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Economic Growth and Protection of Emerging Markets in Eastern Europe*

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This paper investigates beneficiary effects of limited protectionist policy experiments on economic growth and welfare. The setup of the model is a standard endogenous growth model based on quality improvements in a given spectrum of differentiated products. Both individuals and firms are rational optimizing agents, yet the monopolistic competition gives rise to a market inefficiency. Emphasis is put on the concept of productivity in the research and development sector. In accordance with the literature on endogenous growth, research is undertaken as a result of a rational decision in anticipation of future rents. The paper stresses the fact that the knowledge that is available within an economy is important for productivity in R & D. Therefore, once a country has been falling behind in the R & D race, it has little chance to catch up, unless either human capital and labor can move freely, or, of course, a protectionist policy is run to foster growth and catch up with the leading nations.

I. Introduction and Motivation

Talking to businesspeople, students and colleagues in academia in Eastern Europe, one usually comes across the argument that products of East European companies are not competitive in world markets. This discussion has been influenced by the media of the respective countries. The argument would usually diverted by economists giving the standard free trade argument that even countries with absolute disadvantage in products or production can lucrate gains from trade from their comparative advantage. I would assume, however, that this is not the argument that economists in Eastern Europe have in mind when expressing their fears. As they are not satisfied with the current state of the economy, their fear is dynamic in nature, frightened of not being able to catch up with the rest - or not to converge - as economists would say - but instead to fall further and further behind.

The argument is not novel, though. It has run under the popular label 'trade wars' in the western hemisphere for quite some time. Under its academic research project title 'strategic trade', one usually refers to arguments originally made by Krugman (for a review see Krugman (1994)) and others, stating that under increasing returns to scale in mass production, trade of identical products amongst nations is very likely. Moreover, Krugman argues that which particular products are produced in either country depends upon the historic evolution. The paper gives - contrary to common belief - an argument for free trade as it allows to

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lucrate rents from the increasing returns to scale technology. As technology necessarily includes an externality, the argument for free trade is no longer a welfare argument, however. In a dynamic setting, the question is how history comes into being, i.e., how the respective trade shares are divided amongst nations. In a dynamic setting, one is tempted to ask how the historic evolution has come about. Recent work by Matsuyama (1995) has suggested that the process of imitation, innovation and invention causes the division of trade shares. Helpman (1993) continues to argue that even in a setting of more and less developed countries, where less developed countries would specialize in the process of imitation, whilst developed countries focus on invention and therefore exhibit economic growth, free trade would still improve economic well-being.

In this paper on contrast, I try to ask whether 'offensive' protectionism can be a possible policy to foster economic growth. A utilitarian model with exogenous product diversification but endogenous quality improvements is analyzed, in which a country with a relatively high quality level exhibits decreasing marginal productivity in research. In contrast to the previous literature, this model introduces the level of quality as an input to the 'production' process of future products as a novel fact. This seems to fit the facts quite well, considering that very few countries are leading the worldwide innovation process. Protectionism increases relative research productivity and fosters growth and product development. Therefore countries may eventually catch up, and Smithian absolute advantage with equal income in both countries is feasible.

1. Motivation

Eastern European economies are special. These new market economies have inherited an old stock of product blueprints. This implies, that the products are not competitive on world markets, and therefore sell for a much lower price. Moreover, if the current level of quality is a key feature to future innovation - as argued in the introduction - this will cause low growth in the future. The research and development industry, which I shall argue to be a key element in the explanation of economic growth, also exhibits a low level of intranational competition due to the former structure of industry conglomerates, which is prolonged to the present in some of the East European countries. This lack of competition - or the institutionally motivated lack of potential competition - has evidently reduced efforts in the R & D sector. On contrast, due to the comprehensive system of education, human capital in East European countries is fairly at the same level as in the western hemisphere, allowing me to neglect their effects on the economy in this paper.

It shall be noted, that amongst other differences, like the feable financial system, the unbalanced factor endowments, in particular the low level of physical capital will account for some economic growth within the next years or even decades. Productivity growth, on contrast, can not be attributed to capital accumulation. It shall be the aim of this paper to explain potential paths of productivity in Eastern Europe, and the suggest possible means for political intervention.

The theoretical basis for this argument is presented in the following three Sections. Section II presents the model for both the demand and supply side of the economy. Section

III closes the model, and discussion on principle strategies are developed in Section IV & V. The paper concludes in Section VI.

II. The Model

The economy consists of consumer-worker units, or households for short. The households are assumed to be identical or representative, fully rational, infinitely lived, to exhibit perfect a bequest motive and are utilitarian welfare maximizers with perfect foresight. For the sake of simplicity, I assume that they supply one unit of labor inelastically, thus voluntary unemployment is ruled out. The supply side is characterized by an infinum of diversified products, on the unit interval from zero to unity, produced by Schumpeterian entrepreneurs. These acquire rents by improving the quality of an existing product variety, the Schumpeterian innovative process, which enables them to lucrate monopoly profits. Once again, for the sake of simplicity, I shall assume the production and innovation process is Ricardian, that is it relies on labor only. The consumption bundle of the representative agent, defined by a Dixit-Stiglitz subutility function, can be given the interpretation of a homogenous final good production. The variety of consumption goods would then be intermediaries, (see Ethier (1982), for details) which one can very well label capital goods. Instead of physical goods, one may very well label these products services, which will give a good explanation for the increasing share of the service sector (Matsuyama (1995)). Therefore, the model is not as far away from reality as the reader might assume.

1. Households

In application of standard microeconomic theory, the household optimization problem is split in three stages.[1] First, there exists an intertemporal tradeoff between consumption and savings, which can be derived out of an additively time separable utility function for the composite consumption good c_t, which is of the constant intertemporal elasticity of substitution (CIES) or constant relative risk aversion (CRRA) - type, with γ, $\gamma > 1$, as the coefficient of relative risk aversion and the inverse of the intertemporal elasticity of substitution,

$$U_0 = \int_0^\infty \frac{c_t^{1-\gamma}}{1-\gamma} e^{-\theta t} dt. \quad (1)$$
[2]

1. Whenever the utility function is linear homogenous in a subset of its components, one can separate the maximization problem into two subproblems, where first the allocation of goods between the components in the group subject to total spending that will be devoted to that group are optimized, and then the optimal allocation of the subset of components is optimized. This method is called multi-stage budgeting.
2. Note that the fact that the intertemporal elasticity of substitution is equal to the inverse of coefficient of relative risk aversion implies that the elasticity of substitution must be greater than unity. This, of course, is intuitive, because otherwise people consuming little today would not mind much consuming little tomorrow, as an elasticity smaller than unity implies that consumption today and consumption tomorrow are complements. Empirical investigation of this inverse relationship estimates an intertemporal elasticity of about 1.1, and this implies that agents are almost risk neutral, which evidently does not capture the facts properly. I guess that this argument is the central critique of Ramsey economics.

θ is the constant individual rate of time preference. Households maximize the preceding utility function subject to an intertemporal budget constraint, which states that the change of wealth a_t is equal to the return on existing wealth, and nominal wage income, minus total spending on consumption goods,

$$\dot{a}_t = r_t a_t + w_t - p_t c_t. \tag{2}$$

Hamiltonian maximization with respect to consumption, wealth, and the dynamic multiplier η_t, representing the shadow value of an additional unit of wealth, yields the following first-order conditions,

$$c_t^{-\gamma} = \eta_t p_t, \tag{3}$$

$$r_t \eta_t = \theta \eta_t - \dot{\eta}_t, \tag{4}$$

the budget constraint with equality, and a transversality condition on wealth, stating that today's discounted value of wealth at infinity shall be zero, a result which is sensitive as it rules out trading a claim on this non-utility-increasing asset for consumption today. Taking logs and derivatives with respect to time of Equation (3), and substituting out the dynamic multiplier via Equation (4), one obtains the Keynes-Ramsey rule on optimal allocation of consumption across time, namely,

$$\frac{\dot{c}_t}{c_t} = \gamma\left[r_t - \theta - \frac{\dot{p}_t}{p_t}\right]. \tag{5}$$

We are now faced with the $n-1$ problem, where all prices except for one are determined. In a monetary economy one usually normalizes the price of money to unity. Here, in accordance with a large part of the literature, as money is not explicitly modeled, the price of the composite consumption good is normalized to unity, $p_t = 1$. This simplifies both the Keynes-Ramsey rule (13), and the individual sector price setting rule. Note, however, that with loglinear utility ($\gamma = 1$) it is convenient to normalize expenditure ($p_t c_t = 1$), because then we would already find out that the interest rate is constant and equal to the individual rate of time preference (see Grossman/Helpman (1989)). If then the price declines over time, long-run growth is possible.

In the second stage of the consumer problem, we ask how much an optimizing household should spend on the various product lines, given the following subutility function,

$$c_t = \left[\int_0^l x_t(i)^{\frac{1}{1-\sigma}} di + \int_l^1 x_t(i)^{\frac{1}{1-\sigma}} di\right]^{1-\sigma}, \tag{6}$$

where $x_t(i)$ shall be defined below. The utility function is of the CES-type, where σ is the constant elasticity of substitution between two product lines. The choice of a continuous spectrum of diversified product lines eliminates problems of discontinuities, which seem redundant for the proceeding analysis. The composite good (in either country) consists of a share l of products where one country has the highest quality level, and a share $1 - l$, where the other country has the state-of-the-art product. Trade shares are attributed whenever trade is opened in a particular market segment, and is not reversed from then on, as targeting another countries product line is more expensive than targeting a domestic product line, as shall be shown lateron. Moreover, if no product line is localized domestically, innovation does cease to take place in that country. The second-stage household budget constraint reads,

$$\int_0^1 p_t(i)\, x_t(i) \leq p_t c_t. \tag{7}$$

The first order conditions for any variety i give

$$\left[\int_0^1 x_t(i)^{\frac{1}{1-\sigma}} \right]^{-\sigma} x_t(i)^{\frac{\sigma}{1-\sigma}} = \lambda_t p_t(i), \tag{8}$$

and the budget constraint with equality. Multiplying both sides with $x_t(i)$, and aggregating over all product lines gives the result that $\lambda_t p_t = 1$. Substituting out the Lagrange multiplier λ_t from the first order condition (8), indirect demand functions for any variety with respect to aggregate demand take the form

$$\frac{x_t(i)}{c_t} = \left[\frac{p_t(i)}{p_t} \right]^{\frac{1}{1-\sigma}}, \tag{9}$$

where $p_t(i)$ is the price of variety i, and p_t is the aggregate price index in the economy. The relative price elasticity of sector demand with respect to aggregate demand is equal to $1/(1-\sigma)$. Finally, the household decides on which quality of a given product line it wants to spend expenditure devoted to the particular product line on. Assuming that the state-of-the-art product spends additional utility of a factor $\rho > 1$ compared to its predecessor product, $\rho x_{m-1} = x_m$, but that households do not care which product they use in terms of utility units, the representative household maximizes

$$x_t(i) = \sum_{m=0}^{n(i)} \rho^m x_{m,t}(i), \tag{10}$$

where m is the quality index of the product line i, ranging from zero to $n(i)$, $x_{m,t}(i)$ is the quantity of that particular product demanded, and $x_t(i)$ is the aggregate demand on a particular product line. The constraint to the optimization problem is that the sum of spending on the particular products of a given product line shall not exceed total spending devoted to this product line,

$$\sum_{m=0}^{n} p_{m,t}(i)\, x_{m,t}(i) \le p_t(i)\, x_t(i). \tag{11}$$

The first order conditions for any particular product m yield,

$$\rho^m = \mu_t p_{m,t}(i), \tag{12}$$

and the budget constraint with equality. μ_t is the Lagrangian multiplier, corresponding to the shadow value of an additional unit spending on product line i. Multiplying both sides of the first order condition (11) with the differentiating variable $x_{m,t}(i)$, and summing up over all m, we find that $\mu_t p_t(i) = 1$. Substituting the Lagrange multiplier out of Equation (12), one evidently finds that the price per utility unit is identical for all products. This comes out of the choice of a linear subutility function, which makes all products of a particular product line perfect substitutes,

$$p_{m,t}(i)/\rho^m = p_t(i). \tag{13}$$

2. Manufacturing firms

For the sake of simplicity, I shall assume that once a new product has been developed, producers possessing the blueprint and the pertinent patent right can produce the output good with a constant returns technology with respect to its only input, namely labor.[3] Choosing units so that one unit of labor produces one unit of output, marginal costs of the firm equals the nominal wage rate, which is identical to the real wage by the chosen price normalization. For the following, I shall assume that blueprints are immobile, which can be argued for two reasons. First, transfers of property rights lucrate monopoly rents abroad. Given the lack of political credibility of some East Europeans countries, there is a substantial risk premium attached to investment in these countries. Second, most 'blueprints'-in particular those involving a reduction in production costs, are implicit rather than explicitly formulated, hence a transfer cannot take place due to a lack of a mode of transfer.

Given full patent protection, or unrealistically high imitation costs, there is exactly one supplier for a given quality of a particular product line. Within a given product line, competitors engage in Bertrand competition, setting a price which is profit maximizing given the prices of all other competitors. As the sector leader, the one possessing the state-of-the-art

3. Patent regulations play a central role in theory of innovation. If it were cheaper for firms to imitate an existing product, which seems empirically reasonable, rather than inventing a new variety, nobody would engage in research any longer, as it would generate losses.

blueprint, can charge a lower price than all of the followers, because of utility adjustment indicated in Equation (4), the firm can practice limit pricing, charging a price which is exactly ρ times higher than the marginal cost of the firm owning the second to the last blueprint,

$$p_t(i) = \rho w_t, \tag{14}$$

where ρ is the mark-up. As no follower exhibits positive profits at that price, there will be exactly one firm in each market segment or product line. Note that if labor is imperfectly mobile across countries, one can have different wage rates within a product line, allowing for international competition amongst suppliers. This implies that the firm with the state-of-the-arts product can lucrate monopoly rents, as long as demand for their product is not fully elastic, whilst the remaining firms will make zero profits. As the relative price elasticity $1/(1-\rho)$ is constant, we are able to derive the flow monopoly profits for each producer to equal

$$\pi_t(i) = (1-1/\rho)p_t(i)\,x_t(i). \tag{15}$$

3. Research laboratories

A firm can enter a particular market when investing at intensity ϕ_t into the development of a better quality of an existing product line. It raises money for development by issuing a 'junk' bond, yielding no return in case of failure, but a high, risk adjusted return in case of success. Technology in research and development exhibits constant returns to labor inputs. If a product line is already assembled in one country, that is $0 < i < l$, research productivity in R & D is equal to $1/a$. Else, I shall assume that research productivity is $1/b$, with $b > a$. For convenience, and without loss of generality, I assume that $1/b = 0$.

Investing at intensity ϕ_t into targeting a particular product line i for a time span dt yields a return equal to $\phi_t v_t(i)dt$, where $v_t(i)$ is the discounted value of the firm if innovation is successful. By the law of large numbers, the firm succeeds in improving a given product with probability $\phi_t dt$, facing a profit stream as indicated below. The flow of profits ceases as another firm invents a better quality of the particular product line.[4] The cost of the R & D activity for time span dt is equal to $aw_t\phi_t dt$. A profit maximizing entrepreneur in the R & D sector would maximize profits or net returns, i.e., the difference between returns and costs. This would evidently imply unbounded research whenever the value of the firm exceeds costs, $v_t(i) > aw_t$, which is impossible given the constraint on the factor markets, no research activity whenever $v_t(i) < aw_t$, and positive but finite research whenever the net returns equal zero, implying the Chamberlain free-entry condition,

4. Note that it does not make sense for a particular firm that is in the market to invest into R & D, as the risk of being kicked out of the market does not decline, whilst profits do not double. See Helpman/Grossman, 1990 for an extensive treatment.

$$v_t(i) = a w_t, \tag{16}$$

The value of the firm is equal to the discounted value of future profits. With probability $\rho\, dt$, the firm is kicked out of the market, and the value of the firm is reduced to zero.[5] A rational investor should be indifferent between placing money into a well-diversified stock portfolio, as she can 'hedge' the idiosyncratic risk of the firm being driven out the market, and investment into secure real interest rate bearing bonds. Hence no-arbitrage on efficient capital markets implies

$$\pi_t(i) + \dot{v}_t(i) - \phi_t v_t(i) = r_t v_t(i). \tag{17}$$

Dividing the no-arbitrage condition by the firm value on both sides, we obtain the dynamic evolution of a single stock. Substituting out profits from Equation (15), the value of the firm from the free entry condition (16), and wages from the limit pricing rule (14), the optimal rule for stock market behavior is defined by

$$\frac{\dot{v}_t(i)}{v_t(i)} = r_t + \phi_t - (\rho - 1)\frac{x_t(i)}{a}. \tag{18}$$

Along a balanced growth path where the stock value gains are constant, and where the Keynes-Ramsey rule (13) implies a constant real interest rate, the quantity of a particular product $x_t(i)$ is constant. Using indirect demand (9) to eliminate the product index, we find that profits and the value of the firm is independent of the particular product line,

$$\frac{\dot{v}_t(i)}{v_t(i)} = r_t + \phi_t - (\rho - 1)(\rho w_t)^{\frac{1}{1-\sigma}}\frac{c_t}{a}. \tag{19}$$

III. Equilibrium

The model closes with a labor market equilibrium condition, stating that the exogenous supply of labor, denoted by L, is equal to labor demand from R & D activities, a_t, and labor demand from production, because of the linear technology and the normalization it is equal to the quantity produced,

$$a\phi_t + \int_0^1 x_t(i)di = L. \tag{20}$$

Eliminating demand with respect to any variety i with Equation (9), the equilibrium

5. Of course, the expected change in value is reduced to zero as well, yet this effect is negligible.

price for a product line with the mark-up Equation (14), the labor market clearing condition is given by,

$$a\phi_t + l(\rho w_t)^{\frac{1}{1-\sigma}} c_t = L. \tag{21}$$

If the intensity of research ϕ_t does not change in equilibrium, as will be shown lateron, and taking derivatives of Equations (5), (14), (19) along the balance growth path, it is noted that in equilibrium $\partial r_t/\partial t = \partial x_t(i)/\partial t = 0$, $\partial w_t/\partial t = \partial v_t/\partial t = (\sigma-1)\partial c_t/\partial t$. Note in particular that the quantity demanded of any given product line does not change in equilibrium, while aggregate consumption is free to grow without bound. This can only be achieved through as increase in product quality, or continuous research, hence we shall obtain an interior solution for a growing economy. Moreover, Equations (5), (14), (19) determine the equilibrium path of consumption, research intensity and the interest rate conditional upon the growth rate of the economy. Invoking the growth rate of the composite consumption good c_t from a technological perspective, I substitute Equation (10) into Equation (6) and take logarithms on both sides,

$$\ln c_t = (1-\sigma)\ln \int_0^1 (\rho^{n(i)} x_{n(i),t}(i))^{\frac{1}{1-\sigma}} di, \tag{22}$$

where $x_{n(i),t}(i)$ is constant as noted above. Taking $x_{m,t}(i)$ out of the integral, we can replace the integral by the expected number of quality improvements for a given interval of time t. Denote $f(n,t)$ the conditional probability that a product is improved exactly n times in the given time interval, and summing over all possible n yields

$$\ln \int_0^1 \rho^{\frac{n(i)}{1-\sigma}} di = \sum_{n=0}^{\infty} f(n,t)\rho^{\frac{n}{1-\rho}}.$$

Invoking the properties of the Poisson distribution, stating that the expected number of quality improvements in a given time interval is exactly $\phi_t \rho \exp\{1/(1-\sigma)\}$, we can substitute this back into Equation (22) and take derivatives with respect to time on both sides. The growth rate of the economy then becomes

$$g = \frac{\dot{c}_t}{c_t} = (1-\sigma)\phi\rho^{\frac{1}{1-\sigma}}. \tag{23}$$

Taking time derivatives of (23), research intensity ϕ is constant along a balanced growth path. Using the no-arbitrage condition (19) to eliminate the wage rate and the level of consumption jointly out of the labor market clearing condition (21), and continuing to eliminate both interest rates and the research intensity with the Keynes-Ramsey-Rule (5) and the technological growth rate (23), we can determine the growth rate of the economy solely by deep parameters of the model, namely

$$g = \frac{(\rho-1)\frac{L}{al} - \theta}{\Delta}, \tag{24}$$

with $\Delta = 1-\sigma-\frac{1}{\gamma}-\frac{(\rho-1)-l}{(\sigma-1)l}\rho^{\frac{1}{1-\sigma}}$.

At this point, it is of interest to ask how specific parameters influence economic growth. An increase in the intertemporal elasticity of substitution, which is equivalent to a reduction in the risk aversion parameter γ, corresponds with an increase in economic growth. Evidently, when people's preferences are more free to substitute current consumption into future consumption, they are more willing to delay consumption over proportional increases. Equivalently, an increase in the pure rate of time preference θ makes people more impatient and thus unambiguously reduces economic growth.

The effect of the increase in the elasticity of substitution between two product lines is twofold. First, an increase in σ reduces market power of existing firms and thus fosters growth through a reduction in consumer prices. This corresponds to the first σ in the denominator. Second, an increase in σ reduces monopoly rents of successful innovations, thereby reducing research effort and economic growth. This corresponds to the second σ in the denominator.

On the technology side, an increase in research productivity, i.e., an increase in $1/a$, evidently increases economic growth, as it reduces costs of innovation for a given stream of monopoly profits. An increase in the quality improvement parameter ρ has three effects. First, the ρ in the numerator increases the mark-up in the production of consumption goods, thereby increasing monopoly rents and research intensity. Second, an increase in ρ increases the duration of the average innovation process, as described in Equation (23), thereby reducing economic growth. Finally, note that the ($\rho-1$) term in the denominator is the indirect (or second order) effect of an increase in research intensity on the technological growth rate induced by a higher ρ.

Analyzing the effect of integration and free trade, note first that an increase in market size, corresponding to an increase in L, fosters economic growth, as it increases monopoly rents for given blueprints, and thus increases research intensity. An increase in the market share l reduces growth as it takes away resources from the consumption goods sector and allocates them in the R & D sector, as can be seen in the numerator. The market share in the denominator by contrast increases economic growth. This is the direct effect of an increase in the market share of state-of-the-art products, as it fosters growth for a wider variety of product lines, implying faster overall growth. Note that the later two effects move in opposite directions.

IV. The International Economy

Consider now the case of an industrialized country and a transition economy. As in Grossman and Helpman (1991), it is convenient to argue that the economy starts out with a given variety of products which are available for every firm to produce. There is full competition in the product markets until one firm develops a better quality of a given product line and takes the entire market share as previously discussed. Assume for some reason that the industrialized country holds a large share of worldwide patents for the continuum of products. Most research will take place in the industrialized country, as research within the industrialized country is much more productive than in the transition economy, where the gap between the products from the industrialized country available in the market and the proper products of the transition economy is large. Several distinct integration scenarios can be analyzed.

1. Economic Union

Full integration would set the market share l equal to unity by assumption. Furthermore, economic union increases the labour force L and sets the number of domestic varieties l to unity. Finally, it would immediately equal wages in both parts of the economic union. The derivative of the growth rate (24) for a change in the labor force is unambiguously positive, as

$$\frac{\partial g}{\partial L} = \frac{\rho - 1}{\Delta a}.$$

An increase in domestic varieties changes the growth rate according to

$$\frac{\partial g}{\partial l} = \frac{-(\rho-1)\frac{L}{al^2}\Delta + g\Delta\rho^{\frac{1}{1-\sigma}} l^{-2} \frac{\rho-1}{\sigma-1}}{\Delta^2}.$$

The effect is negative if and only if

$$g < (\sigma-1)\frac{L}{a}\rho^{\frac{1}{\sigma-1}}.$$

In this case, the innovation process becomes a sink, using up resources without capitalizing them at one point through an increase in consumption. This may become the case of large, satiated economies, but is of no practical concern for the problem of developing economies as discussed above.

2. Protection

Note from Equation (14) that an increase in the endogenous real wage is equivalent to a decrease in the exogenous labour productivity parameter, $w_t/p_t(i) = 1/\rho$. The growth rate, as derived in Equation (23) depends negatively on ρ, as σ is defined to be larger than unity. The positive effect of low wages on research in turn implies that poorer countries tend to have higher rates of success in R & D, if and only if research productivity is identical in both countries. Whilst developing countries by definition have a lower stock of blueprints, it shall be assumed that they have access to the worldwide stock of knowledge. It can then be shown that a lower wage increases research intensity, as this implies a reduction in R & D production costs.

From Equation (21), we observe that the effect of a higher wage on research intensity, $\partial\phi_t/\partial w_t$, is proportional to $(1-\sigma)^{-1}c_t/w_t+\partial c_t/\partial w_t$. Whilst the first part is unambiguously positive due to the nonnegativity constraint on consumption and wages, one has to invoke the chain rule to analyze the effect of a change in wages on consumption, which is most likely positive. Taking total derivatives of the implicit demand function (9) and making use of Equation (6), yields after some rearrangement,

$$\frac{\partial p_t(i)}{\partial c_t} = (1-\sigma)\left(\frac{x_t(i)}{c_t}\right)^{\sigma} - (1-\sigma)\left(\frac{x_t(i)}{c_t}\right)^{\frac{1}{1-\sigma}-\sigma}.$$

The sign of this expression is positive if and only if $\sigma^2 - \sigma + 1/2 < 0$. As the characteristic roots for the left hand side are $-1/2 \pm 1/2i$, the above derivative is positive for all σ. Taking derivatives of the mark-up Equation (14),

$$\partial p_t(i)/\partial w_t = \rho > 0,$$

and applying the chain rule, the effect of an increase in wages on consumption is unambiguously positive,

$$\partial c_t/\partial w_t = (\partial c_t/\partial p_t(i))(\partial p_t(i)/\partial w_t) > 0.$$

But this in turn implies that the effect of a wage decline on research productivity is positive, hence protection will lead to an increase in research intensity and hence foster economic growth.

A transition economy can therefore specialize in the few products that it is the world market leader in, exhibiting very high rates of progress as long as wages are low, thereby fostering growth through a thin productive channel which makes up for the low productivity in the remaining industry, or it can protect some markets where it does not have the state-of-the-art product. Closing a market would give R & D labs an immediate domestic market for any innovation, even if it is of lower quality than in the rest of the world. As the rate of success in R & D is larger in the transition economy, the transition economy would eventually catch up in the targeted product segments and therefore regain additional markets, i.e., the market share l would increase.

V. Welfare Analysis of Trade Policies

It shall be noted that the economy described throughout does not exhibit any transitional dynamics, as can be seen from the optimal balanced growth rate of the economy, which neither depends on economic time series, nor on time itself. Hence, the Keynes-Ramsey-Rule (5) implies,

$$c_t = e^{gt}c_0.$$

Substituting this into the utility function of the representative agent (1), which can be considered as a first best measure of welfare, yields

$$U_0 = \frac{c_0^{1-\gamma}}{(1-\gamma)\theta-(1-\gamma)^2 g}.$$

An increase in the growth rate is therefore unambiguously associated with an increase in welfare. Comparing an immediate move to free trade to a limited protectionist policy experiment of a targeted market segment ϕ for a time span T, one has to separate three effects. First, as opposed to free trade, during the protection phase, the market size reduces by ϕL^*, where L^* is the foreign population and ϕL^* is hence the share of foreign products domestic consumers can no longer purchase. Assuming that the ratio of domestic to foreign population is λ, the effect on growth is equal to

$$G_{L^*} = (1+g)^T = \left[1+\frac{(\rho-1)\frac{\phi(1+\lambda)L}{al}-\theta}{\Delta}\right]^T.$$

Second, during protection, the market share of domestic firms increases by the amount ϕl, as foreign competition is ruled out by law. This should increase the growth factor in turn by

$$G_l = (1+g)^T = \left[1+\frac{(\rho-1)\frac{L}{a\phi l}-\theta}{\Delta^*}\right]^T,$$

with $\Delta^* = 1-\sigma-\frac{1}{\gamma}-\frac{(\rho-1)-\phi l}{(\sigma-1)\phi l}\rho^{\frac{1}{1-\sigma}}.$

Finally, after the protectionist experiment is concluded, the economy will have, according to the poisson distribution of success when research intensity is faster in the country with the lower wage, succeeded to target a share $l^{*}\exp(\phi T)$. Note that success can only be achieved when wages are lower in the protecting country. The long-run effect on the growth factor is equal to

$$g=\frac{(\rho-1)\frac{L}{al}e^{-\phi T}-\theta}{\Delta^{*}},$$

with $\Delta^{*}=1-\sigma-\frac{1}{\gamma}-\frac{(\rho-1)e^{-\phi T}-l}{(\sigma-1)l}\rho^{\frac{1}{1-\sigma}}.$

One can analyze the government's problem as a maximization exercise with two degrees of freedom, ϕ and T. This would go beyond the scope of this paper. The interest here is simply to prove that an interior solution for protection is feasible. The aggregate effect during protection is $G_{L^{*}}-G_{l}$. This effect is most likely to be negative, but it can be positive if wages are low enough to dramatically boost investment. Note that we are examining the difference in growth rates for one country, which can still mean growth rates are larger than in the rest of the world for any policy rule. The long-run effect is indicated in the last equation. The effect is similar to the comparative static effect of an increase in the market share l analyzed at the end of the proceeding chapter. Taking derivatives of the growth rate with (24) respect to l, it can be shown that the overall effect is positive whenever

$$g>(1-\sigma)\rho^{\frac{1}{\sigma-1}}\frac{L}{al}.$$

This proves that under given conditions, in particular that the size of the foreign economy is not too large (L very big) and the current market share l is indeed rather small, protectionism can be a useful policy to foster economic welfare. It shall be noted, however, that this does not consider potential reactions of the foreign country. Note however that protectionist threats of the industrialist country are incredible, as this would unambiguously reduce growth due to the high wage rates.

VI. Conclusions

The setup of the model is a standard endogenous growth model based on quality improvements in a given spectrum of differentiated products. Both individuals and firms are rational optimizing agents, yet the monopolistic competition gives rise to a market inefficiency. Emphasis is put on the concept of productivity in the research and development sector. In accordance with the literature on endogenous growth, research is undertaken as a result of rational decision delivering future rents. The paper stresses the fact that the knowledge that is available within an economy, or the number of patents, or the average quality of products, is important for productivity in R & D. Obviously, it is much harder for Aborigines to develop a space rocket and land on the moon, than it is for a modern industrialized country like the United States. Therefore, once a country has been falling behind in the R & D race, it has little chance to catch up, unless either human capital and labor can move freely, or, of course, a protectionist policy is run to foster growth and catch up with the leading nations. The model is weak when it comes to give a true microfoundation for the dependence of R & D productivity on human capital. This is a shortcoming which definitely has to be elaborated further.

Another possible extension of the model is the assumption of full information of both lenders and owners of junk bond issuing laboratories. This transaction contains a moral hazard problem, as it is uncertain whether the owner of the R & D lab should not use the funds for his own private benefit. The introduction of a financial market that eliminates the moral hazard problem seems to be an interesting task for further research.

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