpha}}} = (1+g)^{\frac{1}{1-\alpha}} \tag{12}$$

The output per worker also grows at the same constant rate:

$$\lambda = \frac{y_{t+1}}{y_t} = \frac{(1+g)^{\frac{t+1}{1-\alpha}}\, k_{t+1}^{\alpha}}{(1+g)^{\frac{t}{1-\alpha}}\, k_t^{\alpha}} = (1+g)\left(\frac{k_{t+1}}{k_t}\right)^{\alpha} = (1+g)^{\frac{1}{1-\alpha}} \tag{13}$$

In this version of the standard neoclassical growth model, a steady state won't be achieved. Instead, a constant growth of output and capital per worker will be observed. Our focus now turns towards the R&D sector which will endogenously determine the growth rate of technology g with the help of a optimally chosen level of informal institutions.

2.2 The R&D sector of the economy with a constant generation of new technologies

In the R&D sector of the economy there is an organization that produces the blueprints of new technologies, used in the final sector. Naturally, some form of

informal practices will be formed that will impact the rate at which the sector produces technology, as described by the theory of the new institutional economics. The leader of the research centre will then rationally decide how much informality to tolerate by comparing the additional trust, the decrease in the transaction costs and the additional productivity, generated from these informal practices, with the loss of trust, the increase in the transaction cost and the loss of productivity, associated with them. We can think about the rational agent as the head of some research centre, the ministry of science and education or some director of the research department in an innovative company. How much informal practices are tolerated in the corresponding organization is in his control and he is the one that decides when an informal practice is harmful (lowers trust and increases transaction costs) or beneficial for the production process (increases trust and decreases transaction costs). This choice is made at $t = 0$ by maximizing the difference between the total benefits (or the productivity gain from higher trust and lower transaction costs), generated by the informal practices, and the total cost (or productivity loss from lower trust and higher transaction costs), associated with them. The productivity gain from the existence of informal practices is described by the *total benefits from informality (TBI) function* $\omega = \phi(x)$. It is a real valued function of one independent variable x such that $\phi : \mathbb{R}_+ \to \mathbb{R}_+$. The variable x measures the level of informal practices, that is associated with the total productivity gain from it ω. The following assumptions are made about the function $\phi(x)$:

1. The function $\phi(x)$ exhibits "*decreasing returns to scale*". That is: $t\phi(x) > \phi(tx)$ for any $t > 1$.

2. The function $\phi(x)$ is continuous and twice differentiable.

3. The function $\phi(x)$ has a positive first order derivative and a negative second order derivative. That is: $\frac{d\phi(x)}{dx} > 0$ and $\frac{d\phi(x)}{dx} < 0$.

What is the intuition behind these assumptions? Assumption (1) means that while informal practices may overall be beneficial for the organization due to generating trust between the participants in the organization, the total productivity from allowing or introducing more informal activities will not increase with the same proportion – allowing or introducing twice as many informal activities is not the same as doubling the trust, halving the transaction costs and doubling the productivity of the innovation process. This captures the idea that some informal practices are good, more are better, but the overall effect is not linearly scalable. This connects with (3) which implies that marginal effect of introducing more informality is positive but decreasing. Assumption (2) is technical and guarantees that the derivatives will exists. These assumptions illustrate the idea that informal practices in an organization will be beneficial for it due to increasing trust and lowering transaction costs, however the bigger they get, the marginal effect from their size will be decreasing.

In the model the amount of informality is captured by a real number and represents the total number of informal activities in the organization – social

interactions during work hours, informal activities such as holiday parties, non-written behavior norms and many more. This amount of informal activities provide different benefits for the organization – from save and friendly environment, that cares for workers, to unwritten social constructs that promote acceptance and uniqueness. These increase the trust between workers, lower the transaction costs and enhance the production of new technologies. Nevertheless, we know that these are not always measurable, and the reader is advised to look at the model as a way of thinking about economic growth and not about direct application and measurement.

As said previously, increasing the allowed amount of informal practices is tied with some costs. If the informal practices are only very few and with a low impact, maybe they won't provide the most efficient outcome for the organization, because the building of trust will be slow or hard, and the organization will miss potential productivity gains. For example: with informal practices that are too few, the transaction costs of communications won't be close to their minimum. as proposed by Sedlarski [36, 35]. However, if the informal practices are too many, the informal behaviour will make trust building hard, the transaction costs may increase and the environment of the organization will become chaotic, unstable and filled with potential pitfalls which will again hamper the productivity of the R&D sector [34]. This can be especially dangerous in organizations for which there is a danger of ownership fragmentation [37]. To capture this, we associate a "*price*" σ to the amount of informal activities. This price represents how costly it is to consider including more informal practices in the organization in terms of lost trust and increased transaction costs. Then the rational agent can choose how much informal activities to tolerate, by maximizing the difference between the TBI function, multiplied by a productivity parameter ρ, and the total costs associated with the informal activities:

$$\max_{x} \rho\phi\left(x\right) - \sigma x \tag{14}$$

The first order condition is:

$$\rho\frac{d\phi\left(x\right)}{dx} = \sigma \tag{15}$$

And the second order condition for maximum is:

$$\rho\frac{d^2\phi\left(x\right)}{dx^2} \leq 0 \tag{16}$$

The first order condition can be interpreted as: "*the marginal productivity gain, extracted from the additional amount of informal practices must be equal to the marginal productivity loss, associated with it*". By solving the first order condition as an equation with one unknown, one can derive the demand function of the organization for the amount of informal practices as the function of its price: $x\left(\rho,\sigma\right)$. This function represents the optimal amount of informal activities that must be used to maximize (14) as a function of the productivity ρ and the price of the informal practices, σ. Substituting back into (14), with $x\left(\rho,\sigma\right)$

the *net benefits from informality (NBI) function* is derived, which measures the maximum benefits from informality as a function of ρ and σ:

$$\tau(\rho,\sigma) = \rho\phi(x(\rho,\sigma)) - \sigma x(\rho,\sigma) \tag{17}$$

The function $\tau(\rho,\sigma)$ mirrors the profit function from production theory in the sense that getting the most from the informal institutions depends on how higher the cost associated with them are and how much productivity they are providing for the organization. In this version of the model we assume that the value of $\tau(\rho,\sigma)$ is determined only once at $t = 0$, because it depends only on the cost of choosing how much informal institutions to include, determined by the fixed price σ, and the productivity parameter ρ. The institutional framework, combined with the available fixed human capital H in the R&D sector and a constant ε, determines the growth rate of the technological progress:

$$g = \varepsilon\tau(\rho,\sigma)H = \varepsilon H[\tau(\rho,\sigma) = \rho\phi(x(\rho,\sigma)) - \sigma x(\rho,\sigma)] \tag{18}$$

which is a constant. Because g remains unchanged, the economy will grow with a constant rate and move along its balanced growth path. Because of multiplication, higher values of $\tau(\rho,\sigma)$ lead to faster long run growth rates. Stated in words – higher trust and lower transaction costs, associated with higher productivity (or in other words - higher rate of innovation) in the R&D sector, generated by the NIB functions, lead to higher growth of output per capita on the balanced growth path. The properties of the function $\tau(\rho,\sigma)$ mirror the properties of the profit function. First, the value of $\tau(\rho,\sigma)$ determines the growth rate of the economy. Under equal ε and H, the difference in growth rate between countries at their respective BGPs depends only on the value of the NBI function which is chosen based on the price σ. Thus, countries in which informal practices are cheaper (lower σ) or more productive (higher ρ) will grow at faster rates. This is the same as saying that countries, in which informal actions decrease trust and increase transaction costs at higher levels, will grow faster because more informal activities can be successfully used to enhance trust. This translates to the following property of $\tau(\rho,\sigma)$ - the NBI function is decreasing in σ:

$$\frac{d\tau(\rho,\sigma)}{d\sigma} < 0 \tag{19}$$

which states that increasing the price of incorporating more informal practices will decrease the overall NBI and the productivity for the organization. Second, an increase in the productivity parameter ρ will be associated with an increase in the productivity and higher values of τ^*thus the NBI function is increasing in ρ:

$$\frac{d\tau(\rho,\sigma)}{d\rho} > 0 \tag{20}$$

And third, due to the fact that the TBI function is assumed to be one with a decreasing returns to scale, the solution of (14) will exist and the value of (17) will always be positive if the optimal choice has been made.

The model is now solved with a Cobb-Douglas TBI function of the form $\phi = x^{\beta}$ such that $\beta < 1$. The Cobb-Douglas TBI function satisfies all the necessary assumptions when $\beta < 1$. The agent's maximization problem is:

$$\max_{x} \rho x^{\beta} - \sigma x \tag{21}$$

The first order condition is:

$$\beta \rho x^{\beta-1} = \sigma \tag{22}$$

The second order condition is:

$$(\beta - 1)\, \beta \rho x^{\beta-2} \leq 0 \tag{23}$$

Which exists for $\beta < 1$. Solving for x from (22) yields the demand function for informality:

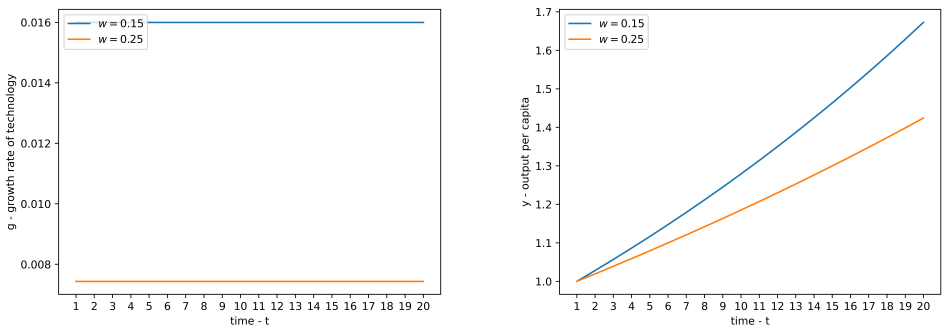
$$x(\rho, \sigma) = \left(\frac{\sigma}{\beta\rho}\right)^{\frac{1}{\beta-1}} \tag{24}$$

And substituting back with it back into (21) yields the optimal NBI for the R&D sector:

$$\tau\left(\rho, \sigma\right) = \rho \left(\frac{\sigma}{\beta\rho}\right)^{\frac{\beta}{\beta-1}} - w \left(\frac{\sigma}{\beta\rho}\right)^{\frac{1}{\beta-1}} \tag{25}$$

We now simulate the model with for two different countries with different R&D sectors. Each of two sectors has different costs of informal practices. For the purpose of demonstrating how the growth rate of the economy depends on these costs, we assume that $\sigma = 0.15$ for the first country and $\sigma = 0.25$ for the second country. Then equations (2), (3), (9), (8), (19) and (25) are used to simulate the economy. The parameters for both countries differ only in the different values for σ. For the first country $\sigma = 0.15$ and for the second country $\sigma = 0.25$.

As seen on Figure 1, the output per capita y diverges as t moves towards infinity - the country in which informal practices are cheaper and hamper the generation of trust less, grow faster. The model has a very important implication about cross country income differences – even if one country can copy and implement the tolerance for informal practices of another one, it may not grow at the same rate as the country from which it is copying it. This is since in the country that imports the informal practices, the costs of implementing and sustaining, measured in lost trust and increased transaction costs, may be higher which will lead to a lower growth. This implies that cross country convergence may not happen at all due to countries being unable to fully utilize their own cultural and institutional frameworks.



(a) Difference in growth rates

(b) Balanced growth paths

Figure 1: Long-run behaviour of two countries with different costs of informality. The country with in which informality is cheaper grows at a faster rate (described by the blue lines)

3 Dynamical Adjustment

The model, presented in the previous section, is static in the sense that the optimal choice of how much informal activities to be allowed in the R&D sector is made once at $t = 0$. However, over the long run informal practices may change the amount of trust and productivity they provide. The idea that institutions will evolve over time is due to North and our model will adjust dynamically to such changes. We rewrite the maximization problem of the organization as being solved each period t:

$$\max_{x_t} \rho_t \phi_t (x_t) - \sigma_t x_t \tag{26}$$

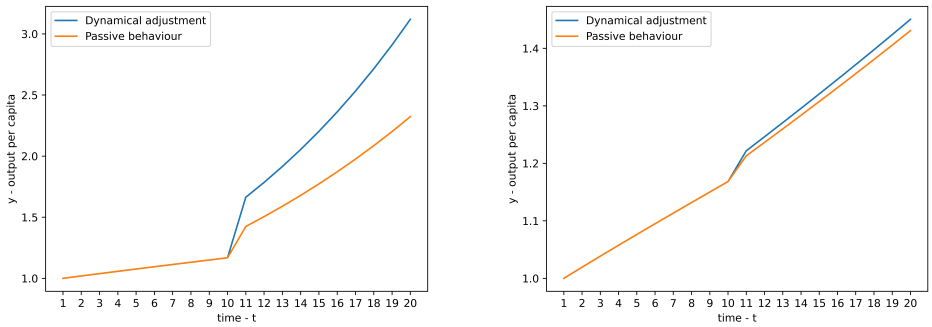
which yields the corresponding demand function $x_t (\rho_t, \sigma_t)$ and the corresponding NBI function:

$$\tau_t (\rho_t, \sigma_t) = \rho_t \phi_t (x_t (\rho_t, \sigma_t)) - \sigma_t x_t (\rho_t, \sigma_t) \tag{27}$$

Then the growth rate $g_t$is no longer constant and will dynamically adjust each period t according to:

$$g_t = \varepsilon_t \tau_t (\rho_t, \sigma_t) H_t = \varepsilon_t H_t [\rho_t \phi_t (x_t (\rho_t, \sigma_t)) - \sigma_t x_t (\rho_t, \sigma_t)] \tag{28}$$

Because of the two properties of $\tau_t (\rho_t, \sigma_t)$ we know how the long run growth rate is going to react to a change in ρ_t or σ_t. However, its interesting to compare the version of the model with dynamic adjustment and the static version from the previous section. This is the same as asking the question - what will be the difference in long run growth rates between country in which the head of the R&D sector uses (28) each period t and one in which the same decision



(a) Increase in ρ

(b) Decrease in σ

Figure 2: Response to one time change in parameters of the model. The country that dynamically adjusts its institution framework (in blue) will grow at a faster rate compared to the country with passive behaviour (in orange)

maker behaves passively and doesn't take into account changes in the economic environment?

Because the NBI function mirrors the profit function from production theory, its also a convex function in (ρ, σ). Assume that at period t there is an increase in ρ to ρ' in two countries. In the first country the head of the R&D sector adjusts the allowed amount of informality optimally according to (27) while in the second country the head of the R&D sector does nothing. Because of the convexity property this translates to $\tau_{1,t}(\rho'_t, \sigma_t) \geq \tau_{2,t}(\rho'_t, \sigma_t)$ and from here to $g_{1,t} \geq g_{2,t}$which means that the country, dynamically adjusting its behaviour will grow with a rate at least as the country with the passive behaviour. In the same way we can also assume a decrease in σ to σ'. Assuming the same behaviour, this translates to $\tau_{1,t}(\rho_t, \sigma'_t) \geq \tau_{2,t}(\rho_t, \sigma'_t)$ and from here again to $g_{1,t} \geq g_{2,t}$. This situation is simulated on Figure 2 by using the Cobb-Douglas version of the model. Normally we are only going to consider improvement of informal practices and actions due to the idea that they should evolve in a positive way. However, events that decrease the productivity of informal actions can be described with a decrease in ρ or an increase in σ. Notice that because the decision maker is not acting optimally, a fast and sudden decrease in ρ or an increase in σ may lead to a negative value of $\tau_t(\rho_t, \sigma_t)$. This situation illustrate an institutional failure - the head of the R&D is so resistant to changes and unwilling to make decisions, that his organization no longer produces new technologies. Mathematically we observe negative growth rate of technology which from an economic standpoint may not be realistic. However, this observation emphasizes the existence of a very low amount of trust that people in the organizations have in it. This vastly slows down the technological expansion of the economic system.

This result is very important, because it can theoretically explain why divergence in output per capita in the long run may be observed - some countries fail to adjust their behaviour by not taking into account changes in the informal practices, that are created or imported in the country [29]. The possible failure will lead to lasting negative long run effects due to lower trust and higher transaction costs, that will create a divergence even if the behaviour of the decision maker suddenly becomes rational. The same applies in the case of importing informal practices from other countries - yes, they can decrease σ or increase ρ, but due to passive behaviour of the decision makers, the overall effect may not be the best possible. Thus the model illustrates how important is for the decision makers in a given country or organizations to take into account changes in informal practices as soon as possible - if they wait too long, their productivity will be already lagging behind potential competitors due to comparatively higher transaction costs and lower trust.

4 Conclusions

The developed model introduces the idea of optimal allowance of informal practices in an endogenous growth model framework. The follow-up discussion shows that economic systems in which the decision makers take into account the informal aspects of the system will grow at faster rates compared to economics system in which decision makers behave passively. As elsewhere in the literature trust plays a decisive role in explaining the meliorative effects of informality on decreased transaction costs and higher productivity levels. This effect is tightly connected with the idea that economies in which institutional asymmetry between formal and informal rules doesn't exist and void holes are closed, will innovate at a faster rate.

This observation may contribute to the fundamental question why some countries fail to converge in output per capita levels even if they try to copy certain informal practices from other countries, explored in the last decades within the research field of New Institutional Economics. Our approach can add to and refine the arguments which have been put-forward by several impactful research streams, connected to capital accumulation, geography, climate, culture, social capital, technology, institutional path dependence, or management practices. Future research of this topic may explore empirically the validity of the presented model or add additional theoretical depth to it.

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